An Introduction to the Natural History of the Giant Tortoises of Galapagos, Geochelone (= Chelonoidis) spp. as detailed in the field notebooks of Craig G. MacFarland. Edited by Craig G. MacFarland and Thomas H. Fritts.

Introduction – By Thomas H. Fritts

The study of the natural history and biodiversity of Galapagos has held the world's attention since Darwin's early work on evolution and subsequent scientists described the unique fauna, flora, and ecological relationships within and between islands. All of these factors result in Galapagos being one of the world's preeminent ecotourism destinations despite their isolation in a remote region of the eastern Pacific Ocean. Perhaps no organisms are more symbolic of the Galapagos Islands than the giant tortoises for which the Islands were named. In contrast to the giant tortoises of the Indian Ocean and mainland continents which have been extinct for centuries if not millennia, most of the giant tortoises of Galapagos survive in their native habitats. But like other giants they are difficult to study, occur in remote areas, and details of their life history are determinable only to those able to invest time, finances, and energies in long term studies.

In 1968, Craig MacFarland, a graduate student from the University of Wisconsin at Madison launched a preliminary investigation of giant tortoises and subsequently in 1969 expanded his efforts into an exhaustive multi-year study of the natural history of giant tortoises in Galapagos. With the encouragement and assistance of his major academic advisor, Dr. William Reeder, support from the National Science Foundation, the National Geographic Society, Organization of American States, University of Wisconsin, and the Explorer's Club of New York, and the selfless aid of his wife Jan, MacFarland spent month after month in remote locales observing tortoises as well as other fauna and flora. He made detailed notes recording behavioral, ecological, climatic, and geographic data for what was intended to be his doctoral dissertation. Following a two month exploratory study in July and August 1968, MacFarland's subsequent observations span the period from August 1969 through November 1971, and notes from an additional trip Isla Fernandina in September 1974. The majority of his work was on the domed tortoise population on Isla Santa Cruz, and to a lesser degree the saddle-backed tortoises on Isla Pinzon. These two geographic areas furnish an extreme contrast of two radically different tortoises. In addition his work included field observations on Islas Santiago, Fernandina, Isabela, and San Cristobal.

However, the threats to the natural ecosystems of the Galapagos and the importance of immediate conservation actions by the Charles Darwin Foundation (through its Charles Darwin Research Station) and the Galapagos National Park prompted MacFarland to assume the role of Director of the Charles Darwin Research Station (CDRS) in 1974 before completing the analysis and synthesis of the bulk of his tortoise work. This refocus of MacFarland's attention was a boost to conservation in Galapagos but a loss to tortoise biology in delaying the basic tortoise research. Unfortunately, the urgency of conservation continued to compete with the task of completing an academic dissertation. Two baseline papers were published in 1974: one on the history and status of the various island populations (MacFarland et.al. 1974a) and one on aspects of reproductive ecology

important to increasing reproduction in the most threatened populations (MacFarland et. al. 1974b). Behavioral and ecological highlights were included in a National Geographic article (MacFarland and MacFarland 1972). Publication on cleaning symbioses between tortoises and finches (MacFarland and Reeder 1974) and conservation efforts for Galapagos tortoise (MacFarland and Reeder 1975) were additional preliminary products of MacFarland's work, but the vast majority of his observations remained as notes in tiny script in engineering field notebooks, and largely unsynthesized for wider dissemination. MacFarland served as Director of the CDRS focused on conservation and management until 1977 and then took a position in the Center for Tropical Ecology at the University of Costa Rica where he expanded his emphasis to training and guiding conservation and park management personnel throughout Latin America. After seven years in Costa Rica, MacFarland returned to the United States, but still traveling extensively throughout Latin America as a wildlands and park management consultant. Years past and the proposed dissertation on the life history and ecology of giant tortoises continued to lay dormant in the more than two dozen engineering notebooks and the photographs amassed during the original field research. Written in bound engineering field notebooks with indelible India ink in nearly microscopic script, the notebooks were preserved in their entirety (with the exception of those pertaining to Volcan Alcedo on Isla Isabela which can not be located) and were eventually given to me (THF) in the late 1980s with the hope that some of the information would compliment other work in progress or contemplated for giant tortoises.

MacFarland was a superb writer of field notes. Even after a 40 year hiatus, it is possible for the casual reader of these notes to understand and visualize the observations recorded and to extract the information on tortoises and their environments that he originally intended to convey. In delving into these notes, I immediately realized their value and the interest they would hold for a wide variety of readers. For the biologist interested in the Galapagos, the descriptions of interactions of the top level herbivores with other organisms in the diverse and unique island situations of the Galapagos are important sources of ecological information. For the persons interested in tortoises (scientist and amateur alike), the details of social interactions, mating, seasonal migrations, and the complexities of nesting, and varying life history traits of different islands are equally intriguing from physiological to evolutionary perspectives. As one of the most conspicuous symbols and objects of attention for the Galapagos tourist, the traits, behaviors, and adaptations of tortoises illuminated so clearly in MacFarland's notes will be of equal relevance to the tourists who have previously visited the islands and those who intend to do so in the future. Together these notebooks comprise the most exhaustive study of the ecology of Galapagos tortoises ever attempted and provide an important supplement to the meager natural history data available to date and to the largely unpublished dietary work of Cayot (1987), behavioral studies documented in an unpublished thesis by Nieuwoldt (1989), and morphological studies only partially published by Fritts (1983; 1984). Ultimately, MacFarland completed his doctoral degree at the University of Wisconsin, with his dissertation focused on aspects of tortoises and the conservation of Galapagos on a much higher plane (socio-economical, political, and the roles of scientific, national, international, and non-governmental communities). [Need to insert citation for thesis and better explaination of scope and content.]

Under other circumstances these notes and other data would form the basis of a valuable book and overview of tortoise natural history. But the unique quality and detail that they contain, prompts their publication in a raw observational narrative format illustrating additional layers of details of the fieldwork that would be lost in a traditional synthesis. I have attempted to transcribe the field notes into an electronic format with the primary objective of preserving the accuracy and understandability .

Throughout the study, MacFarland and the entire Park and Station team used a numbering system to identify and track individual tortoises. The protocol involved carving notches in the marginal scutes of the tortoises with each scute representing a unique number and aggregations of notches when added could represent each of the ten ordinal numbers. The following graphic is copied from Thornton, Ian, Darwin's Islands. A Natural History of the Galapagos. Am. Mus. Nat. Hist. Nat. Hist. Press, Garden City, New York, 1971. Pg 140.

For example the first scute to the left of the nuchal notch represented the number one (1); the second two (2); the third four (4); and the fourth the number seven (7). Thus a tortoise with only the 1st scute marked was number 1; a tortoise with the second and fourth scutes marked was number 9 (2+7). The scutes on the left anterior quadrat of the carapace represented the units (1-10); the scutes on the right anterior quadrat represented the tens (10-90 respectively); the scutes on the left rear quadrat were the hundreds (100-900 respectively) and the right rear quadrat scutes represented the thousands (1000-9000). The unpaired supracaudal scute at the rear of the carapace was not used for marking purposes, but the adjacent paired marginal were. By confining marks to the appropriate four scutes in each of the four quadrats of the carapace, it was ideally possible to mark up to 9999 tortoises. The system was prone to some confusion due to observers occasionally confusing the respective quadrats (thus reading the tens digit as a ones digit, etc.) and due to scute wear, breakage resulting in loss of marks, and by preexisting deformities, and other accidental occurrences producing injuries capable of being confused with notches made for marking purposes. Despite its shotcomings the notching system allowed MacFarland to track daily, seasonal, and sometimes long term activities by individual tortoises. Today such tracking is done with magnetic embedded beneath the animals' skin, branded scutes, or temporary paint markings.

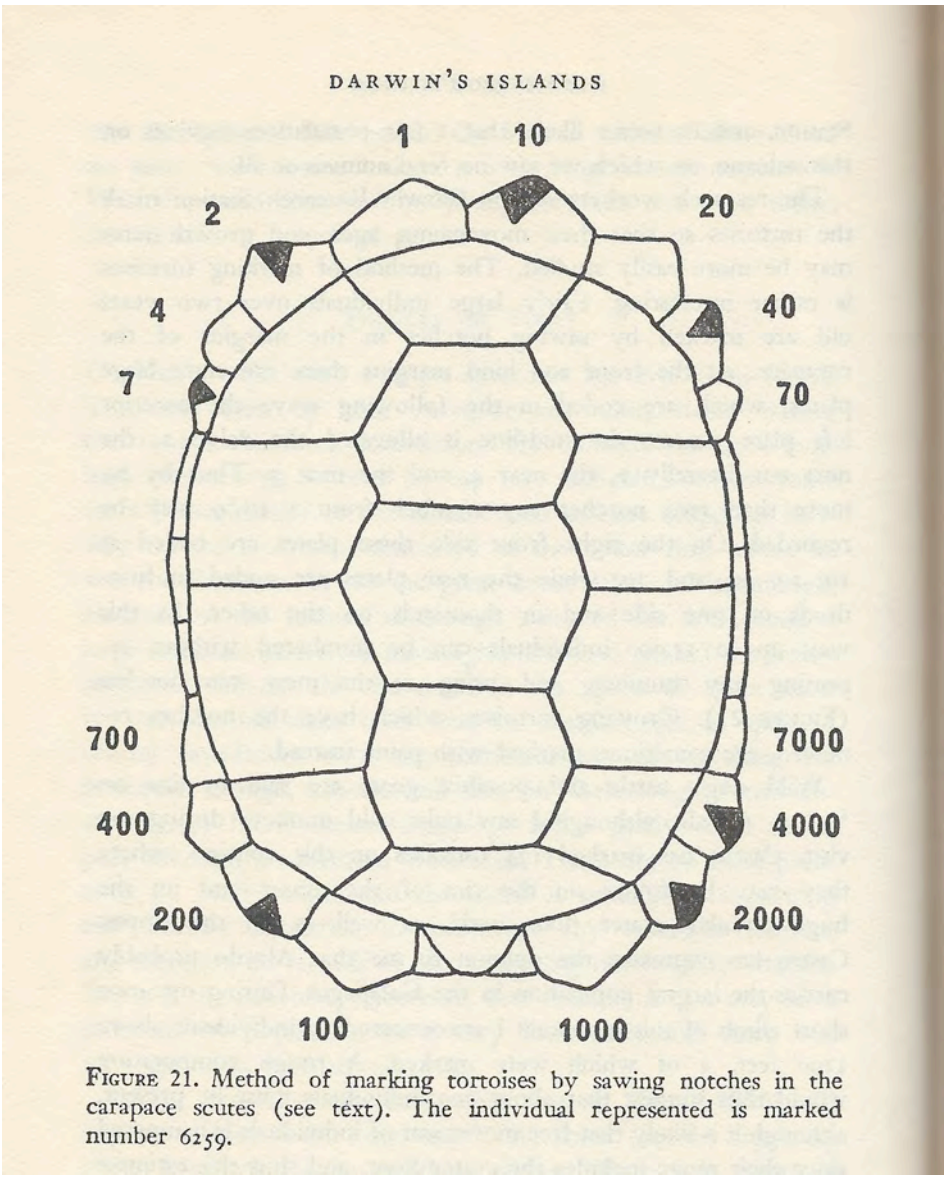


FIGURE 21. Method of marking tortoises by sawing notches in the carapace scutes (see text). The individual represented is marked number 6259.

The notes are a virtual gold mine of information. The reader of these notes will certainly gain the understanding of tortoise ecology and at the same time learn the complexities and allure of field investigations under difficult and isolated circumstances.
I hope that the product will adequately justify the attention of a diverse community of readers and act as a backdrop for understanding the tortoises and the environments in which they live.

Herein are first hand accounts of observations made on cleaning symbioses between finches and tortoises, and between mocking birds/finches with land iguanas. Narrations of nest selection, excavation, and responses to rock impediments highlight the rigors that the tortoises face in their volcanic habitats. The unfolding of conservation techniques, survey methodologies, and research diligence are all obvious within these volumes.

The notes have been edited to a minimal degree with only infrequent insertions or substitutions of words, and the telegraphic style of the composition was left unmodified whenever the meaning was clear. The priority has been placed on clarity of the information and maintaining the potential for future research questions to asked using these data and observations. Many miniscule details (tortoise measurements, weather data, body and nest temperatures, and plant associations) were left in the text because it is this detail that presents an unlimited potential to meet the needs of future queries and as seeds for not yet contemplated studies. As notes compiled over many months, the style, punctuation, and detail varied, and I have not forced the text into a single editorial format except when necessary to facilitate the reader's understanding. Every effort has been made to avoid errors of transcription or data of an unclear or dubious nature. In the few instances where MacFarland intended to provide data and did not do so, the circumstance has been noted. The original notebooks will be archived at the University of Wisconsin Museum of Zoology to allow verification of transcribed information when necessary. To the degree possible any reports of errors of omission or transcription that may be discovered by knowledgeable readers will be welcomed and efforts will be made to make corrections in the future as possible.

I am honored to have been allowed the privilege of working with these notebooks, and for having the opportunity to preserve them and share them with others. More importantly I have benefited over a 45 year period of professional interactions, academic cooperation, and friendship with Craig G. MacFarland who has selflessly served Galapagos, Latin America, and the global conservation and scientific communities.

Thomas H. Fritts.

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Part One – Studies on Isla Pinzon.
Introduction

Among the MacFarland field notebooks available are three that focus on field studies on the Island of Pinzon (known in some English literature as Duncan Island) spanning the period from 5 Dec 1969 through 20 Oct 1971, but also including some data obtained earlier by National Park Service (NPS) wardens. The work ranged from visits to nesting zones previously identified by NPS wardens providing details on vegetation, locations, aspect, slope, and soil characteristics. In the examination of multitudes of nests, descriptions of nest structure, clutch size, nest viability, rat predation, and obstacles to nest construction were provided. This work documented the flask-shaped nest of the giant tortoises, often held together initially with addition of copious amounts of cloacal fluids, and sealed from above with a hard cap comprised of tamped earth bound with the fluids released by the female in the ultimate stages of covering the nest. The hard cap is often further fortified with the inclusion of tortoise feces, fibrous pellets, likely serving the same function as straw in adobe materials. Nest holes that were abandoned due to obstacles to digging received no such investment of cloacal fluids.

Sex, basic measurements, and individual carapacial characteristics (lichens, injuries, parasites, etc.) were reported for all tortoises encountered. The detail of the notes are enhanced by data provided by cooperating NPS warden (especially Juan Black, Pepe Villa, Julio San Miguel, and Fausto Llerena).

It is in these notes that documentation is provided of smooth lava catchment basins, presumably important sources of drinking water over centuries for tortoises living in an otherwise porous environment following brief rains or foggy periods. By following a tortoise moving directly from one basin to another, it appeared that the basins were well known and regularly visited by tortoises in the area.

The importance of tortoises in shaping the environment of Pinzon is hinted at with descriptions of differences of spination of Opuntia cactus depending on the height above the ground with pads 1.5-3.0 m above the ground less fortified with spines than those growing closer to the ground. Not surprisingly, a sparsely spined pad that sprouted after falling to the ground from its lofty position, produced large spines in all pads issuing from it as it grew upward again. Opuntia pads and fruits that fell to the ground were quickly consumed in areas inhabited by tortoises and more evident where tortoises were less common. Through repeated visits to areas with individually marked and recognizable tortoises, data were collected that demonstrated how sedentary tortoises were in repeatedly using one to three nocturnal resting sites, and feeding areas where favored food species existed.

Through detailed examination of ticks on the tortoises, and the relationships between tortoises as parasite hosts, finches were recognized as gleaners of ticks when tortoises assume postures conducive to providing maximal access to the birds. Detailed notes, photographs, and movies provided a basis for describing the commensalisms of tortoises and finches, that ultimately would be found for other Galapagos reptiles.

MacFarland participated in and described the first and second releases (Dec 1970 and Oct 1971) onto Pinzon of captive reared animals presumed to be more resistant to rat predation on the basis of their larger size relative to neonates. In the initial days and months after the releases, food species were recorded, movements measured, behaviors monitored, and growth documented. Plants like Portulaca, Commelina, and Opuntia were favored and others such as Maytenus and Prosopsis were avoided or minimalized in the diets. The activity patterns of the young tortoises were monitored in response to direct sunlight, cloud cover, nightfall, and temperature extremes.

The curious nature of Galapagos hawks (especially juveniles) was evident when hawks often landed near the tortoise juveniles, eyeing them for a few seconds to minutes, and then flying away without overtly molesting them.

These notes contain some of the most detailed descriptions available of aggressive encounters between tortoises, head rearing, open mouth threats, and vertical posturing. Such agonistic behaviors are most apparent in relation to perceived competition for resources such as food, water, shade or mates. The notes provide detailed accounts (frequency, duration, sequential stages, etc.) of tortoise mating attempts, documenting ways the female circumvented mating and the persistence of males in eliciting cooperation or submission.

It is here on Pinzon that innumerable biologists and park personnel encountered the tortoise popularly known as Onan (see Cayot 1991) who lived apart from other tortoises and when first found was apparently attempting to mate with a rock. Onan was quite small by giant tortoise standards, but his extreme saddleback form, worn carapace, a aggressive disposition gave him a formidable aura that made him a special feature of Pinzon and Galapagos in general.

Outline of CG MacFarland field notebook project as currently envisioned and prepared.

A. Introduction and Overview – this will stress the potential value and interest that these notes hold, a brief explanation of the circumstances that they were prepared under, a statement stressing that the transcription was conducted with an emphasis on comprehension, rather than stylistic editorial rigor. And that changes or emendations were made only when the meaning was going to be enhanced and the author's original intentions were obvious to the transcriber. [Note: this section is included in this draft transmission, but remains to be completed – input is welcomed. Thf]
B. A selected bibliography of "technical" papers on Galapagos Reptiles by Craig MacFarland.
C. A list of the 25 field notebooks spanning the natural history of Galapagos giant tortoises and the ecological settings in which they occur in Galapagos, each of which will be a hot link that will allow the user to "jump" to the appropriate volume. Some consideration should be given as to whether a brief synopsis of each volume could be included to highlight what types of information is included. For example, the Isla Fernandina Vol.2 Other Animals volume include detailed first hand observations of mutualistic commensalism of mocking birds and land iguanas and of finches and land iguanas. Pinzon Volumes 1, 2, and 3 provide details on interactions between tortoises and finches, as well as details of the release, acclimation and survival of juvenile tortoises produced by the Pinzon Head Start Program.

List of Individual Notebooks

Isla Pinzon-

1. CGM Isla Pinzon 1
2. CGM Isla Pinzon 2
3. CGM Isla Pinzon 3

Charles Darwin Research Station – Isla Santa Cruz

4. CGM CDRS 1

Isla Santa Cruz

5. CGM Isla Santa Cruz 1
6. CGM Isla Santa Cruz 3
7. CGM Isla Santa Cruz 4
8. CGM Isla Santa Cruz 5
9. CGM Isla Santa Cruz 6
10. CGM Isla Santa Cruz 7
11. CGM Isla Santa Cruz 8
12. CGM Isla Santa Cruz 9
13. CGM Isla Santa Cruz 10
14. CGM Isla Santa Cruz 11

15. CGM Isla Santa Cruz 12
16. CGM Isla Santa Cruz 13
17. CGM Isla Santa Cruz 14

Isla Santiago

18. CGM Santiago 1

Isla San Cristobal

19. CGM San Cristobal 1

Isla Isabela

20. CGM Azul Negra
21. CGM Wolf Darwin

Isla Fernandina

22. CGM Fernandina I
23. CGM Fernandina 2

Other Animals

24. CGM Other animals
25. CGM ticks&mites

Note all files are in Microsoft word format (97-2003 version) i.e. xxxx.doc but are compatible to being converted into Word 2010 format. Xxxx.docx

All figures, sketches, and maps have been scanned and placed in appropriate volumes.

Pinzon 1 – Isla Pinzon – Volume 1
Field Notebook of Craig MacFarland
Transcription started 31 October 2006 by T. H. Fritts; text transcription completed 4 Nov. 2006. Throughout this project English island names have been replaced with the Spanish geographic names in current use. thf

(Pg. 1) -- 5 December 1969
To Pinzon aboard "Bronzewing" with Julian Fitter. Accompanied by Srs. Juan Black and Julio San Miguel of the Parque Nacional.
Arrived at NW disembarkation point at 0930; were on shore by 0945; and left for nesting area by 1020 after setting up camp.
Will bring back eggs from nests encountered by Black and San Miguel on 15-16 Oct., 1969 trip and look for others. Also I plan to more fully look over and describe these nesting areas.
Went first to Nesting Zones D and E on W side of Pinzon. These two zones are very close together and about a half hour walk from the disembarkation point on the NW side of the island. See map for all these locations.
Zone D: General description: this area is the larger of these two, but in actuality it occupies an incredibly small area on a huge rock covered western facing slope. See map for location.
1. Size – hard to measure, but the area is more or less oblong, running up and down the hill (i.e. width is narrow and lies in N-S in direction; probably about 20-25 m by 60-70 m; difficulty in measuring is that the area is nearly all rocks with a bit of soil between them here and there.
2. Exposure – faces about 250º WSW, running down hill quite steeply.
3. Slope – slopes around, and immediately above and below the area, are about 20-25º, in the small nesting zone itself these drop to about 15-20º more or less; the open spots of soil between the rocks where the tortoises lay in fact are nearly flat, the whole area having the (Pg. 2) general slope but with almost little spots like terraces here and there among the rocks – these little flat terraces are where the soil and nests are located.
The exposure and slope give me the impression that the nests probably receive good strong sunlight from 0900-1000 (at least) till sunset, in other words during the hottest part of the day to be sure.
4. Altitude – varies, of course, from ___ ft at top of zone to ___ ft at bottom.
5. Physiognomy – the area is mostly covered with rocks of all sizes, mostly fairly large ones and boulders; scattered here and there are the small patches of collected soil in amongst these boulders; these spots of soil are of odd shapes of all types but usually about equal to or less than 1 square meter – most are smaller, an occasional one may be 1.5 – 2 sq. m by almost never larger; the number of these areas and thus the amount of available soil is very limited; can't now estimate how many potential non-overlapping nesting sites there are, but certainly few (Pg. 3) mostly rocks and vegetation such as spiny trees and shrubs which prevent any nesting.
6. The vegetation – mostly small sapling- and seedling-sized trees and shrubs – Croton very abundant, some legume (probably Acacia) [Marginal note – yes] less prominent but also prevalent – most of these plants are only 1-2 m high or smaller – rarely old dead or nearly dead ones up to 2.5-3 m Many of the stems are dead, almost all Croton is leafless

(as is most other stuff but Acacia). Most of the dead stems and many live ones are heavily draped with the hanging dense pale-green lichen [Marginal note – Usnea?]– this in fact is what offers some shade to tortoises in the area – one is sitting well in shade under a lichen covered bush near me as I write.
The vegetation is fairly dense, filling in between cracks and small places among large rocks and boulders and even in some of larger open spots of soil which I am sure would be nesting sites if these larger stems were not there. Not much in way of herbs (or tortoise forage plants) at all – ground is littered with dead stems and sticks and some thoroughly dried up grass (must be from rainy season). Are some small herbs, but very sparse.
In sum, the plants and rocks cover the area rather well, and densely, and leave only a few spots of soil here and there for nesting sites.
(Pg. 4) The nest sites to me appear to be shaded only very slightly or not at all by plants or rocks and if some probably only during late afternoon hours when sun is not particularly strong anyway. The only time shading might be important would be in early morning and this due to slope and not plants or rocks.
7. Flooding potential – given the slope, almost none unless got terrific down pours which partly destroyed nest cap followed by more slow steady rains which lasted a long time and then filled up nests. Suppose nest could fill up like little hanging pools, but I doubt it.
8. Soil conditions – Soil is very fine, beige-brown in color, seems to have a low humus or organic content; almost a dust in places, it is so dry and fine. Has some small rocks and pebbles in it, but not much. Much finer than any have seen in any Santa Cruz nesting areas except low areas in lava fields just S of Zone 3 Nesting Area. Soil is not hard at all either on surface or inside – appears to present no digging problem itself to me.
It is rather deep in the few places I dug down – in three nest (Pg. 5) sites examined. See below; ♀ had apparently not been forced to stop digging due to rocks or other obstructions in bottom of nest – on contrary could dig to 30 cm and as I did – could perhaps have dug even more – did not try this time. In agreement with this saw only a few sites where it appeared to me that a tortoise had begun a nest, getting a hole started, and been "forced" to stop. [Marginal note – By what? – see below] Of course hard to detect this because Srs Black and San Miguel and M. Castro have dug all over this place looking for nests. (See more on this below).
Soil seems quite workable when moistened. ♀♀ clearly use cloacal fluid in digging and then completing nest (hard cap, even nest filling material often wet or moist or caked (thus previously moist). It does make a mud cake and does harden as does red soil on Santa Cruz. However when this soil dries out, mud cake is more crumbly, easier to break and less durable than hard cap material on Santa Cruz. Thus would seem to present young hatchlings less of a problem when they need to dig out and escape. In general, hard caps on nests examined were still intact even when dry, but are just not as extremely solid and durable as those of red soil on Santa Cruz (e.g. Zone 3 Nesting Area).

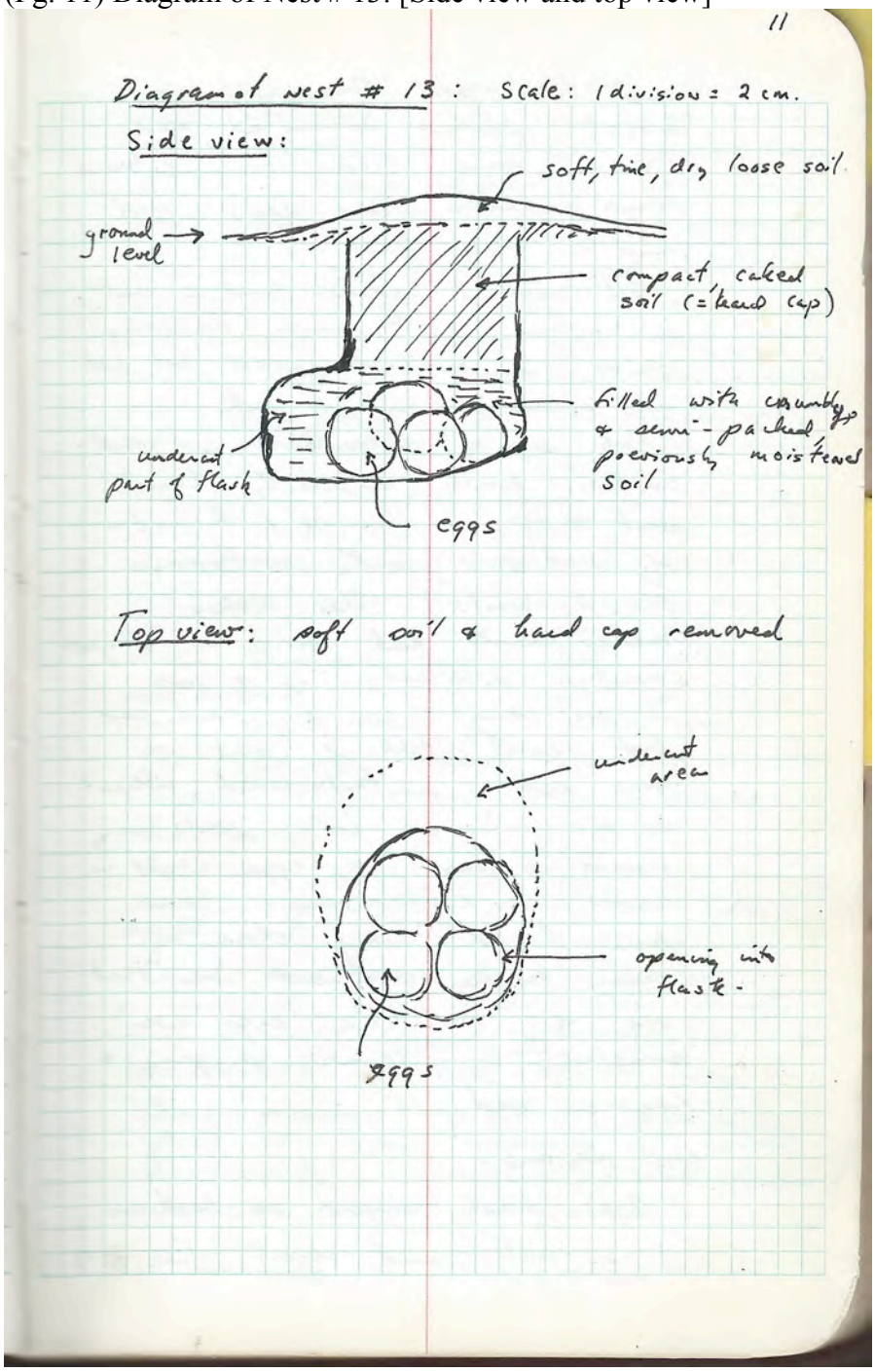
Nesting Sites in particular:
1. Size – as discussed above most are about 1 m square or less. Often (Pg. 6)
or almost always, surrounded by rocks; quite in open; saw a few semi-bare spots of soil under rock overhangs (i.e. quite shaded much of time), and no digging sign – females

probably can't get to some of these, but also probably avoid them(?) – would seem so from looks of some of them – room for a ♀ to dig, but have not.
2. Shading and exposure – mostly fully exposed; shading almost completely due to slope, only a little from vegetation and rocks if at all.
3. Nests all on open spots of soil- no herbs or even dead vegetation – all nesting sites and soil in the area which is not very closely surrounded or covered by rocks and or large pieces of vegetation (e.g. shrubs or trees) are open, devoid of plants, and look well used from past nestings (a lot of shell and membrane fragments in almost all open soil sites).
4. Density – Nest density almost equal that of number of soil sites – virtually all sites now have nests or have signs of old nests. Will later count nests and # potential sites for a given year for each zone.
5. Almost no sign of attempted but uncompleted nests – but may be due largely to difficulty in (Pg. 7) adequately detecting such because Srs. Black, San Miguel, and Castro have all been digging around here; Castro in past years and the other ones in Oct of this year. (See below).
6. Interference by one ♀ with another's nest; one example- see below – probably occurs fairly often with so few nest sites as are here – depends of course on numbers of ♀♀ nesting here.
Nests found:
1. On 16 Oct. 1969 by Srs. Black and San Miguel – Nests # 6, 7, 8, 9; eggs from #6 and 7 returned (to nest) then.
2. #6 – reopened; all eggs appear OK; all obscured – thus large embryos; returned to CDRS – 5 eggs – no signs of any disturbance to nest. [Marginal note – completely dry inside].
3. #9 – reopened ; both eggs appear OK, although of extremely different size; all obscured – thus large embryos – returned to CDRS - 2 eggs - No signs of any disturbance to nest.
4. #13 – new nest –
Weather – 1100 hr – overcast, light breeze, cool so far today. Air temperature at 1m (shaded) 27.8º C; Soil surface temperature on top of nest 31.0º C. Temperature inside nest on top of eggs 29.0º C (before opening – open 1 cm diameter hole to inside).
Eggs and young – four eggs; all "normal" shape and size; all OK. Apparently fresh eggs because can not see any embryo; are clean, and yolk clearly visible. Nest probably only a few weeks old at most. However entirely dry throughout, including all of hard cap.

(Pg. 8) No signs of any disturbance of nest. Eggs marked and replaced and nest marked for later return of eggs.
Nest structure: Typical flask shape, with undercut and resultant overhang only occupying anterior 2/3 of nest; very similar to those seen on Santa Cruz. Tiny bit of undercut, 0.5 cm in rear third of nest but not much and barely noticeable. However eggs all arranged in one layer, but not any under overhang; all in central part of nest below main portion of durable cap. One egg is about 2-3 cm higher than others because nest bottom not uniform. Nest site is surrounded by large boulders; smallest diameter across it between rocks is 75 cm. But opens out on two sides into more soil covered areas where nest could probably be made.

It is hard to distinguish the hard cap from soil below it on top of eggs – all is now dried out but almost all looks to have been moist when nest was made – however cap is a solid unit and soil around sides of eggs is more crumbly and not part of the cap itself – "cap" (Pg. 9) as such sits right down on top of eggs. About 2.5 cm of soft, fine, dry soil on top of hard cap. Then hard cap is about 10-12 cm thick in central thickest parts; but thickness is less to sides of nest and variable – sort of a dome of mud originally I guess.
Depth to top of eggs from top of hard cap 12.0 to 15.0 cm. Can't tell how large diameter flask was originally at top – about 16-20 cm I would guess. Width inside nest below hard cap and including undercut – 22.7 cm side – side (falls within undercut well); 22.0 cm front – back. Overhang or undercut breadth – varies – about 4-6 cm in most parts, tapering to almost nothing as go to rear of nest on each side. Depth to bottom of eggs – from top of soil 21-24 cm – varies; from hard cap top 18.5-21.5 – varies.
Depths for eggs vary above because one egg on part of bottom which was not as deeply dug out as rest- thus depths to its top and bottom from ground level were 14.5 cm and 21 cm. For other three eggs were 17.5 cm and 24 cm.
Took photos of top of this nest and nest site before opening it. Roll 25, # 28-30.
(Pg. 10) Looks to me as if this nest could have held 3-5 more eggs, probably four, around those already present, if ♀ could push them under overhang – then would all be still on one level – why was nest cavity so much larger than needed to be for this clutch? Of course, this is post-facto examination and she may have not had the nest dug out exactly as it appears to us. Note that no rocks at bottom of nest – could have dug it out deeper but didn't – leg length? Diagram of nest is on next page.
5. Nest #14 – 1130 hr – only 4 m away for #13.
Weather – air temperature 28.4 º C; Surface of nest 32.0º C; inside nest on top of eggs 30.0 º C; still overcast, windy and cool.
Eggs and young – five eggs; four in good condition; can see yolk clearly in all, none obscured and no embryos; thus probably a very fresh nest. One egg smashed in and rotten – probably due to another female laying here (see below). Nest cap except on very top surface for 1-2 cm,

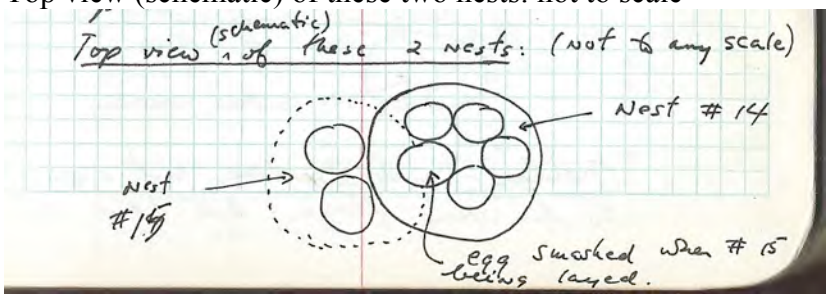
(Pg. 11) Diagram of Nest # 13: [Side view and top view]



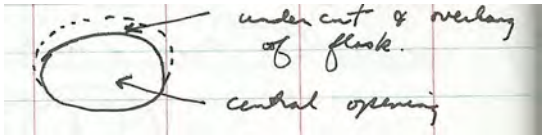
(Pg. 12) and all soil throughout is moist, packed somewhat and like mud (consistency of bread dough or even more dry). Nest must be very fresh.
All eggs at same level in nest, in bottom; not under overhang which is available space, but all more or less in center of nest. Only sign of disturbance is that another ♀ apparently laid Nest #15 on top of and to side of Nest #14 , partly overlapping the three nests. This makes measurements and ability to distinguish structure difficult. Top of nests is one huge area of hard cap but can't tell if one or more nests – in fact could

interpret as one. Since both nests very moist and fresh, and eggs about in same condition, must have been laid very close in time together. Result was that one of Nest #14's eggs was smashed by female digging and laying Nest #15.
Nest structure: Again flask-shaped as best as I can tell, and about like Nest #13 (Pg. 13) in size and arrangement., but presence of two nests in same site has obscured this. Overhang and undercut definitely there and eggs only occupy part of nest, but can't see well to get measurements. Nest site is open patch of soil about 1 m x 0.75 m with rocks and boulders all around – but open to one side into more soil covered area – 1 m along side thus continuous with other soil covered area between rocks.
No soft, fine soil on hard cap – simply hard cap itself at surface. This then sits solidly right down on top of eggs with no intervening air space or soft soil; some loose mud clods around eggs, but most of soil around them and hard cap all one big mass of moist soil. The eggs are actually sitting in little "cups" of moist soil which is hardening.
One rock about 1 dm x 6 cm is part of surface portion of hard cap – built right into it. Could have dug deeper – soil soft and workable still below where female quit – not stopped by rocks or obstructions in any obvious way. Can't measure width of original flask at upper opening or inside below overhang because of two nest structure - not clear at all.
(Pg. 14) Could get two depths: Depth from top of nest (hard cap) in center to top of eggs 22.0 cm. Depth from top of nest in center to bottom of eggs (and nest) : 27.5 cm.
Marked eggs and nest and replaced eggs for later transport; smashed egg removed and thrown away. Looks again as if nest could have held another three or four eggs at same level as these – could have fit around edges and under overhang – same comments, however, apply as before – really hard to determine this.
6. Nest #15 – 1130 hr. Weather – same as for #14; couldn't take temperature inside because of continuity with Nest #14; almost certainly same temperature.
Eggs and young: two eggs; both OK, clear, yolk clearly visible, no embryos can be seen; certainly also a fresh nest and about same age (1-2 days at most) as #14 (perhaps laid on 2 successive nights). Whole nest in same conditions #14 as regards soil moisture, and internal condition. Both eggs at same level in bottom of nest; not under slight (Pg. 15) overhang at all, but in central part of nest.
Nest structure: also flask shaped, but obscured by overlap with #14; can't measure overhang and undercut, original flask opening at top or width inside flask from any points. Overlaps #14 about 25% of what looks to be flask of each and thus are rather thoroughly continuous and hard to clearly distinguish. Size, moisture conditions, and structure all similar to #14; measurement to top and bottom of eggs from top of nest (hard cap) also are 33.0 and 27.5 cm respectively. Also could have dug this nest out deeper – soil in bottom moist and workable – but did not – why? Eggs marked and replaced for later transport. Can't tell if nest exactly could have held more eggs, but probably 2-5 more using overhang and even more of central part – again speculative. Two photos of these nest sites – Roll 25, #20-21 – before opening. This nest laid out partly to side of #14 in area where open soil extends out and is continuous with another open areas between rocks.

Top view (schematic) of these two nests: not to scale



(Pg. 16)
7. Nest #16 – very near #13-15; about 20 m away from them.
1200 hr. – Weather: still cool and overcast; some breeze. Air temperature (as before) 28.4 º C; soil surface on top of nest (hard cap upper surface) 32.8º C; temperature inside nest 31.0º C.
Eggs and young: four eggs, all in good condition; all obscure inside, thus with large embryos. Nest completely dry throughout, thus hard to age but certainly one month plus, I would guess from condition of eggs. Shape and size of eggs normal; no sign of any disturbance in nest. All marked and removed; will take now to CDRS.
Nest structure: Area about 1 x 1 m (round) of open soil surrounded by rocks. Typical flask shape, but oblong in side-side direction; schematically looks like this



Overhang – undercut does not appear to be very large, but hard to (Pg. 17) really determine; the structure of this nest is in general obscured by dryness of it. All eggs at same level, arranged completely in center of nest – perhaps room for a few more, especially under overhang, but hard to tell – perhaps rather full at one level. Entire nest well dried out, hard cap and all; the hard cap is difficult to distinguish from any soil around and on top of eggs – all was obviously wet and hard cap seems to sit right down on top of eggs. Eggs sitting in little "cups" of dried mud which remain after eggs are removed. Was all clearly quite moist at laying time - all cloacal fluid or some garua? No air space at all in nest – soil all around eggs and above them. But no real loose soil anywhere now. As with #14 and 15, hard cap is exposed on surface – no covering of loose, fine soil as with Nest #13.
Top of ground (hard cap) to top of eggs (depth) 15 cm; top of ground (hard cap) to bottom of eggs – i.e. bottom of nest 21.0 cm. Again no rocks at bottom of nest – appears that ♀ could have dug deeper, but did not.
In general, nests, nest sites, and general conditions in this area all very similar.
(Pg. 18) Tortoises – quite a lot of dry droppings and some few fresh ones all over this area – almost certainly tortoises here now and must come at least in part from areas directly above down this steep slope. One tortoise present – stayed in same site under an Acacia tree covered with lichens in shade (even though overcast much of day) from before we arrived (arrived at about 1100) until I left at 1630. Just starting to move about

some as I left – quite overcast and air cool at this time – was hot and sunny from about 1430 –1630.
#12100 ♀ - shell completely smooth all over carapace and no visible growth rings thus large and old. No sign whatever of attempting to feed or graze all day long – perhaps here to lay or may be connected with Nest #14 or 15. Took measurements CL 66.3: CW(CDRS) 71.4; CW(VD) 67.0 cm. No young ones seen. As noted above very little clear sign of areas where ♀♀ tried to dig and stopped. In part impossible to detect how (Pg. 19) many of these areas there are, or may have been, this year because of digging on previous trip (15 –16 Oct 1969) by Srs. Black and San Miguel, and in previous year by M. Castro; also disturbance in previous years in part due to naturally hatching nests and water percolation into nest cavities. But, I did see 2-3 areas which I think were attempted nestings – all shallow – 10-13 cm – no indication that any rocks or obstructions in holes started stopped the ♀♀ - cause in all theses cases is unknown, but perhaps lack of room to dig in two cases because closely surrounded by large protruding rocks embedded in soil – the other one I am not very sure of as an attempted digging but is not surrounded very closely by rocks – seems to have plenty of room to dig.
Almost no obvious signs of rats here – no obvious droppings, no skeletons, or dead or dying animals; no disturbance of tortoise nests – we have found eight nests; probably are a few more although searched over areas fairly carefully for nest and tortoises – some nests hard to detect. No open, naturally hatched nests encountered. Will more fully examine this whole area and describe and photograph it on future trips.
(Pg. 20) Zone E: Will have to conduct a more thorough examination and write a more complete description at a later time because did not have an adequate period to describe on this trip.
1. Size: did not yet estimate but certainly quite small and smaller than Zone D.
2. Exposure: about as for Zone D.
3. Location: see map; very near Zone D, just a bit further toward SW corner of the island. Area in between the two zones is all rocks and vegetation with no spots of soil large enough for nesting.
4. Slope: conditions very similar to Zone D, both for actual nesting spots, and surrounding rock covered areas. However, here even the nesting spots are in some cases slightly sloping in a downhill direction – but only a degree or a few degrees at most.
5. Altitude – will get later.
6. Physiognomy – very much the same (almost exactly like) Zone D.
7. Vegetation – same as Zone D.
8. Flooding potential: even less than Zone D.
9. Soil conditions – all comments for Zone D apply; exception is that I saw no places where ♀♀ had apparently been digging and then stopped for some reason.
(Pg. 21) Nesting sites in particular: comments for Zone D apply to this zone almost exactly. However, did not examine closely enough yet to get a comparative idea of nest density in relation to available nesting sites; also, saw no examples of interference here at this time.
Nests found:
1. On 16 Oct. 1969, Srs. Back and San Miguel found Nests #10, 11, and 12 in this area; returned eggs and young from #10 and 12 at that time.

2. #11 re-opened – four eggs present in total; two eggs OK apparently – returned to CDRS; two eggs obviously rotting although whole – can see discoloration inside of shell and can hear liquid if shake slightly; returned to CDRS for measurement and examination No signs of any disturbance to nest. [Marginal note – Nest #11 completely dry inside.]
3. #17: When found there was a small hole of about 4 cm in diameter just to one side and on edge of hard cap. This opening went down rather directly into nest with only a very slight slant to it. Took photos of it before opening nest (roll #26, photos #22-25). Upon opening nest found that its structure was rather difficult to determine – can't tell if was a flask in fact because totally dry throughout and soil in part crumbly – hard cap intact, but it also very dry and starting to crumble on bottom – easily broken by slight pressure from the hand. Probably originally contained three eggs; one egg rotten and about half of it broken into and destroyed – some of material (Pg. 22) still in the intact half, still present but putrid and can't tell if contained an embryo – but appears it did contain a small one – 1st or 2nd stage of incubation.
Fragments of shell and membrane of at least one more egg scattered about in nest – no material adhering to these so animal could have hatched naturally; can't say for sure. The remains of one young tortoise – only could find some carapace scutes – about eight of them. They are in such a developed condition that the animal must have either just hatched or been very near hatching and been eaten in its egg or while hatching. No bones or any other remains found. Therefore could be that a rat entered nest and killed and ate small tortoise, then destroyed other egg or two eggs. Clutch size either two or three depending upon whether regard shell and membrane fragments as being from young tortoise or another egg.
Another possibility: one young hatched, escaped naturally and then rat(s) attracted to site, entered nest killing other young tortoise and destroying the other egg. This question unanswerable at this point. Seems almost (Pg. 23) certain that rat (s) entered and killed one young one and carried off or ate all parts but the few carapace scutes found. If had died and decomposed naturally in nest would have expected something in addition to carapace scutes to still be in nest. Question is when rat (s) entered and by own digging or tortoise hatchling's exit hole? Took photos #26 – 27 (roll #26) of remains in nest cavity.
Tortoises – saw no tortoises in this nesting zone, but plenty of dry scat of varying ages – no real fresh droppings, but hard to determine age of others.

For other three nesting zones will have to describe at a later date – simply did not have time to adequately examine them in total and take notes on this trip. Will give general comments on each one however.
6 Dec 1969 – Went to Zones C, B, and A by route indicated on map.
Zone C – General description: very small area, appears to be about same size as Zone E or even smaller. Area all around it covered by rocks and it is mostly rocks with patches of soil here and there. Faces on a down hill slope, about SW. Altitude is around 700 ft would guess. Took one reading with Thommens – 710 – 720 ft. Slope is not very great, perhaps 5-10 º at most in places – fairly steep above and below the areas, but levels off more in a sort of a little plain right in the zone itself. Area is quite open in part; type of vegetation basically similar to that in Zone D and E, but more open here with vegetation more scattered throughout the potential nesting (Pg. 24) site locations. Vegetation is again dense around the area. Almost appears that small pockets of soil here are perhaps

used extensively enough by tortoises that larger shrubs and trees never were able to enter and occupy them. Rocks as in Zones D and E, scattered all over and surrounding little patches of soil – soil again has really in fact collected between rocks as in a terraced hill situation. However, rocks here do not approach boulder size – they are generally smaller and embedded well into the soil. Most of nesting areas surrounded by these small rocks and herbs only. Clearly virtually no shading at all of nesting sites by vegetation or rocks possible – well exposed all day long. Comments on soil below.

Nesting sites in particular: soil is quite different from that of Zones D and E. That here is a darker color – pale brown but with a strong reddish tint. [Marginal note – but not at all like that of Santa Cruz; this is not nearly as fine or red in color as that on Santa Cruz]. It also is not nearly as fine grained – sort of medium in texture whereas that in the two zones (D and E) was very fine. Almost powdery when dry. There are no pebbles or pieces of small rock in the soil here of any great consequence – occasionally a small piece of rock mixed in but not much.

Soil areas are mostly as in D and E – only a meter square or so – but will (Pg. 25) have to examine more closely later. Note - many of soil areas here unlike all other nesting zones on Pinzon, are covered with dead grass and other vegetative litter – probably because sites used only intermittently or not at all.

Didn't examine soil for depth but did some digging about here and there and the areas certainly seems adequate for digging nests – got down 15-20 cm and with no problem – don't know yet how much deeper one could dig. One interesting aspect however – in a few places saw small openings or cracks running down into soil. When dug down through and around these found that the soil was rather hard and clumped into clods in part. Appears that the holes and clumping of soil are due to water percolations. This brings up the question of whether or not this is really a very suitable nesting area. Appears to be perfectly adequate but amount of rainfall may be such that areas lower down are more favorable (e.g. Zones A, B, D, and E). This area could not really flood and hold standing water, but excessive rain could keep soil in nests too damp, or excessive cloudiness could slow incubation too much. In agreement with this possibility is fact that have found no nests here yet this year on trips now and in middle of Oct. Also egg, shell fragments, or membrane remains could not be found in soil at what look like nest sites. Unable to determine workability of soil with water yet – will do later.

Soil is harder than in Zones D and E, but I do not think ♀♀ would have any problem digging in it based on their capabilities as witnessed on Santa Cruz and in red soil areas there.

Nests: Cannot comment on interference or actual nests in this area because have found none to date. However found one site where a ♀ had obviously been digging some. Only about 10-12 cm deep and quit. However, no obvious rocks or other obstructions; however, should note that this was in one of those areas where soil was (Pg. 26) somewhat clumped together and hardened and thus crumbly due to water percolation through it and certainly also due to alternating cycles of drying and wetting of soil. This at least indicates that ♀♀ will try to dig here, even though may be unsuccessful.

Tortoises: besides this one digging attempt saw many fresh and dry droppings on way down to the nesting area along our trail (cut by T. deVries and C. Calapucha most recently, used by M. Castro before) and along a sort of natural boulder-strewn pathway which runs down from the "rim" or high area above to the nesting areas (see below).

Also some fresh and dry droppings (latter of indeterminate ages) in the nesting area itself. Finally, a ♀ tortoise in the nesting area itself – she was not measured but was lying in shade under some lichen-draped Croton and Acacia. Old animal certainly because of large size for a ♀ and carapace scutes all completely worn smooth. The natural rock strewn pathway comes down to Zone C from high area above almost directly in a N to S direction. Sr. Black thinks it is a galapago pathway but I am not sure – certainly are droppings on it but tortoises (Pg. 27) could be using other pathways and simply crossing this on their way. The "pathway" almost looks like a stream bed which might be gushing with water after heavy rains – if so what does this do to Zone C which lies directly at the bottom or in the central part of this rock covered pathway?
The reasons I am doubtful about it being a pathway are:
1. It is certainly navigable by tortoises, but would be difficult traversing even for them – plus there are more easily navigable areas with small rocks and which are semi-open on either side of the pathway,
2. It comes down from an area on the "inside" of the island where tortoises have not been seen and may be scarce or absent from – this however remains to be seen. Will investigate this whole area more on nest trip.
Zone B – Description: will be very brief, simply need to examine more closely at later time. On a very steep slope, 15-20 º by far the steepest of the five zones, but close to that of Zones D and E. Very similar to Zones D and E in that is full of large rocks of all shapes and sizes – approaching boulders in some cases. Vegetation similar to that of those two zones also; same species by and large, but also a bit taller in general, though not by much more than 0.5 m overall. In general very open around nest sites – well exposed and unlikely to get any shade (Pg. 28) except that caused by slope. Virtually no flooding potential that I can detect and not much sign of water percolation in soil. Nesting sites in small area of soil set in the midst of surrounding rocks and boulders. Most of these areas 1 sq m or less in size. As in Zones D and E like small little terraces in midst of general steep slope.
However, here as in Zone E, sometimes even a nesting spot is sloped downwards a few degrees itself. Soil is medium to fine, pale brown with a reddish tint and in most places rather well mixed with pebbles and gravel-sized pieces of black and red lava rocks and similar–sized small clumps of soil. Overall a much less fine consistency than Zones D, E, and even C.
Soil is not hard and seems easy to dig into. Didn't test depth, but also doubt this is a problem. Certainly is workable with water because nests have hard caps which do remain as one piece even when dry – however loose and easily crumbled – even more so than in Zone D and E, probably due to pebbles and dirt clods in it. As in Zones D and E, no vegetation at all in actual nest sites, used and unused this year – not even dead (Pg. 29) stuff; probably because sites used virtually every year thus preventing vegetation from getting established. Nest density not yet determined. No cases of interference seen. No clear examples of places where tortoises had attempted nests and quit were seen except one rather well excavated hole, but soil all very loose and in shape of ant lion's nest – perhaps done by Black and San Miguel. They do not remember.
Nests found:

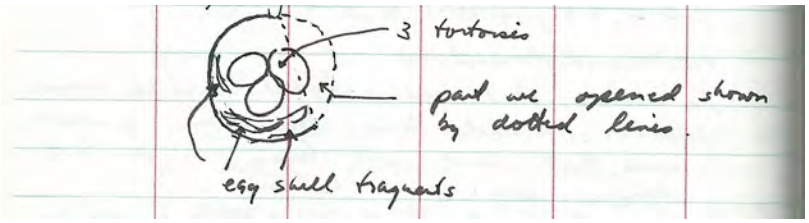
1. On 15 Oct. 1969 – Srs. Black and San Miguel found Nest #1 here. Re-opened today and three eggs removed – all appeared OK and will be returned to CDRS. [Marginal note – Nest #1 completely dry.] No signs of any disturbance to nest.
2. #18 – had about a 4 cm diameter opening right at the side of the hard cap and just barely to side of where eggs were found to lie in the nest. Runs almost straight down into nest at only a very slight angle.
Eggs and young: Probably three eggs originally, maybe four. When opened found shell and membrane fragments of what appears to me to be one egg; however, no carapace fragments or any other sign of young tortoise or a well-developed embryo having been destroyed. Also there were two eggs present obviously rotten, but whole. [Marginal note – rough measures (Lufkin tape) of two putrid eggs: 60 x 60 mm; 60 x 58 mm.] Opened and found they were decomposing inside - no sign of any embryos at all – thus infertile. Question: did one young hatch and then escape singly, or did a rat enter the nest and destroy one egg? Since two eggs were untouched I prefer the former hypothesis but impossible to determine.
(Pg. 30)
Nest structure: Hard cap very large and wide at ground level; no loose soil on top of it. It is about 10 cm thick in central part. About half of its thickness on underside is made up (in central part) of tortoise droppings and tortoise droppings mixed with some soil. Looks like maybe used 2 or 3 individual scats. Just beneath hard cap is about 8 cm of more loose soil, pebbles and small tiny mud clods – probably in part loose fill which was somewhat moist when nest originally made; in part also portions of underside of hard cap which have been crumbling away a little as nest dried out. Looks as if female laid eggs, then put in loose fill, then dropped excrement and then made hard cap on top of and partly mixed in with excrement. This is the first nest have seen in which excrement was actually part of the hard cap – seems to hold together very well and does give added durability – I wonder how easy it is for young tortoises to dig out of a cap made partly of excrement in fact because it is so durable (Pg. 31) and holds together well. Wonder if this would not cause problems?
All eggs appear to have been on same level in nest. Depth to top of eggs from surface of ground (hard caps) 18 cm.; depth to bottom of eggs and nest from surface of ground 24 cm. Can't tell much about nest shape or size otherwise; very dried out and hard to open without causing some caving in and general disturbance of structure. Eggs right below center of hard cap, so if young one exited through hole did so at about a 75 º angle to horizontal plane at nest bottom. Eggs certainly not under any flask overhang- can't tell if any room for more eggs.
Tortoises: No animals actually seen in this area, but scattered dry droppings here and there and a few fairly fresh ones along a trail in between this zone and Zone A.

Zone A:
General description: Also a small area, but did not have time to estimate size or describe well. Slope most gradual of all zones except perhaps Zone C; estimate to be about 10-15º at most. Vegetation and rocks and nest site locations in terms of being small areas of soil of about 1 sq. m or less; all similar to Zone B. One main difference is that rocks here a bit smaller and not as prominent in the areas. In other words (Pg. 32) vegetation like Zone B, rocks more like Zone C. Nest sites again small areas between rocks – like little

terrace spots. All very open – certainly very little or no shading except that caused by slope. No flooding potential and soil does not appear to have had much water percolating through it. No vegetation, dead or alive on open soil spots here – i.e. nest sites – appears well used each year. Some shell and membrane fragments of tortoise eggs from past years can be detected in open soil areas. Some very open slopes around the nesting area proper, but covered with reddish plate-like rocks in great profusion; simply no soil on these gentle slopes for nesting; if there were I am sure would be heavily used.
Soil here even more gravelly than in Zone B – in fact much of soil is marble-sized pieces of red and black lava; basic soil type is a medium-grained darkish grey-brown in color. Certainly the coarsest soil of the five zones. Seems to present no problem in digging as are plenty of nests. Didn't check maximum depths of bedrock, but in nest opened no rocks in bottom stopped ♀♀.
(Pg. 33) Also seems easily workable with water as ♀♀ capable of making solid hard caps with it – however as dry, tends to be more easily crumbled and broken than those of Zones D and E and even a bit more so than that of Zone B. Nest density not yet determined. Saw no clear examples of locations where ♀♀ had dug and then stopped for any reason, but hard to tell because area well dug up by Castro, Black, and San Miguel in searching for nests. One case of interference was discovered – see below –
Nests found:
1. On 15 Oct. 1969 Srs. Black and San Miguel found Nests #2, 3, 4, and 5.
2. #3 re-opened – all four eggs appear OK – removed to take to CDRS. One has small hole on side – about 1 cm diameter – but just shell broken – membrane inside is intact and egg seems to be OK. No signs of any disturbance to nest; perhaps due to soil pressure. [Marginal note – nest completely dry].
3. #4 re-opened – all four eggs OK – removed to take to CDRS. No signs of any disturbance to nest. [Marginal note – Nest completely dry.]
4. #5 – re-opened; this "nest" is really two nests at one site, one slightly overlapping the other – actually about half to two thirds overlap – but second nest not dug as deeply as first one, thus minimizing destruction. Looks definitely as if one nest originally contained seven eggs (the bottom one) and the other contained five eggs (top nest). One of the eggs of the top nest was broken artificially when opening the nest. One of (Pg. 34) the eggs from the bottom nest was found at the first opening on 15 Oct to have been naturally broken – perhaps due to second ♀'s activity. Also looks as if each nest originally only had one layer of eggs - Black's measurements of 15 Oct would agree with this - see data sheets.
Nesting site is very small – only about 1 m x 0.6 m open soil in this area – surrounded by rocks, thus forcing any ♀♀ which choose this site to dig in almost the same spot – as apparently happened in this case. Almost no soil between the eggs originally – a few mm according to Black. Reason it seems to be two nests is this small amount of soil and the fact that second nest is shifted a bit to one side in relation to the first one.
Of remaining eggs- four of those in bottom nest OK – removed for return to CDRS. Other one whole but can see is discolored and putrid. Opened – rotten and apparently infertile.
Two of those in the top nest OK and removed for return to CDRS. Two others from top nest broken – one crushed completely and caved in and rotting; no sign of embryo in it,

(Pg. 35) but hard to tell. Other one cracked only on top and bottom, i.e. where was taking force of eggs from below and soil from above. Also rotten; opened it and found an embryo in first incubation cycle stage – but large – stage 1/stage 2 transition perhaps. Preserved this for CDRS museum. These 2 almost certainly broken by pressure of soil from above because no signs of disturbance in nest at all. Perhaps due to way nest refilled, but might have happened naturally anyway? One thing tending to prevent this in natural nest is presence of hard cap intact - in opened nest cap is unavoidably at least partly broken and they are not careful about how the soil is replaced – just fill nest back in! – big and small dirt clods included. Thus a total of seven eggs to CDRS from these two nests. Nest completely dry inside.
5. #2 re-opened – 1100 hr, sun out and damned hot. Has been mostly overcast till about 1000 however. Temperature of ground surface on top of nest – 49.4º C Temperature inside nest just as opened but before hole enlarged – at level of young tortoises inside – 32.8 º C; cloacal temperature of one young tortoise in nest – however after sunlight falling on him in one area (about ¼ of body area for 1-2 minutes) 33.4 º C.
Inside found three young hatchlings all sitting in a tight cluster and just below them one egg. [Marginal note – soil in between young and egg but egg partly embedded in soil.] This remaining egg may be rotten but hard to tell, since it is only slightly discolored – certainly at least partly developed because obscured inside – can not see yolk.
(Pg. 36)
The three young were at same level, tops of their carapaces being about 15 cm below the soil surface of the nest. All three were inactive and completely surrounded by loose soil; all healthy – began moving with a few minutes after nest opened and light entered.
They were all three sitting in a cluster with the clearly defined remains of their three respective eggs around tightly pushed up against the sides of the nest cavity. These shell were still about 33-50% intact – tortoises had come out of them toward center of cavity in all 3 cases where now sitting. Thus, virtually no sign that have yet been trying to dig out of cavity at all. No real moisture in cavity could be detected – all soil very dry. Relative ages of tortoises interesting to note: all three still had clear places where yolk sac was attached – not closed completely in any of them, but one nearly closed up. Another more opened up still, but closing. The third like the other slightly open one but even more recently hatched – certainly the most recent of three animals. Plastron still very soft all around yolk sac attachment area and a bit caved in on one side – i.e. depressed. Hard to tell but the three (Pg. 37) certainly, two at least, slightly different ages (hours) and perhaps even a few days difference between oldest one (nearly closed plastron) and the other three more recently hatched ones.
Took some photos of young in nest and underside of most recently hatched one – Roll #43, photos #5-9.
Nest undisturbed. Interesting that all three still inside because:
1. Shows hatched fairly close in time probably and that have not begun digging out singly soon after hatching.
2. Demonstrates that there must a waiting period in nest after hatching before they begin digging out – this of course could be dependent or independent of presence of other eggs or hatchlings in nest – can't say anything about this possibility yet. Alternatively could depend on physiological condition (e.g. yolk sac absorption and closure of plastral opening) and be totally an individual characteristic as to when they begin digging out.

Fly in the ointment here is that may have tried to dig some but been unsuccessful because of restructuring of nest after artificially opened by Srs. Black and San Miguel on 15 Oct. 1969 – e.g. could have resulted in soil being closely stacked around them so couldn't dig. [Marginal note – normal hard cap might prevent this.] However, doubtful because did at least get out of eggs and moved a bit – also no sign of digging at all and would expect some sign if they had really tried – (unless of course we disturbed area where they had been digging when we re-opened nest) – possible because the one area right above them and to their side was opened by us – but only (Pg. 38) to side of one of the three really, the other two in such positions that all soil around them was undisturbed in re-opening nest – thus I don't think we obscured anything.
[Diagram of nest cavity from above and three tortoises with it. Diagrammatic only, not to any scale.]



Tortoises: No animals seen in the area, but plenty of dry droppings. No real fresh droppings but some of old ones rather well formed – but of course hard to age exactly. No new nests found.
Other tortoises seen today:
1. Opuntia tree area (see map) where T. deVries has a campsite. On S side of island but inside central part (not crater itself) below 1000 ft rim. Some dry, but well formed droppings, some fresh scats, and one medium-large ♂ animal walking about. This animal's # (Pg. 39) rather hard to determine but perhaps #xx,014; reason hard to say for sure is that can't tell much about front marginals because rather badly chipped and scarred up on both sides. Certainly no 100's numbers marked.
Old animal and smooth all over carapace scutes.
2. near highest area (800 ft plus) which is on SW side and lies directly uphill from Nesting Zones D and E. Four tortoises – two unidentified (failed to check this morning); # xx,078 ♀; smooth all over carapace scutes.
#xx,058 ♂; smooth all over carapace scutes – large ; a lichen here and there on carapace scutes.
3. Bit more toward NW – still up around 800 ft level, but somewhat lower in elevation; near "steamboat" shaped rock. Still SW side of island.
#xx,082 ♂ (or #xx,086 doubtful) old and very large; same lichens species on carapace scutes in places; scutes all smoothed over.
#xx,094 ♂ - also smooth all over, old, medium-large size.
♀ tortoises from this area could also certainly be using Nesting Zones D and E – certainly nearest of known nesting areas. Will look for tortoises and make more comments on future trips. Following comments apply to my methods and those of Sr. Black on previous trips.
(Pg. 40) My methods:

A) 1. In opening nest try to do so right at side of hard cap and go inward at a very slight angle and down – in this way usually enter nest well to one side, thus preventing destruction of area above eggs and any young which might be inside. In particular, this avoids possibility of destroying area which can check to see if any young present have been digging. Also allows one to see if there is an air space between eggs and hard cap and relationships of any hatchling to egg shell remains.
2. Take soil surface temperatures and air temperatures with Schultheis thermometer, shading it with hand and or body. Always place it in an area which was just previously in the sun whenever that is clear at a reading time.
3. In taking depth measurements try to leave part of hard cap intact and more or less fix in sight and with sticks and machete where top of nest was before opening – then take depths from the central area of the hard cap surface down into the nest – in practice not really difficult to perform this measurement.
(Pg. 41)
B) J. Black's measurements:
1. He previously told me that in almost all nests opened on 15-17 Oct. 1969 trip that they found most nests had only one layer of eggs but that some did not. However, judging from the differences in depth to top of upper most egg and to bottom of lowest egg in any give nest, this does not appear to be the case – most of these nests (12 nests in all) show depth differentials >6 cm. Since all Pinzon eggs measured are about 60 cm wide at widest part or less, can not be that most nests had all eggs on one level. Either this or he often took depth to bottom of lowest egg after removing all eggs and perhaps excavating nest some more – could be that some differentials are due to this factor since I saw J. San Miguel (5-7 Dec. 1969) further excavating nest after J. Black had removed all eggs and the latter then took depth to nest bottom – however on the other side of the argument he usually took this measure properly, before removing eggs – so in sum can't say much. Probably true that some nests single-layered for sure, i.e. # 5 and 19 in one site – certainly each single-layered. Others probably certainly double-layered or more.
2. His nest depth measures are off somewhat for sure – watched him take some on 5-7 Dec. 1969 trip; two factors throw real depths and his measure out of whack – first J. San Miguel scrapes much of hard cap upper part and any loose (Pg. 42)
soil away with machete before measures taken, but without taking care to mark where original soil surface was located. Secondly after nest is open, Juan Back puts pencil crosswise at hard cap level and measures down from this – problem is that he doesn't usually span the entire nest with the pencil but just jams it downward till come to rest on a particularly hard level of hard cap – in general I would thus estimate that all his depths (upper and lower for each nest) are about 2-4 cm too short as compared to what actually should be.
10 Dec 1969. See separate sheet for data to date on incubation, hatching, clutch sizes, egg measurements and much more on nest brought to CDRS by Srs. Back and San Miguel from trip of 15-16 Oct 1969 and some additional data on those brought back from out rip of 4-7 Dec. 1969. Some specific observations on the process of hatching, hatching time length, (Pg. 43) condition of yolk sack, scutes, etc. at hatching and other items are described below – these observations made over past two days by Jan and me here at the CDRS. Jan will continue these observations from 11 Dec. until I return just before Christmas to CDRS.

1. Hatching process – The following data were obtained from watching the hatching of tortoises #15, 16, 17, 18 from Nest #8, Pinzon Island 1969/70 nesting season. See separate sheets for history of this nest's discovery, return to CDRS and incubation there. On 8 Dec 1969 looked into incubator (by sea, "old" young tortoises cages) at 1730 hr and found that all four eggs from Nest #8 were in the hatching process; actually one animal had just recently hatched and the other 3 were in the process.
They were all transported, covered by a cloth and thus in relatively dark obscure light very quickly to the laboratory, placed in a dark enclosure and kept there constantly for the rest of the hatching time except to occasionally open the container to check on their progress and to take a few photographs (see end of this volume for details of photos of hatching process, yolk sac condition, etc.). Thus conditions were kept somewhat the same as in the incubator and nature, except that the temperature was certainly a bit lower in the container in the lab – about 23-25º C most of time instead of (Pg. 44) 28–30º C of incubator; also in nature or incubator would have been completely dark. Can't say how much the occasional light disturbed them; in general it probably increased their activity somewhat and thus may have affected hatching time - on the contrary side, noticed that sometimes when light suddenly hit them in the dark container they ceased motion which they had been clearly engaged in just prior to opening the container – in other words the light subdued them sometimes rather than stimulating them during hatching. Thus overall effect hard to evaluate at this time.
a. Hatching time –
At 1730 on 8 Dec. they were in the following conditions – all Nest #8.
Egg #III – Tortoise #15
Egg #I – Tortoise #16
Egg #IV- Tortoise #17
Egg #II – Tortoise #18
#15 was clearly just hatched a short time (one or two hours at most?) before that afternoon; was covered by slimy mucous and still wet all over – had moved only 3-5 cm from its egg and there was a string of mucous (Pg 45) still connecting the animal and the mucous lying inside the egg. Also, the little beast was covered on lower parts with fresh wet mud made by contact of its mucous with dryish fine soil of the incubator. All these things point to a very recent hatching, as I would expect the mucous and dirt to start drying considerably within just a few hours after hatching. This remains to be verified. At any rate the animal was clearly hatched on this day.
#16 was about 1/3 of the way out of its egg in terms of its body size. It had a nice big hole opened in the egg on one side and was facing downward toward the soil a bit though not yet touching the soil. Had head, forelegs, and front of carapace out of egg. Clearly now just a case of crawling out and in the process breaking a bit more of egg's shell away. Not entirely clear if head end made original opening but certainly is coming out head first. This animal then completely came out sometime between 900 and 2000 hr – checked at each time was still about half in egg at 1900, and just freshly out and all mucous covered and in muddy condition at 2000.
#17 had about a 1.5-3 cm diameter hole by 1.5-2 cm opened in side of egg when discovered. Through this hole could see head and one foreleg. Don't know if opened shell with leg or (Pg. 46) if used egg tooth, but it is reasonable (especially in light of behavior of #18 described below) to assume that opened shell with egg tooth and then

during struggles turned more sideways. By 2000 hr on same day this foreleg was sticking out of the opening which was a little bit larger.
At 0730 on 9 Dec. had turned back so that head was in opening and forelegs drawn up beside head – opening now enlarged, but not any of body really out of egg yet. Then continued to work way out of egg. By 1430 on same day was about 1/3- ½ way out and while photographing at 1515 (light stimulated?) came all the way out – mucous covering as in previous animals.
#18 – when found on 8 Dec. at 1730 only a small 0.5 cm diameter pip of an opening in shell – head and egg tooth visible in this opening – pretty clear that made opening by using egg tooth. By 2030 of same day still in same position, hole a bit larger. By 0730 next morning (9 Dec) hole about 2 x 2 cm and had turned sideways (Pg. 47) so that drawn up leg only thing visible through opening – can only barely see head to side, just beyond opening. By 1500 on same day has turned back; hole is larger, and head and both forelegs drawn up mostly – not out of egg at all yet, but will certainly be so soon.
10 Dec – by 0730 has progressed so that forelegs and head out of egg – about 25% of way out. By 1100 noticed that about a third to half way out and moving and struggling, thus removed from container and while photographing at 1130 has hatched out all the way, again with typical coating of mucous.
Most interesting thing about all this is that if we assume that #15 was completely hatched at approximately 1600 –1700 on 8 Dec, then all four were in process of hatching in incubator by 1730 that same day (probably a bit earlier even and all were completely hatched out by 1130 hr on 9 Dec – i.e. only 43-44 hours later. Of course light could have speeded this up, but also they were not near each other enough to be touching in incubator or lab container – perhaps in nature movement of one stimulates same in other and thus might speed up hatching – this remains to be verified. The point is that they (Pg. 48) all began (apparently, even if one assumes whole process requires almost three days/egg) and completed hatching with close proximity in time to each other – this could conceivably be important in insuring that all are in similar condition of development when time for escape from nest arrives – thus could be selectively advantageous for as many of sibling as possible to hatch at nearly same time as possible. Also indicates that eggs were probably in similar condition when laid and developed very similarly in time – none of that is surprising at all in fact.
Data from other two nests does not indicate hatching times so closely spaced – for nest #7, four were hatched between 4th and 9th of Nov., and one wasn't hatched until 17 Nov. For Nest #10, four were hatched from 17 to 20 Nov., and other one not until 23 Nov. However, except for the one date of 17 Nov which is clearly too far apart to be explained by the behavior of the observers, the (Pg. 49) other records may in fact be a bit misleading in that the observers involved were not checking or watching this nearly as closely as I was. They (J. Black and, or T. deVries) in fact were checking incubators only once/day and if found an animal hatched gave it that date and if an egg in the process simply put in lab and let hatch (not in dark) and just recorded when first noted it out of shell – certainly some room for one or two day errors in hatching times given these methods and it is absolutely certain that they were not able to get any hours correctly. Thus data not entirely accurate and except for Nest #8 should be used sparingly.
b. Behavior while hatching – Many of the comments above apply directly to this – use of egg tooth, direction of exit, time of hatching and stages, etc. Will only make a few

comments now and wait till make observation in infrared incubator to get better idea of whole process and behavior. Appears that they probably use the egg tooth which is an elongated (in dorsal-ventral direction) raised horny projection on upper jaw par of beak, to rasp open first hole through inner membrane and egg shell – have still not seen this and have no idea how long a process it is or how difficult it may be. Once the initial opening is made (Pg. 50) with this tooth it may be of only limited use after that. Instead, it appears that they used a combination of simple pressure by pushing body forward and grinding into egg shell with front of carapace, head, and forelegs. This gradually breaks out more and more small pieces of the egg until the opening is large enough for them to get their forelegs out. In some case may turn sideways a bit and get only one leg out while hole is still smaller. Then by moving this extended leg around and contracting and extending it, they break out more small pieces of shell.

Once both forelegs are out, and all three witnessed (# 16-18) for this, they move them about and this aids in enlarging opening. Once about 25% or 33% of body and legs are out, the weight of this side of the egg rolls it toward the ground; then can use forelegs to get traction on ground and this helps move forward out of egg somewhat – before this I think they largely rely on pushing body forward with rear legs almost or entirely exclusively.

(Pg. 51) (The 4 witnessed clearly all came out of the side of the egg in relation to the way the egg was sitting on the ground – is this determined by some sense of gravity? Or is my sample just too small as of now?)

Finally, with foreleg traction on ground and rear leg pushing and giving thrust they just burst the last 2/3 – ½ of the way out of the egg – this may occur rather abruptly after sitting 1/3 of way out for several to many hours – noted also that they alternate long periods of many minutes up to an hour at least, and perhaps more, just resting and sitting doing nothing with short bursts of struggling for a few to a few dozen seconds. Except for final burst of activity in leaving egg, never saw moving and struggling for more than one minute at a time. But must get more observations on this and also do so under controlled semi-natural conditions in infrared incubator – the last container set-up is not a very instructive way to try to get such data.

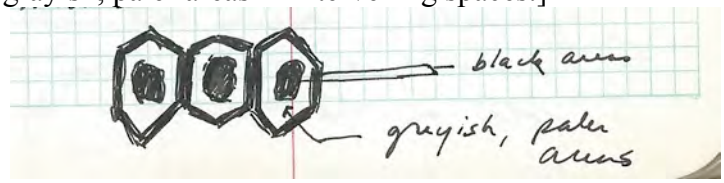
2. Condition of animals upon hatching –

a. Mucous – are covered by a thin coating of mucous, most heavily concentrated around remaining yolk sac; there is a small puddle of this mucous (or egg albumin?) remaining in bottom of egg when they emerge and this stuff looks to have clearly been concentrated around the (Pg. 52) yolk sac area when they were in the nest. Anyway it makes them quite slippery, and well lubricated, and certainly must aid in slipping out of egg – especially may help prevent rupture of yolk sac or sharp edges of eggshell when it is broken.
b. Plastral fold – There is a folded, almost overlapping area in the plastron which is situated as follows: This however is variable in extent. All young and late term embryos that I have seen have it, but not to an equally strong degree. For example #15 barely had such a fold; #16 and 18 had a very strong one, and #17 was somewhat intermediate in its development; #15, of course, could have lost some degree of it by the time we found the animal already hatched, because in all four hatchlings the fold had mostly disappeared as the animal stretched and (Pg. 53) straightened out during the first 24-48 hr after hatching. In fact, seems to be

largely gone by end of first 24 hr in all four animals seen – can still see it but not much even in #16 and 18. When they first emerge there is even a small thin membrane across the fold connecting the flattened plastral areas on either side of the plastron. This gradually dries and ruptures as the fold disappears however. Almost certainly the fold and its degree of development depend upon how large and "scrunched-up the baby tortoise is in the egg.

c. Color of carapace and plastral scutes upon hatching. Of these four, and one embryo near hatching (from Nest #12 on Pinzon – opened before hatching by J. Black), three of these and the one from Nest #12 had plastral and carapace scutes almost entirely black, outer border areas around central part of scutes only slightly less dark than the center. In fact plastral scutes rather uniform extremely dark grey-black. However #17, had very light, pale grayish areas on all carapace scutes all around central areas.

[Sketch of contrasting coloration of black in central and periphery of scute with grayish, paler areas in intervening spaces.]



(Pg. 54) Same animal had lighter colored plastral scutes – fairly uniform color but a bit of a more pale yellowish cast to them and not as dark as other animals. Could hardly argue that this animal more "premature" than the others because yolk sac not as large and exposed as either #16 or 18, and certainly not huge as that in preserved embryo from #12 nest. Question therefore is what the functional and developmental difference, if any, there is at the base of this color difference – vitamin D, amount of horny material or thickness of scute? It is interesting that in very small embryos have seen – those classified as 1st or 2nd stages of incubation and about ¼ - ½ hatching size – the whole animal is this light grayish color, even white in parts – are also softer, and in these earlier stages of development the areas which will be darker at hatching are in fact already detectably a darker gray in color on the scutes and the lighter (Pg. 55) areas to be are still a paler grayish to whitish – so must be a question of degree of development but what is basis of color change?

See photos of # 15-18, and earlier embryos for illustration of these comments – rolls #24, 25, and 45-50.

d. Yolk sac and plastral opening due to yolk sac. Took some notes and general photos of yolk sac of #15-18 at hatching time – got #16-18 right after came out of eggs; #15 probably several hours after first out or more; see rolls # 45-50 for specifics on photos. During this time after hatching, except for a few photos, kept animals in darkness in same container hatched in. Jan is continuing to observe, take notes, and photograph yolk sac and plastral opening condition of these animals from 11 Dec. until Christmas while I'm gone; she is also keeping them in dark in same container in order to simulate natural nest.

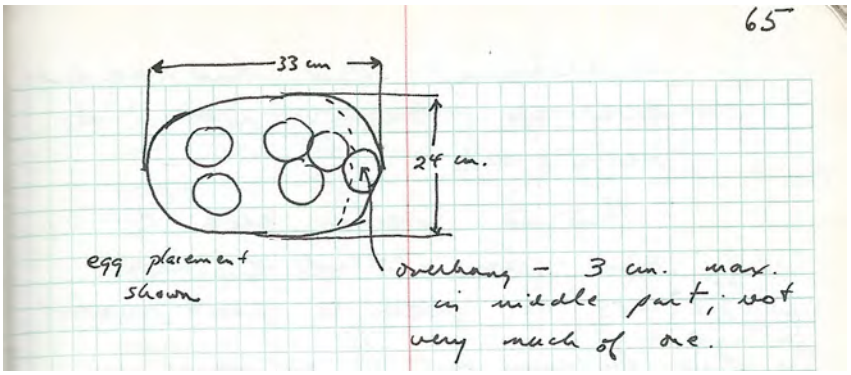
My observations to 10 Dec. 1969: #15 – When found on 8 Dec at 1730 hr yolk sac was only about 0.5 cm in diameter or less; did not take further measurements of yolk sac or plastral opening; but by 24 hr after hatching had decreased considerably and by

48 hr later (after hatching) was really decreased sharply in size – not yet entirely inside and plastral opening still there, but diameter at widest part now only about 3 mm.
(Pg 56) #16 – when hatched, yolk sac very large, about 1.5 – 1.5 cm more or less oval in shape, long direction anterior-posterior in direction. By 12 hr later considerably decreased in size, to about 1 x 2 cm, and by 24 hr and 8 hr after hatching even further decreased in size. By 48 hr widest part only about 5-6 mm in diameter. Decreasing quite rapidly in other words. See photos.
#17 – when hatched, reasonably large, but smaller than that of #16 and 18 and a bit larger than that of #15; size about 1 x 2 cm. Decreased to only 5 –7 mm diameter at widest part by 18 hr later.
#18 – history and size almost exactly as that of #16; last viewed at <24 hr after hatching, in fact about 22.5 hr after; but decreased about same as seen by this time in #18.
(Pg 57) Can't get much additional data from first ten hatched at CDRS or three live ones found in Nest #2 on Pinzon on 6 Dec. 1969 (#2-11 and 12-14 respectively). Problem with those hatched at CDRS is not kept in dark and thus probably more active than normal. Thus yolk sac regression may be speeded up. In addition, unless watch every day find that there is a problem in first stating what is the stage I will call a closed plastron (and thus a regressed yolk sac) and secondly that some stages may appear for a number of days in a row – for example, examined #4 and 5 which were hatched on 9 Nov. 1969 at one month of age (on 9 Dec) and found that one of them appeared to be tightly closed and there was no yellowish coloring left on plastral closure at all. The other, however, was also closed in any real sense, but there was a very yellowish cast and some yellow skin remaining around the closure. Of interest is that can't tell difference between this animal and #11 which was hatched on 23 Nov. 1969 and is thus only 2 weeks old – i.e. simply must follow animals from hatching on to tell much of anything about yolk sac regression and plastral closure time.
(Pg. 58) Finally, yolk sac itself seems to be made of a rather thick skin and is quite tough – they drag it around on sand and in gravel and seem to have no problems in regards to cutting into it or rupturing it.
From this point on all studies till next trip to Pinzon will be at CDRS – these data will be collected and typed up in duplicate on various data sheets rather than in this book. The data sheets in particular are as follows by name:
[Editorial note: rest of page blank]
(Pg. 59) 13 Feb. 1970. J. Fitter dropped us from on board "Bronzewing" on NW side of Pinzon at 0930. he will return mid morning on 16 Feb. 1970. Party consists of myself, D. Weber, and Fausto Llerena. By the time we got food sorted and all assembled for trip to crater campground was 1130, so will go directly to camp and examine Nesting Zones D and E on 15 Feb. and return. En route to campground started seeing lots of old and fresh tortoise droppings beginning at an altitude of about 800 ft. on the NW side after having ascended the steepest part of the trail. We saw a few older dry, weathered but still well-formed, ones between 500 and 800 ft on the steep trail. Certain that are a number of tortoises along this high ridge-like area from 800 to 1000 ft on the western side of the island.

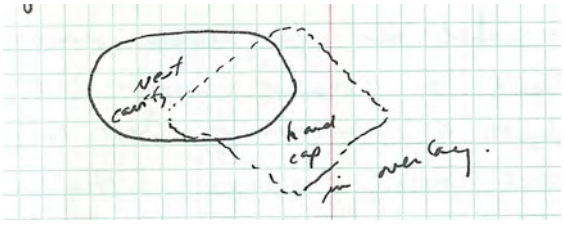
We saw only one animal- #12,056 ♂ at about 850 ft altitude just as we started leveling off after the steep ascent part. He is more or less directly above nesting areas D and E. I took two photos of him resting in the shade under a large rock i.e. in the overhang at one side of it. Mostly cloudy today but sun out off and on and apparently this drove him into the shade (roll #83, photos #12 and 13).

(Pg. 60) He has quite a large amount of a pale green lichen growing in the low protected places on the front portions of his carapace – one might say on the sides of the "saddle" behind the sharply up-curved front parts (marginals).
We then went to the camping area at about 870-900 ft in the upper and higher one (in the floor) of the two craters. This camp is situated in a nice mostly soil-covered area in a stand of Opuntia trees. I will describe this area later for other reasons.
Relaxed, wrote notes, and just poked around a bit all afternoon. Fausto returned to disembarkation point for more water and food, and on his return met one more tortoise at about 950 ft in the flat, high area on the western side just before one starts descending to our crater campground area. Was cool and overcast all afternoon and clouds blew in and covered us (from the S) beginning about 1600 hr.
(Pg.61) 14 Feb 1970.
Up early at 600 and left at 0800 for nesting areas. Will go first to Zones A and B, return to C, but will not describe any of these any more fully because do not have time on this trip; I want to look at places to release small young tortoises from 1965/66 year class. Entered Zone B at 0930 and examined it for about 1.5 hr. Was able to obtain good altitude reading for it – it is a steep slope offering very scattered small open areas of soil among large rocks and runs from about 530 ft down to 490-500 ft in elevation. Found 2 ♀♀ in the area both in the shade of shrubs and trees, although has been mostly overcast and cool all morning up to and including now.
#12,032 ♀ - just above beginning of nesting area at about 600 ft elevation in a boulder strewn area devoid of open soil; a small fresh dirt wallow was noticed near her however, and she probably used this last night – it was completely dry as is everything else here now. CL 62.4 cm; CW 66.1 cm; extremely flattened dorsally in shape.
#12,014 ♀ - at very upper end of Nesting Area B at 530 ft. CL 59.3; CW 63..0. Also a fresh dirt wallow in open near her.
(Pg. 62) Just 15-20 m away from her discovered Nest #20, not moist on top but appears rather freshly made and unweathered. It is sitting in amongst a group or circle of rocks; the soil-filled area occupied an oval of about 60 x 70 cm in diameter. Eggs and young – six eggs inside; all in one level plane but only one under the flask overhang (which is not very great in this nest). The rest being in the central nest cavity. All appear fresh and when candled can easily see yolky mass inside, and cannot detect any darkened spots indicating embryos. One of the six was accidentally smashed when I was opening the nest, so I measured it, about 59 x 62 mm and then opened it fully; it is fresh, full of a nice yolk, but shows no embryo yet and was clearly laid very recently – it is not spoiled or putrid at all. All the other eggs appear to be in the same condition upon candling.
(Pg. 63) I will take these five back to CDRS and thus marked them. Took some photos (two) of nest before disturbing it at all and then three more after having

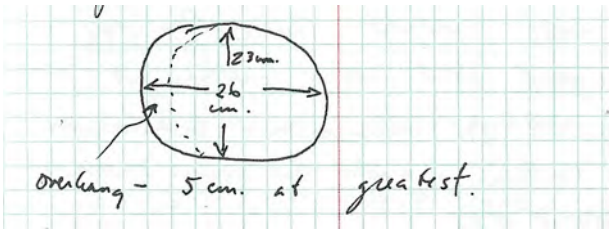
excavated it in order to show 1) position of six eggs, 2) nest size, shape and structure, 3) hard cap (upper part of picture), and 4) surrounding rocky area and soil type. See Roll 83, @ 15-19. No sign of any rats or other disturbance in the area. Soil in the nest and hard walls within were full of old egg shell and membrane fragments from previous years showing that this was and is a well used nesting site. No evidence of any interference by another ♀ tortoise in the area.
Nest site: very open, no shading by trees and shrubs; easy for a ♀ to dig here (60 x 70 cm, open soil area); no potential for flooding because although nest in a flat small planar place, the surrounding area is a strong downhill slope.
Nest structure: not much of a flask at all and not circular; more of an extremely oblong oval from above looking down, mostly a hole; a small overhang at one end of the oval (Pg. 64) only. Sides slant gradually inward toward center of hole from top of ground downward – thus just as one would achieve if he dug a hole with a shovel here.
Six eggs placed as shown; clearly room for at least two more and perhaps three at this one level. There was loose soil all around the sides of the eggs covering them right up to their tops and 1-2 cm of loose soil beneath them, separating them from some hard small rocks which form the bottom of the cavity. The ♀ probably knocked some of this loose soil inside when making preparations to lay the eggs.
The hard cap is strong, hard, well formed, large, and contains some fragments of fecal matter from the ♀. The cap is 15 cm thick in its thickest portion and it clearly was sitting right down on top of the eggs, originally as one solid mass. Everything, hard cap and loose soil is dry now, (Pg. 65) [Diagram of eggs in nest



Overhang – 3 cm maximum in middle part; not very much of one.] but she must have used copious quantities of cloacal fluid originally. The hard cap is of an odd shape but its size is about 40 x 50 cm in diameter and more or less a diamond in shape. It was set off to one side of the main hole a bit and thus did not cover two of the eggs: [Diagram of nest cavity in relation to hard cap at one side.]



Depth from top of soil to top of eggs 17.5 cm. Depth from top of soil to bottom of nest cavity (rock bottom) 26.5 cm. Also about 2-3 cm of loose soil and sticks, twigs and organic debris on top of hard cap at soil surface. Looked all around nesting area but found no more nest or evidences of digging; clearly no feral animal (Pg. 66) disturbances; did find one dead dried up rat in the nesting area.
Then to Nesting Area A – runs from altitude of about 485 ft down to about 390-395 ft. [Marginal note – At least that which I have examined so far! Need to explore more fully in this area.] In upper part in one small area with three small open patches of soil – found three nests – one in each small open patch.
#21 Nest – Nest structure – more or less just a nearly round hole, 26 x 23 cm at top, slanting inward as go deeper down. Depth to top of eggs – 20.5 cm; depth to bottom of nest (and eggs) 26.5 cm; eggs sitting on a mixture of small rocks and pebbles where ♀ apparently stopped or was stopped from digging deeper by small lava rocks. [Marginal note – The hard cap had same fecal material mixed in with the soil.] A slight overhang at one end of 5 cm at deepest part. Eggs were all in one layer and look to have filled the cavity up (Pg. 67) quite full at this one level; I cannot detect any available space but then the nest is quite old, completely dry and therefore it is difficult to tell much of anything. The hard cap was sitting right down on top of the eggs, but it was covered at the surface by several cm of dry fine soil itself. I would guess that it was about 25 cm thick at its greatest depth and it appears to have been centered squarely over the hole covering all the eggs. No signs within or outside the nest of any disturbance by ferals or any interference by other ♀ tortoises.
[Diagram of nest dimensions.]



Eggs and young: Only one egg present, but appear to have been at least four, and I think five more eggs; all the others have hatched and left the nest. Was able to find shells and membranes in little pockets in the nest of what I think was five other eggs. The one remaining egg and two others were all partly under the overhang, the other three were out in the central cavity.
(Pg. 68) All six eggs were in one layer. Only sign at surface was a small 8 x 4 cm hole just at one edge of the hard cap where young had dug out and escaped. They had come up damned near vertically, but just at a bit of a slant so that had to dig through only a few cm of hard cap and then most of way through softer, looser soil which formed wall of the nest to one side of the compact cap. So I would estimate that 5 young managed to escape from this nest; doubt the other eggs is good but will return it to CDRS for incubation. Whole nest certainly two months old plus – very old and dry.
Nest #22 – 1 m away from Nest #21.

Eggs and young: could only find signs of four rotten eggs inside – were almost whole but each had opening and signs where insects had cleaned them out and absolutely no signs of developed embryos (Pg. 69) such as scutes (laminae) – thus probably four infertile eggs. No escape hole and am sure none of these four eggs ever hatched or developed very much if at all.
Nest structure: can not tell much because very old and compacted. Almost certainly from very early in this nesting season or even from the 1968/1969 one. Hole almost circular, very small (15 cm diameter at top and becoming narrower with depth) and only about a 2-3 cm overhang for about 1/3 of it.
Eggs in two layers, two in each – actually the four sort of dumped in and ended up in a stack because of narrow dimensions of the nest cavity. Hard cap thick, durable, all dried out (as in rest of the nest), and appears to have been on top of eggs directly, of about 12-15 cm depth, but with about 4-6 cm of loose soil above it forming surface of the nest (could be from rain washed soil and weathering cap if nest is very old). Depth to top of upper two eggs 19.8 cm; depth to bottom of deepest two eggs (and to bottom of nest where there are some small rocks) 32.0 cm. (these measures from soil surface). Eggs were probably infertile and whole nest looks abortive and small; area (Pg. 70) is large and offers abundant soil and working room!
Nest #23: about 2 m uphill from #22 in another open spot. Again, as in all three of these sites, plenty of open soil (about 1 x 1 m in each case before there are any rocks encountered) and working space. Hard cap visible right at surface with only a few mm of gravel, small pebbles and loose soil scattered helter-skelter on it in parts. Two escape holes visible, each about 7-9 x 3-4 cm in oblong shape; one is at border of hard cap and thus partly in softer looser soil. The other is entirely within the hard cap and the animals must have come right out through the cap. Took photos #20 and 21, Roll #83 of these escape holes and the nesting site. Will now explore the nest further.
Eggs and young: inside could not tell (Pg. 71) much of anything – certainly were a number of eggs and perhaps this was even two nests which in large part overlapped, but I think it was just one. All the eggs were at about the same level. I was able to detect the egg shells of at least three and maybe four that had hatched, and of at least three which had been bad and were whole mostly but devoid of their contents now. These latter ones may have been infertile or at least they died in the early stages of development because there was no sign of bones or carapace scutes. These last three were also more or less in one end of the oblong nest whereas the three or four (or more) hatched ones were toward the middle and other end (this is the main reason it might be suggested that this is two nests at the same site). Finally, one young hatched one had managed to get himself pinned and wedged in between a flat rock and the wall of the nest cavy and I found his skeleton and carapace scutes there in dried out condition. Also, it is interesting to note the two escape holes, one at one end of the oblong nest, near the three undeveloped, rotten eggs and the (Pg. 72) other at the other end of the nest in the area in which all the young have seemed to successfully hatch and escape. This may be another reason for suggesting two clutches of eggs laid at the same level, side by side and only slightly separated. If this is not the case and it all was one nest it is interesting that the young dug more than one hole in escaping and says some interesting things about social facilitation.

Nest structure: can't really tell much about it because a bit obscure, perhaps because is two nests in reality. Hard cap was enormous and thick – about 20 cm at deepest part and set right down on tops of eggs. Nest measured about 50 x 45 cm and is oval in shape, a bit of an overhang at each narrow end of the oval (= two nests?) no real obstructions to further digging at nest bottom, but (Pg. 73) depth to bottom of nest from top of soil (and thus to bottom of eggs in this nest) is about 26 cm; depth to top eggs from top of soil is about 20 cm. The nest is clearly months old and very dried out now. There was no evidence that rats had entered it even after the young had made a hole allowing entrance and even after the one was trapped and died. There is no evidence that anything ate this young dead one save the normal putrification and maggots one would expect.

The more I look at the nest the more I think it may have been two nests placed close together but am just not sure.

The sites of all three of these nest are open, with plenty of working space and soil; none is shaded at all and each is a little on a plane, on a generally steep downhill slope, thus the flooding potential is very low.

On top of Nest #23 I found three owl pellets; all contained rat skull and other rat bones but no signs of young tortoises. I suspect owls sit in these open soil spots at night and day sometimes, as I have seen them do (black or dark species that is) on Santa Cruz. Also these open spots probably serve (Pg 74) as good sites for capturing rats. In Nesting Areas A and B and along trails between them saw a total of about four rats kills, certainly from owl and about 6-7 dead rats, not eaten, but simply dead and dried up. The dryness now (D. Weber says is much drier than his previous trips to rim in 1200 – 1500 ft range where is usually rather moist) during garua times and may account for the low rat population. But it is notable that we had no rat disturbances at all in camp last night, and they do not seem to be entering the nests and attacking remaining eggs (e.g. Nest #21) or the trapped, dead and certainly smelly young hatchlings (e.g. Nest #23) once the escape of some young has opened a hole right down into egg levels. This all seems to indicate that the rat population is quite low in numbers now. We noted same lack of disturbance at NW coastal campsite in early Dec 1969 (even had exposed food in a cardboard box then) and J. Black (Pg. 75) emphasized lack of disturbance at same campsite in mid Oct 1969 and large numbers of dead, dry rats on W side of island at that same time.

In main part of Zone A where Nest #1-5 and 19 were found earlier in this nesting season, found no new nests. Saw four small holes which were attempted diggings by ♀♀ - these are new since early Dec 1969 trip, but none more than a few cm deep. Did find two more nests, but both had small (8 x 4 cm approximately) opening where young had escaped. Was short of time so opened them without taking any measurements or precautions for such. Could not estimate how many eggs were inside previously – in both, no eggs found, only shell fragments – apparently all eggs hatched and young escaped previously. Nothing of great note about size or structure of these two nests and could not determine clutch sizes because too obscure. These would make Nests #24 and 25. On return we were rushed so I did not get a chance to go to Nesting Area C. Will have to check there on next trip or wait until next year's season.

Daniel (Weber) went up toward the rim today along the ridge which runs along the eastern side of the island. At a point along the rim which lies (Pg. 76) directly __° from our campsite, he saw a "small tortoise" #12026. Probably a ♀ from his description but I will check; the altitude at this place must have been about 300-1400 ft I would estimate from its position. D. Weber's Thommen read 420 m at the site. On the return trip to camp I finished up Roll #83; through photo #28 was just scenery, some of the western part of Santa Cruz and the Pan de Azucar islet with the vegetation just E of Nesting Zone A in the foreground – much of the vegetation same as in Zone A, but more green in area where photos taken; then some taken from above Nesting Zone C and looking up toward 1000 ft ridge above to N and NW. We were at about 800 ft or a bit less when took these. Photo #29 is of a young hawk hovering over me; #30-32 of lichens on small shrubs at 1000 ft on S side; #33-35 again of a hovering young hawk; #36 of vegetation to W of this ridge looking down slightly and to (Pg. 77) W from 1000 ft elevation – Scalesia should stand out as bright green in amongst this beautiful shrubby vegetation and lichen covered rock area. Then when was above Opuntia-crater campground took first three photos of Roll #84 of our campsite in the upper crater floor.

15 Feb. 1970 – Through Photo #19 taken yesterday evening. Then took a series of photographs to illustrate Opuntia growth form on Pinzon. Photos #4-16 were all of the cactus (Opuntia) population near our camp in an area where there are now tortoises actively moving about. Many of the photos are just general shots of the whole stand, but some are close ups of young plants, the smallest shown being about 2 dm high, the largest young one a little over 1 m. Two shots are of particular note – I think #15 and 16; #15 is of three fairly tall Opuntia plants standing quite near each other – the oldest and tallest one is about 2.5–3 m high and the trunk diameter at my waist height is 45 cm. Should note that on all three of these, the trunk is still heavily armored with dense strong spines but that these spines are beginning to fall off of the oldest largest plant. The two younger plants in the photo are both about 2 m tall or more and show earlier stages in Opuntia (Pg. 78) growth. Photo #16 shows a plant of about 2.5 m height, with a waist high trunk diameter of 50 cm, but in which the spines have mostly been lost from the trunk to expose the thick bark underneath; note the lichen colonization of the bark.

The most notable things about the Opuntia here are the following:

1. The young plants are extremely heavily spined – very long spines, mostly 4-5 cm and longer. These cover the young plants pads as they grow up by adding one pad at a time to the top of the growing individual. These heavy spines then remain on the trunk of the plant in most cases until the individual plant is quite old and large – 2.5 m plus in height and 40-50 cm diameter of trunk at my waist height. At all younger stages when plants are growing up, even to quite tall heights of 2-3 m, heavy spination remains clothing the lower trunk. Only in these older plants does the trunk seem (Pg. 79) to be study enough and the bark thick enough to serve as well as the spines for protection.
2. Until the plants get up to about 2 m height (this appears to vary from 1.5 to nearly 3 m however) most of their growth is vertical, simply adding one pad at a time to the top of the then growing stalk. Prior to this height they do not put out much, or any, horizontal growth of pad and or arms to support such pads. After getting up

somewhere above 1.5 m but usually 2 m or more, then the tree begins to increase greatly in girth, replace its spiny trunk with a thick-barked type, and to put out a profusion of side-arm branches pendulant with many green pads.

3. These side braches have pads which have only very short scattered(spines) [Marginal note – In fact most of these pads have not really sharp spines but flimsy hair-like little bunches of filaments instead of spines] of low density. These pads could easily be eaten by tortoises but of course because the plant now has some height, the vast majority of these horizontal arms with their pads are just above the reach of even the large male tortoise here on Pinzon. I took a few measurements, and the lowest, live pads (Pg. 80) from these side branches are at distances of 98-105 cm from the ground.

The sum of all this would seem to be that E. Y. Dawson's theory seems to fit Pinzon Island well, at least for the co-inhabited Opuntia – tortoise areas which I have observed to this time. When the plants are small such that the tuna pads and trunks are smaller and within the easy reach of tortoise, the pad and trunks are heavily armored with long dense spines. As the plant increases in size, the thick barked trunk forms and increases in girth and eventually only this serves as adequate protection against grazing tortoises and the heavy spines drop off of the trunk; and when the plant becomes tall enough, the pads which it produces both at its summit and along and at the end of the side-arm branches (Pg. 81) become less and less heavily spined such that they finally have only a weak spination of very low density. But the pads are almost all beyond the reach of the tortoises! My photographs should illustrate all these points. One fly in all this ointment around the basis of the large Opuntia trees near camp are many nice weakly spined pads in various stages of decay – yet I can find none with signs of tortoises having eaten any of them – no bites! So the question remains as to what extent the tortoises really eat the Opuntia when given the opportunity – i.e. how strong is such a selection pressure in reality? Part of answer in this particular Opuntia population is that are only very few tortoises ever here now and in fact all droppings present now are at least one month old, I would guess. In Dec 1968 trip saw only one animal here; so may be that this areas is not now very illustrative because of low tortoise population, whereas in past was greater density of tortoise here (before the whaling boat depredations), the selection pressure may have been much stronger.

(Pg. 82) However should correct this statement. After examining several of droppings in the areas, found that all of them had remains of Opuntia pads and fruits; thus must be that tortoises which come here eat the fallen parts, because most side branches are too high and I do not see any evidence of tortoises having grazed these lower branches and pads. The famous caterpillar is here on the Opuntia in great abundance and for that reason it may be difficult to detect a fallen pad which has clearly been bitten into by tortoises versus one which has been grazed upon by the caterpillars; the same holds true for low hanging, live pads on the trees, many low as well as the higher pads have signs of caterpillar activity, as do many on the ground. Anyway, the caterpillars probably find easy entry to any spot where a tortoise has taken a bite of a pad on the ground. But the unequivocal evidence of the tortoises eating the pads is in the many droppings in the area, all (Pg. 83) of which have Opuntia remains – I examined about 10 in all. Photos #17-19 at campsite with Daniel

and Fausto and area right above it. Photos #20-21 and 26-28 are the grand daddy of the Opuntia trees on this crater floor – it must be at least 4 m tall at the greatest, has a beautiful red-barked trunk, and the trunk girth at the base is about xx cm in diameter. Photos #22-23 show the light, flexible, filamentous spines on the pads of the side branches (at heights of 1 m and up on the trees, above tortoise reach I think). Photos #24-25: lichens on the side arms of the grandfather tree.

Just after going over western ridge found a ♂, #12,050 in the big open rock-covered area there at 950 ft; as the sun is now coming out in spurts (0930-1015) he is moving W to shade in rocky ridge on far western side of this open spot. His measures: CL 81.2; CW 82.3. Took photos #29-35 of him moving, sitting still and sniffing me, etc. #36 on roll 84 and #1-3 on Roll 85 are of this general area – vegetation, rocky ridges, plants etc. Photos #4-7 – lichens on rocks in same area; Photos #8-9 Scalesia in flower – same area. Photo 10 – lichens, Maytenus, and other vegetation on a rock – same area. (Pg. 84)

Instead of taking the trail, which is in rather open areas with little shade, I worked my way along western ridge in area with lots of Croton, Acacia, Maytenus, Alternathera, and generally rather dense, spiny, very dry vegetation. Area is covered with large boulders, these offering plenty of shady spots for tortoises under little ledges some of them have. Went along like this from about 950 ft where saw #12050 to about 800 ft where trail starts steep descent. At this latter point took trail down.

Through this area of boulders saw very abundant tortoise sign; droppings in all stages of freshness, dryness and decay; many shade spots under boulders where tortoises had obviously been resting; here and there nice open unshaded patches of soil where tortoises had been wallowing, defecating, and presumably feeding; lots of broken down brush where tortoises had been moving through it. Also found a number of large lava blocks, fairly low to ground, with hollowed out (Pg. 85) cavities on top where water obviously collects during garua and rain times. I am sure tortoises use these sites for drinking since they could easily clamber atop most of them or even on the lower ones simply raise up on legs and arch neck over to little pools.

Tortoises seen:

#12,100 ♀ at 850 ft, under a large rock overhang in shade, sleeping. CL 66.5; CW 71.0; about 1/3 of way between open area of #12,050 sighting and trail descent beginning at 800 ft.

#12,056 – same exact shady spot as where saw two days ago. CL 98.8; CW 98.0.

More photos: #11-12 – scene of semi-open areas along ridge where I was walking and where there is abundant tortoise sign – looking WNW – can see Jervis in far background. #13-14 scenic – large rock in same area. #15-16 - #12,056 in shade under his rock.

Then met Fausto (Llerena) with egg-carrying can at turn off to Nesting Zones D and E. After a delicious lunch of hot water and cold oats we went to Zone D. Sun has been out now since about 0930-1000 and is blazingly hot and stifling where vegetation cuts wind force down sharply!

Opened up Nest #13: At 8 cm down found young one digging his way out – he was coming straight (Pg. 86) up vertically from his egg site and hatching place below at a depth of about 18.5 cm. [Marginal note – Top of this egg probably at about 16.5-17.5 cm but hard to tell now that is hatched]. His body was at only a slight slant, maybe

15°, with head end higher up. Probably a long slow process of gradually working up through soil. No other young from the four eggs was anywhere near him so he was digging out strictly on his solo. He is from Egg #1 of this nest. Should note that this nest is in very soft, fine, powdery soil and has no real hard cap of any notable size, thickness or normal construction. Thus this surely is what allowed him to dig straight up from the center of the nest below. At 19.5 cm depth found tops of two other eggs, #II and III both of which seem to be rotten and undeveloped. At 21.5 cm found top of Egg #IV, dug it out and found a small pip of 0.25 cm diameter in side of the egg. Young one inside is alive and hatching. Interesting to note thus that hatching time difference (Pg. 87) between eggs I and IV probably at least ten days to two weeks. The young one appears to be healthy, but is a bit compressed (actually in front half of carapace between costals and marginal scutes on each side; plastral fold is still there but disappearing obviously. Yolk sac-umbilicus area is about 8.5 mm at widest point but is becoming a bit dry and wrinkled – obviously still regressing as he was digging out – is still a bit moist and is caked with mud in this area. He is very alert and healthy and am sure he would have made it out alone barring severe obstructions.
Dimensions of other three eggs –
II – 62.5 mm x 56.1 mm
III – 62.2 mm x 58.0 mm
IV – 62.0 mm x 58.0 mm.
II was clearly putrid so I opened it – rotten and infertile; can't be sure about number III but does have a few crack lines with characteristic fungus; will take III hatchling and IV (hatching now) to CDRS.
Opened Nests #14 and 15 and found all six eggs OK, but none hatched; removed and will take to CDRS for completion. Searched all through Zone D which runs from about 380 ft down to 300 ft in altitude on a steep slope – found two more Nests #24 and 25, both in which young had hatched and left. Each (Pg. 88) had a hard cap (as hard as can be made in this fine, dry, crumbly soil, that is) and the characteristic single small hole just at one side of the hard cap from which the young exited. Both were rather old nests, and well weathered and hard to detect as being a nest from above. Neither was easy to excavate so I did not take measurements. One had remains of one small tortoise (scutes) inside and at least remains of three other eggs which appear to have also hatched. Were some rat pellets inside near the scutes. Therefore looks as if three hatched and escaped and rat entered and ate the 4^{th} – whether it was a dead animal at time rat entered, or even hatched, is of course impossible to say. Finally, there was one rotten, apparently infertile a bit lower in the nest (i.e. just one layer below) the above four items; upon opening it, found putrid egg. Was still whole, but had a small pip in it and was full of maggots of some type. Apparently rat did not open this egg at all; it was covered with fine soil, but the rats (Pg. 89) could easily dig to it. Perhaps however they can not detect the odor when the rotten egg is surrounded and covered by a thin layer of soil. Could not tell much at all about the other nest – were some shell fragments indicating that at least two and probably more young had hatched and escaped. No signs of rats, dead tortoises or bad eggs in this nest, but simply could not tell much about is structure or clutch size. Searched all through Nesting Area E but absolutely no new nests or signs of digging, or signs of nest we might have missed before on previous trips.

Saw no tortoises in either of these two nesting areas and freshest droppings were at least two weeks to one month old if not older – no really fresh signs like recently used dirt wallows in shady spots or fresh droppings. I suspect all the tortoises are at higher altitudes since everything is so very dry and hot. Before returning, went down to sea cliff below Zone D to look at ocean and for hawk nests; saw none of the latter but got a rather spectacular view of the cliffs. Point we were on was about 240-250 ft above the ocean and as we looked to SW could see some areas of the cliff which must be close to 300 ft high. Took a few photos of this area, of lichens on rocks, and of (Pg. 90) Fausto (Llerena) looking at the sea below. (roll #85).

Then returned to camp arriving at approximately 1715. I finished roll #85 on the way taking general scenery photos of sea cliffs and ocean, lichen covered rocks, spiny vegetation, etc.

Took a nice, but dangerous, bath at the disembarkation point by scooping up sea water with a small cooking pot and sloshing it all over my filthy self – this was cool and soothing because am sunburned even more than usual and am covered with soil, dust, egg shell fragments and sawdust from the work with transporting eggs and examining the nests. Nearly got washed into the sea at one point while doing this because an extra large wave came smashing up onto the rocks where I was standing and plastered me against them. I luckily had a good foothold and managed to grab a protruding piece of lava above with one hand, In the process my dirty underwear got washed down (Pg. 91) into a crack in the rocks where I had to rescue them from a young sally light foot crab who was making off with them - something about them must be savory but that does not particularly flatter me.

Then took most of a roll of high speed Ektachrome (Roll #86) of scenery in little bay here, sea lions (especially a friendly pair of females which were sleeping together) and odd shots of surf, sea cliff, etc.

As yesterday, it was again a clear, very hot day all day today from about 0930 until sunset. The most notable results of the trip is that 1) have good incubation time record now for Nest #13, and maybe will get close guess for Nests #14-15, and 2) saw one good clear example in the wild of the absence of social facilitation in escape from the Nest (#13 Nest) and 3) got some good observations of the Opuntia trees in an area co-inhabited by tortoises.

16 Feb. 1970. Julian and Vicente picked us up at about 1000 hr. As added surprises they brought Jan, Daniel (Fitter), and Johnny along. Jan appeared exquisitely fit and was sailing along just like a happy balloon. Took rest of Roll #86 as they were arriving.

(Pg. 92) 26 Oct. 1970 – Party to Pinzon for one week including Peter and Ultika Kramer, Nancy Jo, Juan Black, Fausto Llerena, Vicente Flores (Condorito), Jan Bennett, and I. Arrived aboard "San Pedro" at 1300. Today we plan only to go over to campsite inside upper crater as there is not time to do much more. Set Luftt altimeter just before leaving – set at 1500 hr, 25 m altitude at coastal campsite up on a cliff.

27 Oct. 1970. – Going to explore a few areas today in view of need to decide where to release young from CDRS. Jan, Nancy, Bennett and I in group. Luftt reading 237m then, 19° C in case. We proceeded E of camp finding a few small rocky –beds which must be ponds in heavily rainy years – now all dry. Some open soil, but mostly fairly

dense low (2-5 dm) vegetation all over here. Last droppings we found were only about 150 m E of (Pg. 93) camp near a small dry pond bed in area just same as campsite area – dry loose, reddish brown soil; soil deeply cracked from drying out after heavy rains. Water appears to stand here and there all over this upper crater floor after heavy rains.

Continued on around passing through floor of upper crater, on the inside of high eastern slope of the mountains or crater rim. This area is also much like campsite in structure – same soil type, same cracking of soil, scattered Opuntia in a stand, spiny shrubs, Croton. Most of area is open and semi-open soil covered "pampa" with old dead flattened grass (from Mar 1969 rains) and small herbs. There are a number of pond beds full of black lava blocks and these vary from only a few meters in diameter to one largest one of about 30 x 20 m. These beds are all dry now and certainly stay so through garua seasons – must have water only temporarily for a few weeks to months after very heavy rains. This whole area is at only a very slightly (few meters) higher elevation than campsite.

Area now has small green herbs scattered all over it – Commelina, (Pg. 94) some succulent species, Opuntia seedlings, a small verbenaciusm, **{check spelling of this plant}** same Solanum as on Santa Cruz, and many others. Small tortoises could certainly do well here now for food – and certainly some garua collects in tiny holes and pockets in lava rocks so they could get some water also. Question is how well they will do if have a long or partially long hot, rainless season in Jan-Jun period this year.

These herbs here now, are certainly the only food for small tortoises, and I suspect all of them have gown in recent months only due to garua. This area must have been a real desert from late Feb-mid Jun before gárua began again.

Evidence that tortoises used to use this area – two partial skeletons – see Roll #202, photos #23-24, 27-28; both very old and crumbly and well decomposed and broken apart. As with whole eastern side above port or anchorage, man must have wiped adults out from this area. We found some old (Pg. 95) World War II rifle shell casings here also. But no sign all over these pampa-pond areas of any recent tortoise activity, no trails, burrows, droppings, or even recent skeletons. Really seems that since being slaughtered here, population has not moved into the area again from area to SW and S and W where they now exist. This is especially incredible since ponds here must be lush for short periods after heavy rains as abundant dead grass indicates. Also since the tortoises pass within only a few hundred meters of here at same elevation just to S and SW always near our camp area. – really incredible but apparently true from sign we have seen and reports of others (T. deVries, M. Castro). Took photos #15-22 and #25-26 on Roll #202 of these areas. Then down S wall of lower crater to its floor to look for tortoise sign there. Circled around a great part of the floor, then climbed out by way of pass (in fact a steep encanada) which runs from upper to lower crater floor. Enroute saw neither old or new sign anywhere of tortoises. At many places around lower crater inner walls tortoises could have passed down into it. Whether they did or not is (Pg. 96) of course only conjecture now. Probably some did occasionally, but is a very dry desert-like environment, certainly only a suitable place for food and water after heavy rains in hot season – i.e. only very seldom. At present is extremely dry with most of trees (especially Cordia) and

shrubs dead or dry. Soil is same as that around camp above and full of deep cracks. The first tortoise sign we saw was up on open planada just W of camp where trail passes through this part of upper crater floor. Here we found many dry scats from past few months to many months (some bleached almost white).
28 Oct. 1970 – Lufft altimeter at camp 0845 hr 242m; 21.5 °C in case. To Nesting Zones A, B, C with J. Black, Nancy Jo, Vicente, Jan, Bennett and I.
#40 ♀ (12,040) CL 61.2; CW 67.8. Coming up encañada from Zone C area – about half way up between it and top of hill. [Note: scat all way down trail from hill to this area.]
(Pg. 97) All smooth scutes, no lichens; white growth increments non-existent. Black-green algae in two usual areas growing in scutes juncture groove only – also scattered in same areas all over carapace. Mud on feet but can't tell if laid; no clear sign of recent copulation. Collected some of algae in FAA; collected ticks from her underside – all over legs in rear and along plastron-skin junction in front and rear. Continued down main tortoise pathway along an encañada – dry and fresh droppings all over along this clear tortoise trail; many shallow pockets and depressions for water where they drink; these rocks and those all along pathway smoothed by frequent use. Below just at edge of Nesting Area C - #12,0?2 – #20 and 40 both have deep circular shaped worn cuts – I can't tell – could have originally been notches. [Marginal note – probably #12,002; maybe 12,042] CL 76.5; CW 79.3; white growth intervals clear but rather thin – but growing; relatively lush and green along this side where gárua is most heavy - i.e. – S facing slopes. All smooth scutes; same green algae as above ♀ - all over two usual areas and along scute juncture grooves elsewhere on carapace; large patch of a pale whitish paint-like lichen on first left front marginal – no others. When I first approached him, he was stretched up full on all four legs in an open space and with neck stretched fully out and head up at a 60° angle – clearly holding this position by choice and he (Pg. 98) was not moving at all. There were three finches, all Geospiza fuliginosa as far as J. Black and I could tell, (two ♂♂, one ♀) hopping about on front legs and neck and head and picking off something – mostly just looking but occasionally picking in a crack in skin. Very clearly a cooperative effort on part of tortoise and birds – a real symbiosis. He quit soon after I arrived because he saw me. Turned him over and checked for ticks - found none in front area at all; in rear found only two - both in rather protected sites between skin and plastron. And, no grass seeds or other plant material on his skin in either front or rear; thus birds must have been getting and looking for ticks. This makes 3rd case of tortoise in which I have noted this cooperative behavior – G. e. porteri, G. e. vandeburghi, G. e. ephippium.
Ticks appear to be same type as in ♀ #12,040. When I approached ♂ reacted to my presence and drew in and finches flew away.
(Pg. 99) #12,063 - ♀, CL 62.0; CW 56.7; slightly lower down also in encañada. White growth increments extremely (extra) thin; scutes all smooth; no lichens; same algae as on previous two all over rear 1/5 and front area and along scute grooves all over carapace. No clear sign of recent nesting or copulation; same as ♀ #12,040 mud on all 4 feet.
#12,043 ♀ - (also a deep notch in 20 scute – seems to be broken naturally) CL 58.1; CW 64.3; white growth increments clear but rather thin – not growing; no lichens;

algae as in #12,040 ♀; scutes all smooth completely. No clear sign of recent copulation or nesting. Just below last one a bit in open area; in a spot of red-brown soil acting as if may be beginning to dig – hard to determine; will check by here later. Ticks two species; collected – in same areas as on #12,040 ♀. While examining her, she released about ¼-1/2 cup full of fluid from cloaca – about ½ brown, amber liquid, other ½ a thick gelatinous material mixed in with it and very like that I have seen in G. e. porteri ♀♀ when laying eggs. All more evidence she is going to lay a nest soon.
Nest #1 – 1970/71 – four eggs – Nesting Zone C

1	65.6 mm	x	57.0 mm
2	60.6	x	57.7
3	57.5	x	59.5
4	61.9	x	57.8

Eggs taken to CDRS
(Pg. 100) No broken eggs; just a small hole – no flask; eggs at bottom in one layer. Fresh, fairly so; hard cap dry only a few cm down completely; rest still slightly moist and full of fungus, and old egg shell and membranes from last year. Nest probably ten days – two weeks old. [Marginal note – Hard cap full of ♀ droppings.] Bottom of nest – depth from ground surface 27 cm. Hard cap depth 15 cm; right down on top of eggs; about 5-6 cm. Loose soil above hard cap itself.
This site very well used in past – soil full of egg shells – probably a nest here nearly every year. Loose, pale brown soil - very powdery - hard cap strong but as it dries becomes easy to pulverize it into powdery soil. See Roll #203 (KII) for some photos of this nest. Found one (1969/70 old nest here – two infertile eggs, four escaped young. Continued from this nesting area to SE toward Zones B and A. Above these, entered trail down from hill above and found a small (before) unknown nesting area with three old 1969/70 nests – all had opening in them where young had left and egg shells inside but (Pg. 101) not possible to count numbers of eggs in each. In one, at least, rats had entered and destroyed one young while still in nest and perhaps some eggs; probably entered after one or some young had left nest but not possible to clearly determine. Altitude here with Luftt – 1230 hr – 184 m, 31.4 °C in case.
#12,032 ♀ - CL 62.1; CW 66.0; en route to Zone B – about ¾ way between last stop and nesting area – under a Maytenus resting in shade; no lichens; algae same as in ♀ #12,043. Scutes all smooth; white growth increments present and medium thick; growing. No clear sign of recent nest or copulation; just below a big flat rock water collection area where are a lot of tortoise scats, mud tracks, etc.
#12,087 ♀ - CL 58.9; CW 60.4; white growth increments clear and medium thick; scutes all smooth; no lichens; algae as in previous animals – no clear sign of recent copulation; but has nested sometime in past few weeks and has red mud like soil in Zone B all over rear areas. She has very few ticks, only on rear skin/plastron border – of most common type like those collected from #12,040 ♀. In same large encañada as #12,032 – a bit lower down just at upper border of Zone B Nesting Area.
(Pg. 102) #12,008 ♂ - CL 71.7; CW 70.8 – (could be #12,028 but doubtful – looks like a natural break in #20 scute); all smooth scutes and very worn; no lichens; white growth increments present but thin. Algae as in previous male. Ticks, collected some, common one, plus a huge one from perhaps 3rd species but all on plastron/skin border, in front in an area where skin folds over and birds can't reach –otherwise

completely clean. [Marginal note - Roll #204 – watering area of above Zone B shows smoothed lava rocks and collection sites in encañada.]
#12,033 ♀ - CL 58.7; CW 61.6. Smooth all over; no lichens or algae. White growth increments clear but rather thin. No sign of nesting yet this year and no signs of recent copulation. Common type of tick on rear area scattered all over; in front only a few along plastron/skin border.
#12,014 ♀ - CL 58.8; CW 62.7 – smooth all over; no lichens; algae abundant in two usual areas; white growth increments clear but rather thin; but growing Roll #204, #15-17 of body with algae. No recent nesting or copulation sign, but has probably laid in soil typical of this area, not recently, but this year; had old worn in (Pg. 103) dry red soil all over rear skin areas. Lots of common ticks along skin/plastron border in front and rear.
Above five animals all in upper end of Nesting Area B.
Nest #2 – in Nesting Zone B – five eggs; nest reasonably fresh; about as in #1 in terms of moisture inside. Small nest – two eggs on bottom, two above; rock in front wall and undercut made under it. Total depth 28 cm. Rock down 21 cm from surface and undercut made under it. Very tiny nest in sum. Eggs taken for CDRS. [Marginal note – Hard cap with female's droppings].
Found four more 1969/70 nests in Zone B – appears that some young had left each and some eggs were infertile in each; but hard to say; none had clear exit hole because soil so pulverized and dry now. Also J. Black opened them all ahead of me so hard to see anything.
Then to Zone A – down to S and to E.
Nest #3 – five eggs; about same age as #1-2; hard cap a bit drier so probably one week older. J. Black opened so can not tell much of structure; removed to carry to CDRS. Hard cap thick and full of female's droppings.
(Pg. 104) Nest #4 – seven eggs; same area; nest all dried out but eggs very fresh. Black opened this one also so nothing of structure; he broke two in process, both fertile; other five to CDRS. [Marginal note – only slightly developed – tiny, tiny embryos and beginning of blood vessels.] This nest definitely older than first three. Almost no female's scats in hard cap. Both Nest #3 and 4 in nearly shaded sites, relatively speaking; some Croton around them giving slight shade for parts of day. Soil of pale reddish brown type – as in Zone B.
Nest #5 – five eggs; same area; nest all dried out; probably oldest yet found today; with good strong dried-mud type hard cap. No scat material in hard cap. Soil same as in above two nests. All five eggs to CDRS.
This little area is slightly above Nesting Area A; altitude at 1500 hr reads 120 m on Luftt; temperature 34 °C in case.
To Zone A – Altitude there at 1520 reads 105 m on Luftt; temperature 34 °C in case.
(Pg. 105) In Zone A.
Nest #6 – two eggs only; nest very dry and full of scats in with eggs, but none in cap. Mixed into system of old nest so badly that I could not determine anything of structure; thus possibly several other nests here from 1969/70 – hard to tell exactly. Will take these two to CDRS.
Nest #7 – nice well made nest; fresh – eggs fresh and most soil in all around them. Hard cap of about 13 cm thickness, dry throughout, so nest probably two to a few

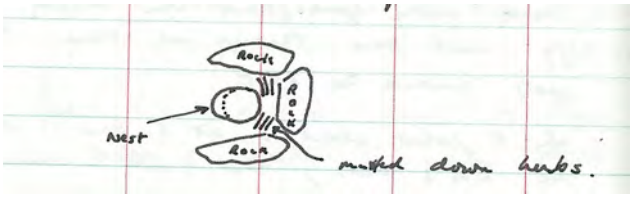
weeks old. Seven eggs, five in one layer on bottom, two on top of these. Eggs all surrounded by chunks of wet soil and same on top, then hard cap. Maximum depth of nest – 36.5 cm; depth to top of uppermost two eggs – 24.5 cm. Nest very deep and flask-shaped – very well made; about 3 cm loose dry soil above hard cap at ground surface. Abundant dung in hard cap and in soil clods around eggs. Eggs to CDRS. See Rolls #205 – last three photos –#33-35.; Roll #205 – 1st photo (#1).
Nest #8 – same size and almost exact dimension and age as #7; only two feet apart. Six eggs; all to CDRS; abundant fecal material in hole and hard cap.
(Pg. 106) On return – altitude at upper end of Zone B in water collection area of encañada – 192 m; 31 °C; 1630 hr.
#24 ♂ - CL 80.0; CW 78.2 – #12,000 mark; not sure of #20 or 34; #20 seems most likely to be read, #4 a bit less so. Very old and all smooth, pitted worn shell with many pieces knocked out of marginals; no lichens; white growth increments present and moderately thick! Greenish algae present all over carapace in dips and depressions and low places. Way up on trail from Zone B to N on up toward island's eastern crater rim.
(Pg. 107) All smooth scutes; no algae on rear, but bright pale yellow-green type on front marginal area (see photos). Lichens: at least three types and all seem to be very similar to those found on G. e. chathamensis; none on rear, but all three types generally scattered in protected, depressed areas of first three front marginals and front borders of first vertebral where it joins first marginals (see photos).
Lichen types:
One (1) – pale grey-green type – like painted on – very flat – as on G. e. chathamensis.
#Two (2) – pale yellowish-bluish-green fructiose or liverwort growth form.
#Three (3) – yellow - also liverwort growth form.
All three of these lichens and algae are growing in same areas.
Roll #205, photos #26-32 of this. Collected all lichens dry and some of algae in FAA and some in a bit of water. Has clear but thin white growth increments.
Ticks – very few – collected some (perhaps two or three types) from near plastron/skin border and along midline; no others seen on legs or elsewhere. Saw a Geospiza fuliginosa ♂ cleaning his forelegs just before we disturbed him – or rather hopping on forelegs and neck out, did not stay long – perhaps because no ticks there now. He has no grass seeds or other plant material on legs (Pg. 108) or neck/head area.
Jan finished Roll #205 of him and me doing various things. Roll #206, #1-5 of a male crossing same area with Los Hermanos and Isabela in background Roll #206, #6-7 of #12,050 ♂ drinking in water collection spots. Roll #206, #9-13 of #12,050 walking.
#12,078 ♀ - same area as #12,050 ♂. Still sitting in a soil burrow at 1145 hr. CL 59.3; CW 65.3. Scutes all smooth; no lichens or algae. White growth increments clear and medium thick. No clear sign of recent nesting or copulation. Very old pitted, worn carapace.
This area is very nice all over this slope – much soil for burrows, water collection sites all over (huge, worn, smooth pieces of flat lava), little caves for shade, scattered food. There is tortoise sign all over it – old to new scats, dirt conclaves, almost every

small cave and potential watering site shows recent tortoise scats, movement (trails in soil, muddy footprints), etc. Some well worn trails over rocks and soil up and down slope.
(Pg. 109) Saw a wonderful old worn male on slope a bit further down than above two animals – Roll #205, photos #14-19 of him stretching way up to eat Croton branches and leaves. Measured his maximum reach – approximately 85 cm from ground surface (rock) to maximum height at which he can bite. Notable that he was up on large flat rock to get closer to leaves of the plant.
#12,051 ♂ - (probably) – also has a rounded cut in #4 scutes and a huge missing piece of #20 scutes but these probably natural. All smooth scutes; very old worn shell with lots of injuries to carapace marginals. White growth increments clear but very thin. Same type of algae as have been seeing all over marginals of two usual areas and scattered along scute juncture grooves and in other low spots all over carapace. Very large patch of Type #1 lichen (see above) on first two marginals, first costal, and first vertebral on each side in front; a small circular patch of same on second right rear marginal. See photos #22-25, Roll #206 of these lichens. CL 89.8; CW 86.7. He has ticks all over plastron-skin border in rear and in cracks and crevices all over plastron; none on exposed areas of legs, head, neck. Collected some – mostly common type; also some tiny red ones. Photos #20-21, Roll #206 of water site in this are where #12,051 and below animal were found.
(Pg. 110)
#12,061 ♂ - CL 77.1; CW 75.5. Scutes smooth all over and carapace very worn. White growth increments clear but rather thin; algae as in last animal; Type #1 lichen on first vertebral and first marginal of right front, first and second marginal of left front, last costal and first two marginals of right rear, last vertebral, last costal and second marginal of left rear. See Roll #205, photos #26-28.
Working along western rim to N – found fresh trail of a large ♂ who passed by two large rock water holes and then directly down toward sea via dirt-filled area and well worn tortoise trails. One of these water sites is a large rock about 1 m above ground and animals have to climb up to it, which they do – took photos of it, #6-7 of roll #207 (KX).
From this water site to move down slope and tortoise trail, they must pass through a narrow place formed by several large boulders – it is closed on sides and top. Big ♂ went through it OK. Actually there are two small passages, one being large and (Pg. 111) adequate for even largest males and one beside this and separated from it by another rock which is very small. In here, we found remains of two tortoises i.e. plastrons and carapaces, badly decayed and soil had silted in over most of them. No skull could be located. Both about half size of largest ♀♀ we have seen here, smaller than any have found on Pinzon yet. Appear as if both were trapped here because tried to pass through smaller opening and became stuck,. Roll #206- photos #8-9 of Jan and bones in hole; #10-11 of all bones found; #12-14 of some of more exposed (on surface bones with abundant and colorful lichens on them). Collected these with lichens for preservation and photos in better light. All bones weak and badly decomposed – probably ten years old plus at minimum.
#12,077♂ - CL 85.7; CW 86.2; (might be #99 but 220 and 2 marks look like huge natural injuries) All smooth carapace; algae in usual places and all over shell in low

places; small bits of Type #1 lichen on first vertebrals, first marginal in front on each side and on first marginal in rear on each side. No other lichens; stomping about in openish "red-soil" pampa on W rim by "Steamboat" rock outcrop. (Pg. 112)
#12,080 ♀ - (perhaps only 70 but 20 cut looks like a notch) CL 610; CW 65.5. No lichens; same algae in usual areas but only in scutes juncture grooves; white growth increments clear and medium thick. All smooth shell and very old and worn. No sign of recent nesting or definite copulation. Same area as last animal, moving over edge of rim planada and downhill (to nest?) Most common tick type heavily present along rear carapace/skin border above tail, but none elsewhere; collected.
one male (♂) CL 67.8; CW 68.6 – seems unmarked; could be #20 but doubt it because both 20 and 2 scutes as is so common are severely broken; white growth increments clear and thick. No lichens but common algae scattered all over. Shell completely smooth and very worn. In same system of red soil areas but about 24 m altitude down hill directly to W. Sitting in a soil spot resting (1540 hr). I put an X on first vertebral scute.
#12,056 ♂ - CL 99.2; CW 97.7; could be #12,052 or 12,056; #4 mark not as clear as others and could be natural; not sure. (Pg. 113) In a dirt wallow at 1515; in similar area just on other side of rock outcrop to W from previous area. All smooth and very large; algae in usual areas; algae and lichens as in #12,051 ♂ in fact, except in rear has patches of lichens Type #1 on first and second left marginals and second right marginal. Heavy cover of this lichen all over front area in big depressions formed by first and second front marginals, first vertebral, and first costals. Also a patch of considerable size on forward borders of fourth vertebral. White growth increments clear and thick.
#12,094 ♂ - CL 74.5; CW 75.0. White growth increments present but very thin; algae in usual areas; small spots of Type #1 algae on rear marginals and last costals area; same in front area only small spots in depressed areas. All smooth scutes. In soil burrow for night at 1600. On downward slope about 50 m below last animal, but still on rim.
30 Oct 1970 – Going directly downhill from "Steamboat rock" on W side today to look for nesting areas First part of way down is covered with abundant and ancient tortoise pathways and much tortoise sign – tracks, old and new droppings, etc. Is a mixture of canals, alleyways, and large open patches of pale red-brown soil with big boulders and scattered vegetation all through this. Mostly Croton, some Scalesia. (Pg. 114) In first really big open areas (several hundred sq meters) found some tortoises.
#12,069 ♀ - CL 60.2; CW 63.4; all smooth and very worn, old shell; no lichens or algae; white growth increments clear but rather thin. Resting in shade on edge of this area. No sign of having nested or copulated recently. Some ticks of small yellowish, bloated type on front plastron/skin border; but very clean of them in general.
#12,??? - ♂ - No other clear marks – deep rounded cuts out of 20 and 2 scutes but look like natural injuries; perhaps was cut in #70 scute but if so well healed over – hard to say. CL 76.3; CW 74.7. Scattered algae and Type #1 lichen in low depressed protected areas all over carapace. Collected some small black "ticks" from him which were under a piece of worn dead, dry scute material on top of carapace. Also one tick from rear leg – perhaps a fourth or fifth species? White growth increments

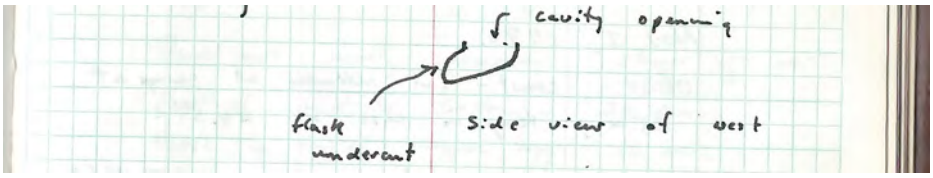
thick and clear. Scutes all smooth and very old looking worn carapace. Lots of injuries on carapace and plastron. Resting in shade in same area. (Pg. 115).
Altitude of the spot is 183 m; 1200 hr; 25.5 °C in case of Luftt.
Here found one 1969/70 nest – only egg shells inside and appears young had all left.
Many rat bones and rat sign (freshly eaten twigs) in this area.
Just below here about 15 m is another similar area but a bit more flat and on a shelf – same gravelly pale reddish-brown soil. Here found two 1969/70 nests – both in same condition as one above.
Also a nest from this year – will number nests today with Roman numerals since J. Black is elsewhere looking for nests also. Nest #I: [Marginal note: = Nest #9] old and dry mostly; soil only very slightly damp; forms a poor hard cap - easily crumbled and very gravelly. Soil here is absolutely full of old egg shells and membranes from previous years. Hard cap thickness - 11 cm. Depth of loose dry soil on top of nest - 4 cm. Depth to top of uppermost egg (hard cap right down on top of it - in fact it is stuck in dry mud of hard cap) – 16 cm. Depth to bottom of nest from ground surface – 25.5 cm. Four eggs; three in one layer on bottom; one on top of these and embedded in lower part of hard cap. Nest slightly flask shaped; two of bottom eggs under overhang, i.e. half of their (Pg. 116) diameter; nest cavity small but could have held all four on bottom layer just about perfectly, then another three to four on top of these; but only four eggs.
Re-correct statement on nest moisture - hard cap moist yet for 75% of depth and eggs very fresh – can see yolk in light. Female put feces in hard cap.
Marked nest and replaced eggs. One other fresh digging attempt here also.
#12,084 ♀ - CL 60.4; CW 65.1 – Just below nest a bit. All smooth shell; no algae or lichens. White growth increments extremely thin. No clear sign of recent nesting but could have as has mud of this type of soil on rear feet, tail, etc. but not much on forelegs- thus probably did lay. Sitting in shade of a rock. She has an abundance of most common types of tick on rear plastron/skin interface. Could have copulated recently as she has copulation sign on top of carapace – i.e. mud smears.
Then continued down another 35-40 m in altitude dropping more sharply now (Pg. 117) than from Steamboat Rocks to former area. Continuous tortoise sign (dry droppings and trails) even through these very steep portions. Eventually again returned to some still steep (10-15° slope) areas but with small nearly level patches of soil – more nesting sign again and lots of dry scats.
Nest #II – [Marginal note – Nest #10] four eggs, same soil type but more organic matter in hard cap. Not fresh; dry inside for most of hard cap's depth; moist only just around eggs. Flask shape normal and fairly large; two eggs below under flask overhang; two above and wedged onto these but in center of nest; ♀ appears to have knocked a lot of loose soil into nest when laying thus allowing eggs to sit in this fashion. Room for about four to five eggs in one layer on bottom – three to four more in second layer. [Marginal note – very typical and perfect flask shaped nest.] . Depth of loose soil on top – 4 cm; depth of hard cap – 13.5 cm; depth to first two eggs' tops – 17.5 cm; depth to deepest part of nest – 25 cm. Nest strange in that at its front edge is a root running all across front – top of nest – ♀ must have had this in way through entire nesting; she simply built hard cap under, over and around it. Marked nest and replaced eggs. Some fresh droppings in hard cap; none in nest. (Pg. 118).

Another 1969/70 nest here – all young had successfully hatched and left; no bad eggs. Two more digging attempts in same general area; soil here, in nests, digging attempts, and everywhere in open level soil patches. is full of egg shell and membrane fragments.
Nest #III – [Marginal note – Nest #11] – same area; 10 m from Nest #II. Same soil type; very fresh; hard cap wet all way through and eggs covered with moist soil. Probably a few days to one week old at most. Depth of loose dry soil on top – 2 cm; depth of hard cap – 17.5 cm; depth to top of uppermost egg – 19.5 cm; depth to bottom of nest in deepest part – 29.5 cm. Eggs four; all in nearly one layer on bottom of nest, two under flask overhang in part (50% more or less), two not ; one egg a bit higher than others because pushed against side wall; one is a bit lower because nest a bit deeper in rear (slopes to rear so about 1.5 – 2 cm difference in depth in rear and under flask overhang - because rocks under flask overhang in nest floor). (Pg. 119) Nest could have held six eggs if arranged tightly on bottom layer alone, and another four above these, i.e. a relatively large cavity for this island. Very typically a perfectly flask-shaped nest – as #II. Fresh droppings in hard cap; none in nest. Replaced eggs and marked nest. See Roll #207, photos #26-29 of nest site's location. Found two more 1969/70 nests in same area – one with six eggs, all hatched and escaped; one with about six hatched and escaped and one infertile one inside. Also found Nest #IV here – will return to it in a moment – is just below area where # II and III are located; want to check below for Nesting Zones D and E first.
Found Nesting Zones D and E were directly below here - ♀♀ must pass through all these higher nesting spots en route to D and E. In D, poked about a bit and saw what seems to be two or three nests, but will have to return to make sure. Found ♀ #12,100 in Zone D in shade CL 65.9; CW 70.1; inactive in shade; no lichens or algae; scutes very, very worn and smooth; white growth increments clean and medium thick. No clear sign of recent nesting.
Nest #IV – [Marginal note – Nest #12] - four eggs; all OK; reasonably fresh; about same age and condition as Nest #I. Eggs all in one layer on bottom; very large well-shaped, well-formed, flask type nest. Could have held at least one or two more eggs on (Pg. 120) bottom layer, probably only one more; no droppings in nest or cap. Depth to soil above hard cap 2 cm; depth of hard cap 19.5 cm; depth to top of upper side of eggs 21.5 cm; depth to bottom of nest 27.5 cm. Marked nest and replaced eggs. Really made in an incredible position - ♀ was backed in and surrounded on three sides by boulders about 1-3 dm high each. Her feet were resting on mashed down, dried herb stems just up against rear boulder and yet she dug a perfect flask in the small place!
[Diagram of nest position in relation to surrounding rocks.]



On return – About 34 m above Nest #I (in altitude) found another 1969/70 nest – one infertile egg and an indeterminate (three to four probably) number of eggs which hatched and young escaped. Like others of those seen today, a nice nest hole in side of hard cap when young dug out. (Pg. 121)
John Black found a new small nesting area today on S side with four old nests; also saw four unmarked ♀♀ - will include all this at end of trip notes because have yet to ask him for details.
31 Oct. 1970 – Happy Halloween.
Checked a tortoise Jan found yesterday - #12,004 ♂ CL 77.7; CW 77.0. Very old, very worn male; in a small group of cacti just NE of camp area abut 150 m. She also found a very old, small bottle made of green glass – an exact replica (just about half volume) of those we found on San Cristobal in late Sept 1970. No marks on it; just N of camp 50 m in upper crater floor – i.e. very near camp.
Collected cacti this a.m. – see roll #207, photos #34-35 and Roll #208, photos #1-17 for Opuntia population in camp area – photos of many of different sizes. Collected two pads of an adult to press, two very tiny seedlings in FAA and one larger seedling to press. Also fruits of a large adult in FAA (same one of which have photos of Jan, and have fruits in FAA). Also root hairs preserved in Langlet's for Heslop-Harrison – one small bottle from two preserves (FAA) seedlings; other bottle from a pressed seedling (larger one). (Pg. 122) To coast for equipment; will look for a few tortoises en route.
#12,050 ♂; #12078 ♀, #12056 ♂ all in same area.
#12,091 ♀ - CL 64.7; CW 66.4. All smooth shell; very worn and old; white growth increments clear but thin. No lichens; algae all over carapace but only along scute juncture grooves. No sign of recent nesting or copulation. Along trail by last rock pile on crater's W side just where trail starts very steep descent.
Just beside trail and at about same elevation as Nest # II and III from yesterday found a very nice little nesting area or rather series of three small areas of pale brown-yellow soil on a steep slope. Slope is quite sharp but each of three little areas is one flattened place where soil has collected in little natural terraces. These areas are obviously quite productive of nests as is evident from following notes: found a total of 11 1969/70 nests, all with small opening in side of hard cap where young had escaped from nest. Opened all of these and found that in most I could not determine number of eggs exactly, but in all but one nest all the young had hatched (Pg. 123) and escaped. In the one exception, all had hatched and left except one young one which had apparently hatched but never gotten out of nest. The entire skeleton of this little fellow was inside and stuck to the roof of the nest cavity (i.e. hard cap). There were rat hair and bird feathers (finches I think ?) in nest cavity also; perhaps a rat ate this young one after nest was opened by exit of other young; if so why are most bones of skeleton present? Perhaps rat was only using this as a feeding and sleeping place. This nest had six eggs in total, so five hatched and escaped. Only could count number of eggs clearly in two other of these nests – one had four to five eggs, one other over six – all young hatched and escaped these two as with other eight nests. One nest in area which had four or five eggs could have been 1970/71; the young had all already hatched and escaped, but the egg shells inside where very white, clean and fresh looking and not at all similar to one year old ones which see more yellowed and

broken. This nest also seemed less weathered than 1969/70 ones – i.e. hard cap was dry but very solid. There was a nice exit hole in one side of the hard cap where the young escaped. (Pg. 124)
It is conceivable that this nest was laid in Jun-Jul of this year and has already hatched! Am not sure of this at all, but it is a better explanation, given the evidence, than that the nest is a 1969/70 one. Two of the 11 1969/70 nests were side by side with the cavities actually almost joining but not quite – the centers of the nests were only about 2 ft apart. One of these was the nest with six eggs all of which escaped; the other the one with the one hatchling skeleton.
Most nests here were in very open, unshaded sites; however, two were in amazingly protected places, yet both hatched. One of these was a nest that may be 1970/71 nest – see photos #19-20, Roll #208; surrounded by some small shrubs which give it some slight shading for many of hours of the day; also, ♀ must have had to really wedge into here in order to lay eggs. Other site [Marginal note: See photos #18-20, Roll #211 taken 1 Nov. 1970] is much more protected – it is up against a rock block of about 2 m height – in fact the rock has a slight overhang and (Pg. 125) the nest was laid up under it a bit. Must be shaded for about 50% of sunlight hours at least (rock blocks sun from E); yet in nest all young hatched and escaped. Two new nests here, and also several digging sites; two new digging attempts here; three old ones.
Nest #13 – eight eggs – very large, but odd-shaped nest; fresh nest but probably two weeks at least in age because completely dry in hard cap for several cm down and only slightly moist around eggs and through rest of hard cap. Eggs are very fresh however, and can see yolks in them against sun light – embryos must still be very, very small. Nest has a flask but there is a rock in back and so that nest floor slopes sharply from back to front under overhang; [Diagram of nest from lateral view showing sloping floor.]



Depth of loose soil on top of nest 2 cm; depth of hard cap 13.5 cm (but a bit variable); depth to top of uppermost eggs 15.5 cm; depth to bottom of nest 28.5 cm in deepest part; much more shallow in rear, i.e. about 22 cm. Three eggs on bottom layer and down under overhang; five above these, some partly (Pg. 126) under overhang, most in central part of cavity; nest really full of eggs; could not have gotten even one more into it without adding additional upper layers. Took photos #21-25, Roll #208 of this nest. Marked nest and replaced eggs for future removal or study.
Nest #14 – very, very fresh will return here tomorrow to excavate fully and put in thermocouples.
On to coastal camp. Noted tortoise droppings all way to base of sharp rise here where trails divide for camp and nesting zones.
1 Nov. 1970. – 0830, coast, set altimeter at camp at 25 m; temperature in case is 24.5 °C

1000, at nesting zone, Nest #14 (is at upper end of zone) – Luftt reads 162 m; 27.5 °C in case; zone extends over a slope for another 10 m altitude further below. Nest #14 – will implant thermocouples, soil clocks, and set up controls now. (Pg. 127)
Nest very fresh, wet (very) all around eggs and hard cap wet and moist right up to almost surface. Has about 3 cm loose soil which is dry over hard cap. Cap not very durable; in fact breaks and crumbles easily because soil is very gravelly and not much organic material in it save for much old egg shell and membrane fragments. Inside could see five eggs; probably more, but only made a small hole in from one side to enable placement of thermocouples and soil blocks. Did not open to see nest structure. Saw three eggs in bottom layer, two above these but in their interstices. Moist soil in clumps all around and between eggs; no real air space present. No feces seen in hole or in small part of hard cap we could see; none exposed on surface of hard cap. Could not really decipher shape of nest. Depth of nest to bottom 26 cm; depth to top of upper eggs 16 cm; hard cap depth 16 cm also. Put in eight thermocouples and two soil blocks. Soil blocks placed at 1) 18cm in egg mass but to side in wet soil 2) at 9 cm in wet part of hard cap and well above eggs. A control set of soil blocks put in (Pg. 128) at 18 and 9 cm respectively 40 cm away from nest center in open space which receives exact same sun, etc.
Thermocouples at:

Position	Location
1	surface
2	1 cm
3	3 cm
4	5 cm
5	10 cm
6	16 cm – hard cap bottom/top of eggs
7	21 cm – center of egg mass
8	26 cm – bottom of eggs

Will return here to take measurement as soon as possible. This whole nesting area is clearly a very well used one because soil is full of old shell and membrane fragments.
To Zone D: poking about here found two 1969/70 nests – one had all young hatched and successfully escaped – could not tell how many eggs. Other had several young hatched and escaped (number unsure) and (Pg. 129) remains of two others inside eaten by rats – clearly chewed up by rats, one via plastron, one via carapace, and tooth marks abundant. Rat pellets all over inside nest. Collected tortoises' remains and rat droppings – photos all Roll #211, photos #21-24.
Two ♀♀ here –
#12,100 ♀ - same as saw here on 30 Oct. She is about 50 m NW of where was before; no sign of recent digging or nesting by her in this area.
#12,076 ♀ - CL 62.7; CW 68.9; no lichens or algae; all smooth carapace and very worn; white growth increments very thin; moving around in nesting zone and grazing on lichens (common grey-green one on bushes) and resting in shade off/on. No sign of recent nesting or copulation. Was not here other day (30 Oct) I do not think.
Nest #15 – five eggs; reasonably fresh because soil around eggs and hard cap just above them moist; can see yolk of eggs also; however not as fresh as #13 and 14 at

all; cavity more or less normal but almost no flask to it, having at most a 1.5-2 cm undercut; but a nice rounded hole, sloping up to rear some; three eggs on floor in forward part of nest; two in rear resting above, partly and on other three - but not really two clear layers. No fecal (Pg. 130) material in nest or hard cap; as usual cap here is very crumbly because soil is so gravelly. [Marginal note – eggs all on one layer; nest full on this layer could hold three to four more in second layer I suspect.] All eggs appear normal and OK. Depth of loose soil over hard cap 1.5-2 cm; depth of hard cap 17 cm; depth to tops of eggs 19 cm; depth to bottom of lowest three eggs 29 cm. A very noticeably deep nest. Well-used spot; many egg shell fragments in soil here. Nest marked and eggs replaced.

Nest #16 – In a very tiny patch of soil in very rocky area – just to S of and isolated from main nesting area a bit. Six eggs; extensive dry mud in nest but not moist anymore; however eggs still visibly very full of yolk; thus can't be too old a nest but certainly several weeks to be completely dry inside; five eggs OK and normal; one of those on bottom with a big wad of loose mud on it is cracked on top and surely would have rotted. [Marginal note – egg was fertile and developing; had a very tiny embryo. I collected it in 70% ETOH.] Dimensions of this egg – (a bit oblong compared to other five) 67.3 x 60.0 mm. (Pg. 131)

Nest very nice flask-shaped one but flask only with about 3 cm undercut. Three eggs on bottom, two partly under flask, (one the broken one); two eggs next, fitting into interstices of lower three, and one egg above slightly from these two and propped in between them and wall of nest cavity. Cavity pretty full of eggs; reason only three on bottom is that there is a big rock in floor of main cavity at rear which in effect took place of two eggs which otherwise could have been there.

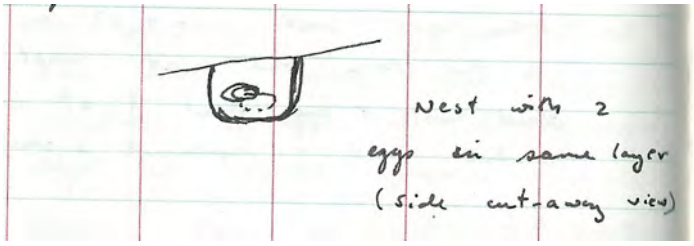
Depth of loose soil on top of nest 1.5-2 cm; depth of hard cap and to top of first egg 11.5 cm (hard cap); depth to top of uppermost egg 13-13.5 cm; depth to bottom of nest in deepest part (flask undercut) 28 cm. Nest marked and eggs (less broken one) replaced.

Nest #17 – five eggs; about same age as #16, same condition; broke one egg in opening by accident; fertile and with an embryo a bit younger than that in Nest #16 egg. [Marginal note – feces in hard cap.] One of the four remaining eggs oblong and lying on side just as cracked one in Nest #16 was; about same size and (Pg. 132) form as Nest #16 egg; also cracked naturally on top in laying or covering of nest by ♀. Appears that membrane is OK so left it to see if will hatch and develop normally. Nest about full; large rock in rear center; flask shallow – only 2-3 cm undercut; rock so large that only one egg on bottom of nest per se wedged into flask undercut to side of rock. Others form not a second layer but are slightly above this other egg; this cavity full at this level; could hold only another three eggs in another upper layer I would guess. [Marginal note – all five eggs almost on same level in bottom of nest - only slight difference – all essentially on bottom layer.] Depth of loose dry soil on top 1-2 cm; depth of hard cap 17 cm; depth to top of four upper eggs 19 cm; depth to deepest part of nest bottom 25.5 cm. Marked nest and replaced four good eggs.

All three of above nests in complete open; due to slope and low bushes all three shaded till about 1030-1100 hr each day now, but get full sun until virtually sunset from that (Pg. 133) time on all day.

Nest #18 – on trail just to S of Zone D, en route to Zone E. Did not excavate carefully enough to check its measurements adequately; very fresh and wet; about like Nest #14; did not excavate carefully because appears like nests here occasionally do; virtually no real hard cap; just slightly tamped down wet soil over eggs; four eggs; one either broken in laying (I think so) or I broke it as was opening, had to say; has a very tiny embryo; much smaller (half size) to those of Nests #16-17 and probably a few days old at most. Small cavity and eggs filled it at bottom level; marked nest and replaced three good eggs. [Marginal note – no feces in nest or hard cap].
Zone E – three freshly attempted nests, all shallow (5-8 cm) and stopped due to rocks in bottoms and or sides of nests. None utilized cloacal fluid. Tortoise tracks (♀ sized) all over. One finished nest: Nest #19 – two eggs; both oblong-shaped as one egg each in Nests #16 and 17 which were cracked; however, neither of these two in Nest #19 cracked at all. Strange nest because built into a rather steep (15-20 °) slope in very gravelly, rubble soil with no real hard cap. Nest very, very fresh; (Pg. 134) probably one or two nights old at most because soil around eggs and right up to almost surface of ground is very, very wet. No real hard cap, just dug hole, put in eggs and covered with gravel; thus no real air space around eggs, just wet grave; from best I can judge, nest could have held one or two more eggs in area ♀ excavated, assuming all would be in one layer on bottom.

[Diagram of lateral view of nest with two eggs.]



Eggs replaced and nest marked; 3 cm loose dryish soil over nest (wet more solid part). Total depth to top of eggs 25 cm; total depth to bottom of nest below eggs 31 cm. Area above eggs wet for about 0.5 x 0.5 m; ♀ must have slopped cloacal fluid all over here in making nest. She certainly did one hell of a lot (Pg. 135) of work for laying only two eggs.
Late so returned hurriedly to campsite.
Total nests for trip: 19.
Zone A – six (three in A proper; three near it.)
Zone B – one
Zone C – one
Zone D – four
Zone E – one
New areas above Zones D and E – four.
New area beside main trail and N of Zones D and E – two
Total number of eggs – minimum of 92; could only see part of Nest #14 (i.e. five eggs); since Nest #14 probably has more than five eggs this total will change to

upwards slightly; of the 92, four broken by people in opening nest; one broken by ♀ in laying, these five all discarded, all fertile; 39 eggs to CDRS for incubation ; thus minimum of 48 eggs remain here in nest; i.e. are eight nests from Zones A, B, C, to CDRS now. All 11 from other zones marked and left in place for further study and retrieval later in year. (Pg. 136)
Notes from J. Black on animals seen, new nesting areas noted, old nests, etc. during certain days when he was passing through different areas than I (we) visited.
29 Oct. 1970 – en route to coast along trail he saw several animals – all along E rim.
** (seen by C. M. on 29 Oct or 30 Oct or 2 Nov.)
** #12,050 ♂
** #XXXX ♂ - most of scutes broken but marked; however could not get # because not clearly readable.
#12,052 ♂
**#12,094 ♂ (#4 scutes; perhaps a natural breakage).
**#12,091 ♀
30 Oct 1970 – he went to check on a new (potential) nest area found by Peter Kramer on previous day. This is around on the SE side well to the E of Zones A and B. This area is along an encañada and is on rather steep slope. The soil is very poor here and cracked deeply from percolation and drying-wetting cycles; it is much like the substrate of Zone C. In this area he found three small but old and unmarked (Pg. 137) ♀♀. No signs of new nests or digging activity. Also noted four nests which appear to be 1969/70 ones – in three young had all apparently left. In other one no exit hole and inside a "group" of rotten eggs and one dead, trapped young hatchling (he failed to count number of rotten eggs or check them for fertility).
31 Oct 1970 – he and Kramers crossed through pond area on eastern side of floor of old, upper crater, and thence to highest point of the island on eastern rim of upper crater. From here, they moved along the rim to the S to the second highest point and from it downward to some encañada on the SE slope.
They saw no sign of tortoises near the highest point, but on the outside slope immediately below the second highest point saw some very fresh tracks and droppings of a tortoise.
Along the encañada, they saw mostly fresh droppings of tortoises and one ♀ #12,057 CL 63.7; CW 73.2.
1 Nov. 1970 – Black examined SW and S slopes from Nesting Zone C over to airplane (B-24) wreck. Saw two tortoises. (Pg. 140)
#12,045 ♀ - just below Zone C.
#12,06 ♂ - to W of Zone C and below it: eating Croton when discovered. Also found the carapace and bones of a recently expired ♀ tortoise, unmarked. Maximum of one to two months dead and with skin and some flesh still dried on the bones. In semi-shade up under a rock overhang. Cause of death unknown, but clearly of natural causes; not slaughtered and no signs of any accident. This carapace, plastron, skull and some of other bones returned to CDRS for cleaning and preservation. Some scattered old nests in small soil-covered areas along this side at altitudes between those of Zones B and C, but no new nests or digging signs; not much available (Pg. 139) nesting space and clearly are not major nesting areas as are slopes on western side and SE side.

2 Nov 1970 – returned early this a.m. to take soil moisture readings at Nest Site (#14) and then returned quickly to coast.

	0815	
Nest	9 cm	55%
	18 cm	60%
Soil	9 cm	nr
Control	18 cm	nr

(Pg. 140 – 142 – blank)

(Pg. 143) 6 Dec. 1970 – Took weights, measures, and marked (permanently) 20 young Pinzon 1965-66 hatchlings today in preparation for release on Pinzon on 10 Dec 1970 more or less. Treatments (special) supplied to them prior to trip and definitions of these measurements in Vol. I of CDRS notes. Weights taken with a Chatillon spring balance, fixed type with maximum weight of 40 lbs. and readable to 1/8 lb. Measurements taken with standard type I use in field – Lufkin 3 meter metallic tape. Took these weights and measurements carefully because will use same instruments in the field in the future and check on the animal's well-being.
Since Miguel Castro has in fact marked more animals than in formal CDRS files (#12,098 is last recorded # ; we think Castro marked through #12,104 or 12,103) began marking these at #12,110; in fact scutes too small to double notch any single one, so I marked only 110-129 and left 12,000 mark off for now till they grow larger. In following page is data; approximate grams given for weights also by simple conversion from pounds. (Pg. 144)

Tortoise #	CL(cm)	CW(cm)	lbs.	Grams
110	34.6	36.2	7.75	3418.5
111	31.8	32.6	7.5	3305
112	38.15	38.6	9.25	4199.5
113	35.1	35.3	7.25	3292
114	35.4	34.7	8.5	3859
115	33.3	32.8	7.5	3305
116	32,4	32,5	6	2724
117	34.7	34.0	9	4086
118	32.3	32.1	8	3632
119	35.5	34.5	8.5	3859
120	27.8	27.8	4.38	1986
121	32.0	32.2	5.5	2497
122	32.3	32.3	6.5	2951
123	38.1	38.6	10.63	4881
124	32.6	33.3	8	3632
125	30.0	30.5	5.5	2497
126	31.1	32.9	6.25	2838
127	30.9	31.7	6.63	3008
128	32.5	32.4	6	2724
129	37.7	36.9	8.38	3802

Dec 1970 – Arrived at Pinzon at NW disembarkation point at 0800. Party includes Jan, Juan Black, Camilo Calapucha, Sr. Jacinto Gordillo (Station representative at

Villamil, Isabela), Fausto Llerena, (Pg. 145) myself, Sr. Lucino Saltos (school inspector on Santa Cruz and correspondent for El Comercio, Quito newspaer0 and Lt. Ballardo Coronel. Port captain from Santa Cruz; and last but not least 20 1965/66 tortoises. Took till 0800 to unload everything and in process nearly tipped panga over on shore and dumped Coca-Cola (captain of Cristo Rey) into ocean; needless to say he has a short temper and was rather angry.

Sr. Saltos and Lt. Ballardo were here to observe the unloading and as reporter and official government representative respectively. They both took photos of unloading process and we "staged" a facsimile release near coast on rocky (but fairly typical Pinzon landscape) NW slopes. Jan took some photos of tortoises and them at this false release and many of unloading process – see Rolls #228 (HSE); perhaps a few photos on Roll #229 also. In afternoon we came up to regular upper crater camp with only camping gear, water, etc., intending to bring tortoises to this area or to release them tomorrow depending upon the number of trips required for their transport. On leaving coast at 1230, I set altimeter at 0 at coast at water line (high tide) temperature in Luftt case was 29.5 °C.

On arrival at camp, we simply relaxed till dark and cooked a bit. Set up Taylor max-min in open at camp to check tonight's low here. (Pg. 146)

11 Dec 1970 – low last night was 61.5 °F in camp – note that camp is at approximately same altitude and same exposure as release point on eastern side of this upper, older crater. Five of us (Juan, Camilo, Fausto, Jacinto, and I) went to coast to obtain tortoises. Loaded up (four each) and we were back to crater camp by 1130. We rested here a bit before heading on to release area.

Some notes: 1) En route to coast this morning saw three adult tortoises only; all still inactive and burrowed in (0800-0845); has not been garuaing (misting) as much recently as when we were here in late Oct 1970 because soil does not give appearance of it. No garua at all last night or this morning and tortoises thus inactive this a.m.

Tortoises:

#12,077 ♂ - near trail at Steamboat Rock (same area where saw him in Oct).

#12,056 ♂ - near trail just below Steamboat Rock (also same area in Oct).

#12,091 ♀ - near small rock outcrop just where trail starts steep descent on W side (same area as Oct).

No others seen and not much more sign than in Oct when traversed this area (Pg. 147) several times; however, Jan saw five up on W rim near drinking spots, etc. (i.e. where we saw #12,050, 12,051, etc. in Oct) – will check on these in a day or so.

2) Young tortoises have obviously lost some weight to the present time date due to transport. They became very agitated and excited when placed in the large holding box (roughly 2 x 2 m) at CDRS and defecated and urinated with great profusion during trip from CDRS to loading on boat at Santa Cruz. Did very little of this on entire journey to Pinzon but commenced again when being unloaded at Pinzon; especially defecated a lot, not too much urinating (ladders probably running dry). Once again, on shore last night were calm in holding box and did very little of either type of excreting. Then again while being carried to release site today defecated a great deal and urinated a bit – note that some did neither – for example the four I carried did neither at all. Very probable that systems are cleared out now. Anyway, they have gone without food and water since 1500 hr on 9 Dec, but we will give

them both water and some Commelina nudiflora to eat at release site at approximately 1230 today. Jan took photos of us carrying tortoises – see Roll #230 and first part of Roll #231. (Pg. 148)
At 1200 checked altitude at campsite since it and release point are at almost same exact altitude – temperature in case 28.8 °C, altitude 294 m.
Continued on to release site and began operation at 1230 hr, sun just out for past hour, but pleasant because of a cool breeze. I will be making a map of, describing, and photographing release area in detail tomorrow as well as collecting plants from it; therefore will confine today's observations to behavior of tortoise in this new environment.
Released animals in one central location which is about 75 m S of main largest pond bed in the area of upper crater floor just inside highest eastern rim of Pinzon. Same area we explored on 27 Oct on last trip here and described briefly then.
Upon release all 20 began moving about with great activity and interest in new location. Right away a few of them had brief aggressions (raised up on all 4 legs, heads and necks arched up fully, just like adults but there almost never involved biting and were usually over in a matter of a few to a few dozen seconds. Most often because both lost interest and moved away from each other simultaneously; sometimes one (Pg. 149) continued to aggress till the other retreated head, neck and legs and then moved away, vanquished.
During this first hour after release, the majority (17) moved only a few meters up to about 20 m away from the release site, in all directions, eating scattered herbs as the moved along, a few decimeters at a time from one clump of herbs to another. In fact, the main characterizing behavior of about all animals (three exceptions) was to forage; they clearly began searching for food, then grazing and foraging when they found it, immediately after release. By 15 minutes after release every animal but these three was grazing, most dispersed out in all direction around release pint, and three still at release site eating. These three exceptions took off rapidly right after release and continued to move rather steadily for the first hour. At the end of this hour two had progressed over and beyond a small pond full of dark black lava blocks directly to W of release point and were about 125 and 140 feet respectively from release point. Other animal had moved similarly over open soil covered and brushy area to SSE and was about 140 feet from release point.
The sun had been out full for this entire hour and beginning at about 1330 they began to find resting spots in shade, (Pg. 150) some under Opuntia, others under arched arms of dead Cordia lutea trees, in thick clumps of Prosopsis or Alternathera, etc. By 1345, all were in shade, sitting quietly, some sleeping, some looking about, and five grazing on small herbs in these rest spots. The three wanderers were also in shade by this time. Then at about 1430 began to get stronger cooling breezes and sun was behind clouds off and on so that was shady about 30-40% of the time. By 1445 eight of them were back out of rest spots and active, six foraging, two having a bit of a confrontation in middle of rocky pond bed and then later walking around in the pond bed. This pattern continued till 1600 when we left, i.e. about half active, half in resting spots, sun out off and on. Before leaving I set up Taylor max-min thermometer and rain gauge (Taylor Clear-vu type, 6 inch capacity, reads in mm) in open at release site. (Pg. 151)

Several noteworthy aspects of their behavior:

1) Did not appear bewildered or confused; as soon as they had dispersed out anywhere from a few to a dozen or so meters, virtually all (save three) began immediately foraging and grazing on native herbs and other plants in the area.
2) We put a few pounds of Commelina herbs from Santa Cruz, scattered about in about ten spots around release site, i.e. about 10-15 m away from release point in a circle of spots. They ate this when they encountered it from time to time, but did not at all concentrate on it. In fact at most never saw more than two grazing on it at once when as many as 17 were grazing at one time. Even those eating this herb would only take a few bites and then move on to native plants. Occasionally returned to feeding station and then off to native plants again. In other words clearly not the case that these plants were slowing down, interfering with or altering dispersal pattern.
3) Camilo Calapucha gave water to a few in a small plastic disk and they drank it down greedily, so clearly are thirsty. Accordingly, we distributed five of these small dishes in shady spots around release area and filled them. They (Pg. 152) each hold about one cup of water; I noticed that when a tortoise encountered one of these and discovered it was water, they would greedily drink it dry in only a minute or two. We will continue to fill these with water till we leave the area permanently for this trip, just to enhance their survival chances.
4) Plants they were eating (native species) – Almost every foraging animal (eventually saw every one grazing at one time or another) concentrated mainly on Commelina which is growing scattered here and there all over release area, in pond beds, etc. Also were eating a lot of a small, succulent, reddish, low-growing herb (will collect it). Also saw tortoise greedily munch down a new offshoot, green succulent pad which was growing on a fallen larger Opuntia pad. He did not try to eat the larger pad but really devoured the small young spineless one and got a lot of water out of it because juice was running all over the tortoise's mouth. In case of all three of these plants, they clearly like them and had no adverse reactions. Also saw two animals try some dried-up ferns with no detectable [Editorial note: CGM did not finish sentence. Subsequent eight pages are photographic log of photos taken on Pinzon 21 Oct – 10 Dec 1969.

[Editorial note: The following are photographic notes on 8 unnumbered pages at end of notebook.]

Photographs – Pinzon trips and related activities at CDRS

Date; Roll #; Photo #; Subject

Oct 21, 1969; Roll #24 HSE; Photo #25-35; Pinzon tortoise embryos with yolk sac; approaching hatching age; from same Nest #12 in which a hatched animal (#1, 1969) was found on Oct 15, 1969 by J. Black; the egg from which came was slightly deformed and Black thought bad and opened it – questionable? No obvious discoloration of egg as usually find in bad ones.

Oct 21, 1969; Roll #25 HSE; Photo #1-15; photos of Pinzon tortoise embryo which may be about 1 month in age (incubation time). From Nest #1 (1969), found on Oct 15, 1969 by Sr. J. Black. Yolk sac removed when he preserved the animal.

Oct 21, 1969; Roll #25 HSE; Photo #16-30; Photos of embryo of about three to four months in age from Pinzon island. (near hatching I guess). Found in Nest #7 then by J. Black on Oct 16, 1969. Yolk sac removed by him when preserved but mostly absorbed already. Animal filled up egg well.

Oct 21, 1969; Roll #25 HSE; Photo #31 to end; Pinzon baby hatching #1 from Nest #12, found on Oct 16, 1969 by J. Black and returned to CDRS. Was in nest and alive with egg mentioned above. No yolk sac obvious and plastral opening almost closed when found the animal upon opening the nest.

Oct 24, 1969; Roll #26 KII; Photo #1-10; C. MacFarland and J. Black (National Park official of Ecuador) putting Pinzon tortoise eggs, Nests #7, 8, 10, into incubator at CDRS. Each egg individually marked with Roman numeral.

Dec 5, 1969; Roll #26 KII; Photo #20-21; nest site on Pinzon. Top of area where Nests #14 and 15 found when opened; note that only look like one nest from above. Note hard cap exposed at surface.

Dec 5, 1969; Roll #26 KII; Photo #22-25; top of Nest #17 before opening it; note hole just beside hard cap. Hard cap at surface.

Dec 5, 1969; Roll #26 KII; Photo #26-27; remains inside Nest #17 after opening it, shell, membrane fragments, and carapace scutes.

Dec 5, 1969; Roll #26 KII; Photo #28-30; top of area around Nest #13 before being opened; note that there is loose dusty, fine soil covering the hard cap; the latter is not openly exposed.

Dec 6, 1969; Roll #26 KII; Photo #31-end; young hawks, about 40-45 days old on Pinzon at 750 ft, near Tortoise Nesting Area C. Remains of marine iguana and rats in nest. Three adults circling and swooping on me while taking photos. T. DeVries says almost certainly 2 ♂♂ and 1 ♀; young probably one of each sex but not sure. Nest is relatively new; not here on Oct 15, 1969 according to Sr. Black.

Dec 6, 1969; Roll #43 HSE; Photo #1-4; ditto to Roll #26, Photo #31-end above.

Dec 6, 1969; Roll #43 HSE; Photo #5-9; Nest #2, Nesting Zone A on Pinzon. Opening of nest, three young hatchlings inside; note positions, how opened, lack of any digging or activity apparent prior to our opening of nest. Also one shot of youngest animal showing condition of yolk sac and plastral closure at time nest opened. About 1100 hr.

Dec 6, 1969; Roll #43 HSE; Photo #10-12; What I thought was a nest site in Zone B Nesting Area on Pinzon; turns out that is just an area of soil which is hardened by

alternating water percolation and drying to look like a nest's hard cap. But OK for showing soil and nest site types in this nesting area.

Dec 6, 1969; Roll #43 HSE; Photo #13; Crater of Pinzon from SW side of island at about 900 ft.

Dec 6, 1969; Roll #43 HSE; Photo #14-end; Scenery around Pinzon on NW side-lichens, rocks, hills, campsite, hawk (< 1 yr old, juvenile plumage).

Dec 7, 1969; Roll #44 KII; Photo #1-24; Juvenile (< 1 yr. Old – probably fledged in late Jul or in Aug 1969) Galapagos hawk on Pinzon near NW corner campsite. Two adults attacking me while photographing the younger one. Also some scenery around campsite.

Dec 8, 1969; Roll #43 KII; Photo #25-end; Weighing and measuring of Pinzon tortoise eggs before placement in incubators at CDRS these all returned from trip of 5-7 Dec 1969.

Dec 8, 1969; Roll #45 KX; Photos all (roll not completed); Pinzon egg data taking continued at CDRS lab prior to incubation. Weights, diameters, etc. Each egg numbered for individual and nest identification. Deposit into incubator.

Dec 8, 1969; Roll #45 KX; Photos continued; just hatched young animal (1/2 to 1 hr out of egg completely) from Nest #8 from Pinzon (Egg #III). Hatching young one also Nest #8; Egg #I. These taken 0800 at night. Also photos of whole clutch of two eggs from Nest #9 from Pinzon – interesting because of great difference in two eggs' sizes. Have exact measures in files.

Dec 8, 1969; Roll #46 HSE; Photos all, #1-36; four Pinzon tortoises in various stages of hatching – all hatching at roughly same time – all began within one day of each other. From Nest #8, total of four eggs. Circa 2000 hr. Nearly same area open first on egg for all; but one has foreleg out before head. In specific photos #25-31, hatchling from Egg #III, Nest #8, Pinzon. Probably (almost certainly) completed hatching just this afternoon. May have begun one or two days ago. Found still moist and with mucous covering at 1730 hr today. Note yolk sac and plastral closure condition and that folds in plastron nearly straightened out. Circa 2000 hr.

Dec 8, 1969; Roll #46 HSE; in specific, Photo #32-end; hatchling from Egg #I (#16) same day as hatched. Found ½-2/3 of way out at 1730 hr and hatched between 1900-2000 this evening. Note yolk sac size and plastral closure condition. Also fold in plastron still fairly tight and look as if mucous and membrane are holding in that position – but drying and will certainly begin to flatten out tonight and tomorrow.

Dec 8, 1969; Roll #47 HSE; Photos #1-7; circa 2030 hr; same as Roll #46, #23 to end.

Dec 9, 1969; Roll #47 HSE; Photos #8-12; 0730 hr; hatching form Nest #8; same one which began by pushing fore-leg out of egg first; note head not near opening an opening larger. From egg #IV.

Dec 9, 1969; Roll #47 HSE; Photos #12-23; measuring and weighing three new young from Pinzon Nest #2, returned to CDRS on Dec 7, 1969 and found in nest on Pinzon (hatched) on Dec 6, 1969. Also painting on identification numbers of tortoises (these are #12, 13, 14 for 1969).

Dec 9, 1969; Roll #47 HSE; Photos #24-25; baby Pinzon tortoises < one day old, with skull of tortoise from 75 ft deep cave on Isla Floreana (found recently by crew members of "Golden Cachalot" and brought to CDRS).

Dec 9, 1969; Roll #47 HSE; Photos #26-29; hatchling from
Egg #IV, Nest #8 continuing to slowly work way out of shell. Will be #17 tortoise if it makes it out. See Roll #46 for earlier photos. 1430 hr.

Dec 9, 1969; Roll #47 HSE; Photos #30-31; hatchling from Egg #II, Nest #8 continuing to slowly begin exit from egg. Just a small pip of 1.2 cm open when found yesterday at 1730 hr. Slightly larger last night at 2030 hr when photographing – Roll #46.

Dec 9, 1969; Roll #47 HSE; Photos #32-end; 1515 hr; hatchling from Egg #IV, Nest #8 – final activity of breaking out of egg, and hatching; good deal of mucous all over him and some remaining in egg. Can see in photos.

Dec 9, 1969; Roll #48 KX; Photos #1-6; More of hatchling from Egg #IV, showing underside with yolk sac and plastral opening; larger than two previous ones, also folds in plastron – more folded than #15 when found but less than #16 after the latter had just hatched. Also more photos of egg from whence came showing mucous and also hatching sequence (somewhat faked). Can also see egg tooth (actually raised area on upper jaw part of horny beak) in some of these I think.
Also can see that lateral areas of carapace scutes are lighter (almost pale grey to cream in color) in this one than in #14 or 15 at hatching. Same can be said of plastral scutes – black in #14 and 15; slight yellowish color making them all lighter in #16 (this one).

Dec 9, 1969; Roll #48 KX; Photos #7-11; egg of just hatched tortoise from Pinzon showing double structure – inner softer membrane (papery) which dries and hardens while hatching and outer shell, brittle and hard. Also can see mucous remaining in egg after tortoise exited.

Dec 9, 1969; Roll #48 KX; Photos #12-18; #15 Pinzon tortoise from several aspects, carapace and plastron and yolks sac characteristics shown (Nest #8): about 24 – 30 hr after hatching out completely.

Dec 9, 1969; Roll #48 KX; Photos #19-26; #16 tortoise; same as for #15, just previous photos. Nest #8, about 20 hr after hatching out completely.

Dec 9, 1969; Roll #48 KX; Photos #27-32; #15, 16, 17 all together in a bunch; active and moving about when in light. All from Nest #8.

Dec 9, 1969; Roll #48 KX; Photos #33-34; #11 hatchling from Pinzon, two weeks old; hatched on 23 Nov 1969; showing plastral opening almost closed.

Dec 9, 1969; Roll #48 KX; Photos #35; #5 hatchling from Pinzon showing plastral opening closed, one month old; hatched 9 Nov 1969.

Dec 10, 1969; Roll #49 KX; Photos #1-3; Pinzon hatchling #12 from Nest #2 on that island. Found hatched in nest and alive on Dec 6, 1969. Note yolk sac phase and plastral closure (see notes from Dec 6, 1969 this volume).

Dec 10, 1969; Roll #49 KX; Photos #4-6; Pinzon hatchling #13, ditto for above #12.

Dec 10, 1969; Roll #49 KX; Photos #7-13; Pinzon hatchling #14, ditto for above3 #12 and 13. Some shots with hand and ruler for scale.

Dec 10, 1969; Roll #49 KX; Photos #14-20; Pinzon hatchlings #12, 13,14 in group portraits; ruler in some shots for scale.

Dec 10, 1969; Roll #49 KX; Photos #21-26; Pinzon hatchlings #15, 16, 17 in group portraitures with and without rulers in photos; all hatched 8 and 9 Dec 1969; shows size, coloration, alertness.

Dec 10, 1969; Roll #49 KX; Photos #27-36; Jan holding Pinzon hatchling #17; also photos of head and egg tooth of same animal. Photos of Pinzon hatchling #18 (egg #II, Nest #8) coming out of egg; about 1/3 out; also close-ups of head and egg tooth.

Dec 10, 1969; Roll #50 KX; Photos #1-9; 1130 hr; #18 hatchling from Pinzon finally coming out; a number of photos of this process.

End of Notebook.

CGM Pinzon 2
Pinzon 2 – Isla Pinzon (Pinzon) Volume. #2.
Field Notebook of Craig MacFarland
[Transcription completed 13 November 2006, by T. H. Fritts – CGM Pinzon2.doc]

(Pg. 1) Pinzon – 11 Dec, 1970 continued.
[Editorial note: this sentence is continued from CGM Pinzon 1]
. . . reaction, but in each case moved on to patches of Commelina after only a few bites. Also, one animal was eating leaves of Prosopsis with no detectable adverse reaction, but saw no others try it today. Finally, saw three different beasties take a chomp out of Maytenus (grows as a small, dwarfed, decumbent shrub here) leaves and in all three cases retracted head briefly, shook head a bit and moved away from the plant – once even "spit" material back out on ground. They clearly did not like the leaves of this plant at all. I continued to watch these three animals after this experience and though they passed many more Maytenus within their reach, they would look at the leaves only and never attempted another bite.
5) Other photos:
Roll #231 – release of tortoises, J. Black giving work speech, tortoises exploring new environment, tortoises foraging, Camilo Calapucha watering one tortoise; tortoise aggressions.
Roll #232 – more of tortoise aggressions, foraging, walking around new environment, resting in shade etc.
Roll #227 – end only – tortoises and release environment – wide angle shots (28 mm lens).
6) They clearly are naïve about how to move about in this new environment full of vegetation, especially thorny things, down at their level. This is not (Pg. 2) surprising since they have never been exposed to this before. Noticed that almost all of them at one time or another this afternoon simply walked directly into very thorny Prosopsis, Acacia, and like plants, causing them to eventually retract with loud hisses when the thorns stick into their soft nose, neck, and similar fleshy places. In many cases they would have an easy clear path around a low shrub, for example a dense Alternathera and they would simply barrel on full steam and try to walk right through the shrub, become hopelessly entangled and eventually have to back out and proceed differently – quite humorous to watch this.
12 Dec 1970 – Returned to area at 0930. Received 0.5 mm rain last night; actually all fell from 0500-0900 this morning. Minimum temperature at release area was 66.5 °F. In just a quick look around area Jan and I found 15 (Pg. 3) tortoises, one basking, two still in last night's burrows under small Alternathera bushes, and 12 already grazing; 11 of these were eating Commelina (native stuff); other one was eating succulent, juicy fallen Opuntia fruits. Did not see other five animals, but we did not really fully examine the area.
I climbed a nearby barranco and made a rough sketch map of the area showing its major landmarks, substrate types, and release point. Also made an enlarged one of immediate area around release point in order to map in locations of tortoises today. Made a series of four panorama shots of the area mapped from barranco to W of it – Roll #233, #1-4, #5-6 were all taken with about center of them on release point (Jan and 5 tortoises sometimes in these for scale).
Description of area: area is basically a flat plain (a part of upper crater floor, eastern part to be exact) of a long narrow extent running about SSE to NNW, to be exact 160° S to 34° N. It is bordered on E along its entire extent by eastern inner crater wall, on W by a big barranco and hill of large boulders and dense spiny vegetation all along its length, to N by small crater, and to S it

is continuous with rest of upper crater's floor in which lies (Pg. 4) our campsite. Area is made up of a mixture of: 1) open soil-covered areas which are superficially heavily covered with small loose plate-like rocks, and 2) areas of vegetation.
Vegetation consists of basically three layers – scattered trees, more abundant shrub layer, and most abundant but still scattered herb layer. Trees are mostly scattered adult Opuntia, some ferns living and lots of dead muyuyu (Cordia lutea), an occasional Maytenus and a rare Xanthoxylum. Shrubs are mostly Prosopsis, very abundant Alternathera, very abundant Maytenus, most of the latter being very low and decumbent, scattered dwarfed Xanthoxylum, scattered Acacia and a few others. Herbs are Commelina, a fern, a small red succulent (mentioned in yesterday's notes), dry grasses, a verbena – like thing, a vine, a plant I think is a parasite (grows here on ground, on Santa Cruz in trees) and a few others. (Pg. 5) See Roll #233, photos #7-22 of the general area – including ponds and vegetation.
Are a number of rocky small pond beds in the area, the more prominent of which I have put on map. These obviously must have been important sites for population before man destroyed it on this half of the island – three old very decomposed skeletons here attest to tortoises' former presence. Of course, they are dry completely now and must fill only with very heavy rains when such occur every few (or more) years and even then the standing water must be very ephemeral on this low, dry island. Altitude here (1200 hr, 30°C in case, Luftt altimeter) reads 300 m.
From watching tortoises feeding yesterday and today all morning, it is clear that their favorite food is Commelina; they are also eating fallen Opuntia fruits, and the small young pads growing on the large pads which have fallen from arms of fallen adult trees (these young pads unlike seedlings or shoots growing up from fallen trunks or pads after falling that is, are devoid of stiff spines and very tender and succulent – they are on ground only because they have budded out on old pads (also non spiny) which then afterwards have fallen to ground). They also eat, occasionally, the fern, the red succulent herb, and leaves of Prosopsis; they clearly do (Pg. 6) not like and thus avoid Maytenus after eating it once. Conditions here are essentially as I described them on 27 Oct, 1970 notes. For time being, tortoises have plenty of green food which contains water in abundance. Are hundreds of fallen Opuntia fruits, dozens of older (spineless) fallen pads, and hundreds of square feet covered with mostly Commelina and secondarily the red succulent herb in open soil areas and in rocky pond beds. Real test of survival ability will be if we have a long, hot, dry rainy season (Jan-May) and food dries up and no drinkable water occurs.
This morning was only a small bit of water in small pockets in little lava plates and rocks in open areas and pond beds; i.e. garua not enough to fill them even – maximum in largest pockets on 1-3 ounces. But saw two tortoises already drinking from these pockets (they found them very rapidly!) and other animals were (Pg. 7) getting water from Commelina they were eating which was wet with water droplets externally until about 1030.
Noted something interesting about Opuntia in this area which have not noted in campsite area – Probably related to co-evolution of tortoises and Opuntia. In areas where whole trunks have collapsed or large, older pads which have only hairs and not spines have fallen to ground, sometimes new pads, essentially like new seedlings in form sprout up and grow. Interesting thing is that these new little pads, some of which will eventually become trunked trees, have a full and heavy coat of long, sharp, sturdy vicious spines. This is true both in cases when they sprout up from smaller fallen trunks which are spiny still (in which case this would be expected since pads on these young trunks are still with sharp spines) but also true when sprout up from spineless, unarmored pads and old, smooth-barked large trunks. This indicates a very plastic

growth pattern in Opuntia, apparently dependent upon position of pads – i.e. whether high above ground (and out of reach of tortoises) or near ground or on it. Probably have not noticed this in campsite area because old ♂ tortoise patrols it so well that he gnashes down any spineless, hairy pads that fall (Pg. 8) before such spiny sprouts can form; also in that area are few downed trunks. See photos #23-28, Roll #233 for illustration of this. Saw a small tortoise eating open flower from a fallen Opuntia pad. So got two more from a tree and let him have a go at them also – ate all three, petals, base, and all. See Roll #232 – last ten photos more or less and Roll #233 – photos #29 – end.
Tortoise survey – see map done at 1600 – 1645 by Jan and me: all distances and directions are from release point.
#110 – 12 m due W of release point under Prosopsis, eating Commelina.
#121 – 11 m WSW of release point – open eating Commelina.
#123 – 30 m W of release point in pond bed walking around.
#115 – 35 m W of release point in pond walking around on rocks.
#114 – 25 m WNW moving though dense brush.
#116 – 30 m NW in open grazing on Commelina.
#111 - 35 m NW drinking water from a plastic cup.
#117 – 50 m NW eating red succulent herb in brush.
#127 – 40 m NW burrowed in, in shade.
(Pg. 9)
#126 – burrowed in shade, 40 m N of release point.
#129 – burrowed in shade, 30 m NE of release point.
#118 – walking about 50 m ENE of release point in open on rocks.
#120 (mis-marked – mark #102) – did not find but we last saw him five hours ago heading due S; found his last tracks 100 m S of release point; probably in this area since tracks enter brush.
Last tracks of another one found heading into brush about SSW 65 m from release point.
So found two and tracks of two others.
By 1645 quit looking (we covered out about 75-100 m all around release point), because all 12 now burrowed and inactive and although sun is still out it is cooling rapidly.
Note – today they have drunk four of five plastic cups dry – other one untouched.
Note also – activity periods: sun was not out strong until about 1300, before then out only about 25% of time from 1000-1300, not out at all before 1000. From 1300 until now (1700) out almost continuously. They were virtually all (all we could see, varied from 12-15 all day long) active until about 1300-1330, then burrowed. All but about two or three out again between 1515-1530, began burrowing at 1600 and all in burrows by 1645. Two or three never came out of burrows at all for afternoon activity period. (Pg. 10)
Note – hawks: once yesterday and three times today have seen hawks come down and land in vicinity of tortoises to look them over. Yesterday literally only five minutes after we had released the 20 at the release site, an adult hawk flew onto top of nearby Opuntia and looked at tortoise for about five minutes; then he left without disturbing them. Three times today have seen hawks (at least two different ones, one adult and one juvenile) fly down and land a few feet from a moving young tortoise, look at the latter for a few dozen seconds to a few minutes and then fly off. No attempts to attack animals seen at all – just appear curious.
Note – plants – collected plants from area around release site; those collected were 1) Commelina sp.; 2) Alternathera sp.; 3) a small decumbent reddish green-leaved and stemmed succulent; 4) a limy green-leaved, decumbent vine; 5) a small species which is growing on

ground here – perhaps a parasite; on Santa Cruz I have always seen it grown in trees; 6) a fern. (Pg. 11)
13 Dec 1970 – To coast to get temperature measuring equipment, water, etc. En route examined area on planada on W rim from where trail crosses it down to big huge barranco (to look for five tortoises Jan saw here other day).
#12,078 ♀ - literally only 20 m from where saw on Oct 1970 trip – a bit more up in rocks and thorny vegetation. Walking about, foraging.
#12,050 ♂ - only 30 m downhill in planada from where was last trip – Oct 1970 – eating Alternathera.
#12,049 ♀ - CL 60.3, CW 62.2. Could be #12,069 but doubtful and measurements do not fit with those taken on Oct 1970 trip of #12,069. Very old, all smooth and pitted ♀. No lichens, algae, flaking disease; white growth increments very, very thin. Eating ferns (type collected yesterday) up on rocky side of western rim above planada.
#12,051 ♂ - eating Croton leaves, only 25 m from watering hole where saw on Oct 1970 trip. Did not find fifth one, but Jan says was a large ♂ and she thinks it was #12,061 ♂ (was in this area on Oct. 1970 trip). As we moved along trail on western rim saw fresh tracks from this morning heading from planada area we just examined to an area of flat rocks (water collected there this morning) about 100 m to NW then from here tracks led off to another similar (Pg. 12) water collection site to W. Did not follow. Perhaps same ♂ Jan saw, because tracks big – definitely from a large adult ♂. Interesting to note that whatever ♂ it was, he checked very specifically from one water collection site to next. We saw exact same behavior by some other ♂ (could be same one but doubt it because was not #12,051 before and probably is now) on Oct 1970 trip after abundant garua one morning – and exact same two sites checked then.
As we moved along trail saw that tortoises had been stomping around three other water collection sites (large aged, smoothed lava blacks with many small packets and basins and holes along trail, all fresh tracks from this a.m.; every pocket of water was drunk dry. Actually, Jan had been on western rim at 0800 this morning during strong garua (garua from 0630-0930) and four animals recorded above were all out drinking from smoothed, flat rocks. (Pg. 13)
14 Dec 1970 – Jan will record weather and temperatures from Nest #14 today. Fausto and I are going to nesting Zones D and E and vicinity above to look for nests and perhaps implant other thermocouples. Altitude at nest #14, 1030 hr, 25 °C in Luftt case; 180 m.
Just below nest along trail found an adult ♀, unmarked; CL 61.5, CW 65.7. All smooth scutes, no lichens, algae, flaking disease, or white growth increments. At 0900 when we noted her, she was already in dense shade of Croton under lichens, totally inactive. Sun has only been out 1.25 hr and there is a cool breeze. Do not know if she ever was active this a.m. No sign of recent nesting or copulation. Altitude here is 163 m, 1100 hr, 29°C in Luftt case. She is still inactive in shade. Put an X on her last vertebral scute for identification later on. Checked all over this new zone where nest #13 and 14 are located but did not find any new nests. Also, complete lack of any new digging and sign of a ♀ limited to uppermost soil spot, above nest #14, where a ♀ appears to have passed by recently. Did find two more old nests, last year's or older, both had only egg shell fragments inside - looks as if probably even older than last year, as all young had left, no eggs remained, yet exit holes from young not visible at all. (Pg. 14)
Zone D – checking for new nests.
Nest #20 – relatively fresh, but very hard to detect externally; only 1 m away from nest #15, in complete open; moist soil all around eggs and hard cap slightly moist for about 75% of its thickness – rest of hard cap and surface entirely dry; I would guess that nest is 2-3 weeks old at

most. Certainly was not here on late Oct – early Nov trip and yet is not from just past few days. four eggs, all OK. All eggs in one layer with hard cap right down on top of them. Hard cap, as always here very crumbly and not nearly as durable as Santa Cruz. [Marginal note – nest shape very hard to adequately describe – appear to be just a big round hole with very little of an undercut.] Hard cap very large and about 14-15 cm thick and deepest point in center. Bottom of nest 21 cm deep in front under flask; as deep as it could be because of large plate-like rocks; rest of cavity could have been dug out more but was not. Eggs nearly filled cavity but could have gotten one more in on same level. No fecal material in nest but some in hard cap. Removed nest to have eggs for incubation period studies. (Pg. 15)

Nest #15 – checked it – all eggs OK, none hatching yet; yolk not visible now.

[Marginal Note: Two nests in same spot.] Nest #21 – laid right beside and partly on top of nest #16. The ♀ had made two other attempts nearby while en route to this spot, both times at old nest sites where big chunks of hard caps were still present. Not sure why but she abandoned these. Center of nest #21 only about 25 cm away from #16. In process ♀ broke two of the five eggs in nest #16 completely, poked a small hole in shell of another (2 mm diameter) which is OK inside (membrane intact) but may dry out, and slightly cracked shell of another egg superficially. Two broken ones full of some type of larvae and can not determine if were fertile. I uncovered and exposed both nest cavities from above and took photos Roll #235, #1-3 (KII).

In process she had moved and cast aside a large chunk of hard cap of Nest #16 and dug down through another part of it. In covering her nest re-covered one side of Nest #16 which she had uncovered. Nest #21 very large cavity and hard cap, and deep – eggs three, all in one layer on bottom at same depth as Nest #16; no rocks or other obstruction stopped her from digging deeper and thus must have been chosen or maximum depth (Pg. 16) for her legs. Could have put at least one and probably two more eggs in this one layer and easily others on top.

Used no feces in nest or hard cap. Nest very fresh, still moist all through hard cap save for top few centimeters and chunks of moist mud around eggs. Eggs all OK and full of yolk which can see when hold up to light. Hard cap sits right down on top of eggs.

Depth of loose soil on top of nest 1 cm; depth of hard cap (excluding loose soil above it) 20 cm; depth from soil surface to bottom of nest 28 cm; depth from soil surface to top of eggs 21.5 cm.

Area where nest laid is small soil patch surrounded by blocks, rocks, and boulders and could hold at most four nests if very evenly spaced. As it occurred, both ♀♀ laid in very center of the space, probably to allow themselves maximum digging room and ease and result was two nests at nearly same exact spot. There is one old nest here also, about 50 cm to side of these two nests, so at least it shows ♀♀ do not always pick very central spot to dig in this small patch. There is plenty of soil available elsewhere in the nesting area, but ♀ chose here. Certainly shows that they do not avoid each other's nests.

Nest #16 – three remaining ones developing – can't see yolk now; fourth one apparently exploded and was infertile – full of larvae; threw it out and re-covered nest. [Marginal note – plus two more 1969/70 nests – all young hatched and left.]

Nest #18 – did not open up, certainly not hatching yet because fresh on Oct trip.

Zone E –

Nest #19 - ditto to #18. No other nests in Zone E; but very fresh tracks and four attempted nest holes by a ♀ which passed through. Looks as if she moved off to S at same altitude around hill.

Altitude in Zone E at lower end (= upper end of Zone D) – 1600 hrs; 142 m, 29 °C in Luftt case.

Explored about 100 m to S of Zone E at same altitude and found much soil-covered area; soil better than Zone E; i.e. has pebbles, and very much like best parts of Zone D where most nests

are made. Very quickly noted three 1969/70 (Pg. 18) nests, all young hatched and gone and five holes (nest attempts), four seemed last years (full of sticks and debris), one fresh. Also noted two probable nests, but no time to check them. Almost certainly nests. No telling how much actual soil for nesting occurs here to S at same altitude and below to barranco. Will have to check later. One nest was laid (1969/70) in a position near boulder and shrubs so got only about five direct hr of sunlight each day, yet all young had hatched and left nest.
Checked Nests #9, 10, 11, 12 – no young had left any of them; opened the oldest one, nest #10 and all four eggs were OK and developing – no yolk visible in any of them. Found four fresh nest attempts in area of nest #10-12 and fresh ♀ tracks but no new nest. This now means that nests #9-21 all remain in natural cavities in field so that I can get incubation and escape data.
Located ♀ #12,100 in nesting Zone D in shade inactive; was here on Oct 1970 trip also. No visible sign of obvious recent nesting or mating. Could have laid because has old dry mud on rear feet, legs, tail area. Took a few photos of her in shade. (Pg. 19)
Weather notes for day: No garúa last night on this morning at all. Garúa strong yesterday afternoon from 1530-1715 here but none since. Do not know if was garúa in crater during these periods but probably was yesterday afternoon and little if any since.
0600–0800 – cloudy and cool, light breeze; sun jus up and shining on nest from 0740-0800.
0800-1000 – hot and sunny; very light breeze on and off.
1000-1200 – very hot and sunny; light breeze – almost no clouds – very thin ones off and on.
1200-1400 – hot. Some wind gusts; no clouds at all.
1400-1500 – ditto last two hr.
1500-1600 – sun out whole time; hot but cooler than earlier.
1600-1700 – sun out entire time but low in sky and nest surface cooling – sun hitting it at a slant.
1700-1800 - ditto last hour – cooling rapidly.
1800-2000 – clear night; almost no breeze and not very cool.
2000-2200 – still clear; almost no breeze
0600 – clear, sun not up; cool but no breeze.
Soil moisture readings.

		0800	1200	1600	2000
Nest	9 cm	nr	nr	nr	nr
	18 cm	nr	nr	nr	nr
Soil	9 cm	nr	nr	nr	nr
	18 cm	nr	nr	nr	nr

(Pg. 20)
Nest #14 temperatures from thermocouple in nest ° C 14-15 Dec 1970.

Position	0800	1000	1200	1400	1500	1600	1700	1800	2000	2200	0600
1	26.2	46.4	58.9	60.6	55.7	49.7	35.1	28.2	23.8	22.3	21.1
2	25.1	41.7	49.9	51.6	49.1	44.9	38.7	31.0	25.8	23.8	21.8
3	24.4	36.2	44.5	47.9	47.1	44.4	40.2	33.9	28.3	25.7	23.0
4	24.2	31.9	39.4	44.7	43.8	42.4	40.2	35.9	30.6	27.5	24.2
5	25.5	27.9	31.5	35.3	36.2	36.8	27.9	36.2	33.3	30.8	26.8
6	27.0	28.1	28.6	30.3	31.1	31.6	32.4	33.5	32.9	31.7	28.6
7	28.1	27.3	27.9	28.9	29.3	29.8	30.4	31.2	31.0	31.0	29.2
8	29.0	28.1	28.7	28.8	28.9	28.9	29.2	29.8	29.7	29.9	29.4

(Pg. 21) 15 Dec 1970 – to release site to survey young tortoises positions, conditions, etc.
En route found #12,056 – lying in a dust wallow near Steamboat Rock; had four feet resting on ground but was supporting weight on plastron. However had head out fully and stretched way up - completely stationary; two ♂♂ Geospiza fuliginosa were cleaning him; both working on lower neck from ground and also hopping on front feet checking for ticks. One eventually came around to rear and checked out tail and rear legs during ten minutes I watched. Apparently not many ticks as the finches mostly hopped about and looked in various places; they only picked off ticks a few times from lower neck area and found nothing on legs or tail – took some photos (some with finches some without) – Roll #235 - #12-18 more or less. Eventually I got too close and ♂ withdrew and finches left.
Tortoise survey at site:
#120 – 75 m S of release point in open, foraging.
#114 – at release site, eating vine I collected on 12 Dec. 1970 - in open.
#113 – 10 m W of release point eating Commelina - in open.
#110 – 7 m WSW of release point, walking along – defecating in open.
#116 – 14 m SW of release point in open, moving to W.
#115 – 30 m W of release point - coming out of burrow.
#119 – 10 m S of release point, in open, basking.
#117 – 30 m NNW of release point, emerging from burrow. (Pg. 22)
#126 – 30 m N of release point eating Commelina in an open area.
#129 – 60 m NE of release point eating Commelina in open.
#118 – 80 m NE of release point eating Commelina in open.
#111 – 45 m NW of release point walking in dense brush on edge of open area.
#121 – 50 m NW of release point moving in dense Prosopsis.
#123 – 55 m N of release point moving along in semi-open brush – not far from large pond.
#112 – 75 m NW of release point resting in semi-open, basking at edge of large dry pond.
#127 – 125 m N of release point, clear across large pond and beyond it a short ways entering nest pond area; moving along in blow down, once tall dead, dry grass.
#122 – 40 m WSW of release point – across small rocky pond and up into rocky area covered with dense Maytenus, Prosopsis, etc. – grinding along through this brush.
#125 - 100 m S of release point – in area where saw first on 12 Dec – in open eating Commelina. Saw tracks of one as far as 125 m to S coming back toward release point – perhaps tracks of #125 who is near-by.
Interesting that all animals but one (#122) are obviously moving mostly along and through open soil and plate-rock areas and avoiding jumbled rocky areas and slopes to W and thick brush which is scattered all through (Pg. 23) the area; they clearly are moving more or less N-S mainly with some side movements to E along these open soil covered planada which are rich in Commelina (especially) and other herbs now. Only #122 has moved out onto very densely brush-covered rocks to W.
All apparently healthy, and no sign of rats attacking them at all in spite of fresh rat sign in the area (a few owl kills, scat, food remains in pile under rocks. All eating well – have now seen them readily consume Commelina, fern, vine, red succulent, and fallen Opuntia parts here, the first being the clear favorite.
Have seen one defecate with ease and found several more fresh scat so are clearly having no problems in this respect. None seen urinating.

Cool and cloudy nearly entire time during our survey and all 18 we found either active or became active during survey (0800-1020 hr).
0930 hr – weather here – Max 74.5 °F; Min 62.0 °F; Rain 2.2 mm (emptied rain gauge and reset max-min).
Leaving for coast now (1030).
Roll #235 #l - last photo (#19) – bones near release site – another skeleton – looks like a large ♂ - very old and decayed.
Found another naturally dead one – a few years old at least – on W rim – a small one, probably ♀ - bones under a large boulder's overhang in shady spot – makes about (Pg. 24) seven natural deaths I know of for past decade more or less, two this year (see notes from J. Black and T. DeVries to be entered below. This excludes those skeletal remains (at least three animals) found in dry ponds area of upper crater where young tortoises were released. It is not known if these died naturally or were killed by men. Probably the former but not possible to say because all skeletal remains found here to date have been so broken up that decomposition renders such determinations impossible.
Note – 13 Dec 1970 – additional information – collected root hairs from eight small seedlings of Scalesia baurii in Langlet's solution for Dr. Heslop-Harrison of Kew Gardens at point where trail starts down into upper caldera on W rim at about 350 m elevation. Also collected two sheets of leaves, stems, and flowers of adult 1.5 m high shrub of same species growing above and near these seedlings. Also collected flowers and leaves of this same adult flowering specimen in FAA. (Pg. 25)
19 Jan 1970 – returned to Pinzon yesterday with Jan, Bennett, Bob Madden (ed. check these names), Sandy Van Kennen and Ivan Llerena today to nesting areas D and E, to check for new nests, and to examine old ones. Jan will take nest #14 temperatures all day today.
Zone D – opened nest #15 – all five eggs look OK - no hatching yet.
Opened nest #16-21 combination – in #21, all eggs OK and no hatching yet. In #15, one tortoise just hatching – has a very large yolk sac and obviously just coming out of egg (from egg with hole but intact membrane - see 14 Dec 1970 notes). One other egg OK, but no hatching yet. Third one (had crack in shell in Dec. due to ♀ interference) rotten and full of larvae; no embryo detectable at all.
Weight of this hatchling at hatching time 95 g (Centillon spring scale). Recovered all remaining eggs (three from Nest #21, one from #15) and left nest intact as before. Nest #20 – did not open but no obvious cases of tortoises escaping yet. Nest #17 – all eggs OK – perhaps infertile but can't tell yet; recovered.
Nest #18 – all eggs OK; no hatching yet; recovered.
Nest #19 – all eggs OK; not hatching yet; recovered.
Nests # 9, 11, 12 – no escapes yet; recovered; not sure if hatching yet, but (Pg. 26)
Probably not (see nest #10 below).
Nest #10 – one just beginning to hatch – upper one; other upper one infertile and full of larvae, discarded; two on bottom of nest (about half of egg diameter (i.e. 3 cm) lower than top two eggs) appear OK but not hatching. Left three in nest and kept out rotten one; re-covered nest.
Found another 1969/70 nest – six eggs, four hatched and escaped; one rotten and infertile; one dead in egg, third incubation stage. Hole right through "hard cap" – rather solid for Pinzon but not nearly as hard as on Santa Cruz.
Nests #13 and 14 - not opened; no sign of any escapes or anything similar. No tortoises or any recent sign seen in any of these areas covered today. Jan took temperatures in nest #14 during

most of day and then I continued until 1000 tonight. Hot and sunny at nest site from just before 0800 until l 1730 more or less – because cloudy about 1730 and remained so until after 10000; still cloudy next a.m. until about 0830 (Pg. 27)

Nest #14 Thermocouples; 19-20 Jan 1971.

Position	0800	1000	1200	1300	1400	1500	1600	1800	2000	2200	0600	0800
1	24.6	39.3	54.4	56.9	58.1	53.9	51.3	33.7	28.7	26.9	23.6	27.2
2	23.9	37.2	51.4	56.2	57.3	55.7	51.6	37.6	31.2	28.9	24.7	27.1
3	24.4	33.6	45.6	50.6	52.6	53.4	51.1	40.4	33.6	30.9	26.0	27.1
4	25.2	31.1	40.4	45.1	47.6	49.6	48.6	42.1	35.6	32.7	27.3	27.4
5	29.6	30.7	33.2	36.0	37.9	40.4	41.2	41.2	37.7	25.4	30.0	29.1
6	29.6	30.7	31.3	32.3	32.7	34.2	34.8	37.1	36.3	35.6	31.7	30.8
7	30.6	31.4	31.4	31.5	31.7	32.2	32.5	33.4	33.9	33.8	32.0	31.4
8	31.3	31.3	32.1	32.2	32.0	32.0	32.0	32.1	32.3	32.5	32.2	31.8

(Pg. 28)

Soil moisture readings

In nest:	0800	1200	1400	2000	0600
9 cm nr	nr	nr	nr	nr	
18 cm nr	nr	nr	nr	nr	

In Soil;

9 cm nr	nr	nr	nr	nr	
18 cm nr	nr	nr	nr	nr	

20 Jan 1971 – only moved camp today to inside crater.

21 Jan 1971 – to release area to map tortoises and reweigh and measure them. [Marginal note – see map.]

#125 – 75 m S of release point in open, moving along at 0900. Weight 7 lbs.; CL 30.7 cm; CW 31.3. Plenty of urine (concentrated amber type and moist scats released during handling; look very healthy. White growth increments moderately thick and growing well.

#102 (intended to be #120) – grazing on Commelina in open 50 m SSE of release point. Weight 5.5 lbs; CL 28.6; CW 28.7; white growth increments as in previous animal. Also released a bit of amber colored, concentrated urine.

(Pg. 29) #110 – 30 m WSW of release point in open moving toward edge of small pond. Weight 10.125 lb; CL 35.1; CW 33.7; white growth increments as in previous two animals.

#115 – Weight 8.875 lb; CL 37.7; CW 33.6; white growth increments as in previous animals. 30 m W of release point near pond edge, in brush sleeping in burrow.

#116 – Weight 8.625 lb; CL 32.9; CW 33.1; white growth increments clear but a bit less thick than in previous animals. Same area as #115 but a bit N of it - about 25 m from release point.

#119 – Weight 9.375; CL 35.7; CW 34.6; white growth increments very thin and not as well developed as in all above ones; 5 m NW of release point in open walking around.

#117 – weight 8.875 lb; CL 35.0; CW 34.3; at release point, aggressing #113. White growth increments as in #119.

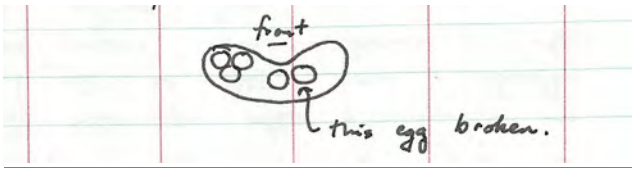
#113 – weight 9.875 lb; CL 35.9; CW 36.0. At release site; eating Commelina and aggressing #117. In open. These animals in an area about 40 m N of release point, semi-open brushy area.

#126 – weight 6.875 lb; CL 31.7; CW 37.7. White growth increments fairly thick, clear on plastron but almost non-existent on carapace. (Pg. 30)

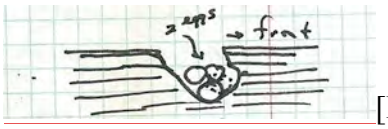
#123 – weight 11.625 lb; CL 38.4; CW 39.0; white growth increments clear and well developed as in #125. In shade, in a dense brushy area at S edge of largest pond, 75 m N of release point. [Marginal note – near open soil areas.]
#114 – weight 9 lb; CL 35.0; CW 35.3. Under an Alternathera bush on S edge of large pond, 85 m N of release point; in shade. [Marginal note: near open soil areas.]
#127 – weight 8 lb; CL 31.6; CW 32.4; white growth increments clear and thick and most well developed have seen yet. Clear across large pond and only about 70 m E of where least saw on previous trip – several burrows, scats, and lots of trails around area where was in Dec and where now is – obviously using this area and growing very well.
#111 – weight 8.5 lb; CL 32.3; CW 33.2. On central E side of large pond on its border; in shade out of sun; has been crawling around in pond itself.
Found no more tortoises than these 14 but a recovery of 70% is (Pg. 31) actually very good. Main problem was that searched from 0830 to 1300 and last 2.5 hr was very sunny and increasingly hot; between 1030-1130 all 14 of those discovered sought shade and became inactive in burrows. It was precisely the areas to NE, E, and SE of release point which were searched from 1100 until 1300 and in these same areas found no tortoises. Fresh tracks in soil spots in these areas extended out to 89-100 m from release point so am sure that at least half of six undiscovered young are in fact in these areas. The fact they were not seen is probably due mainly to fact that young had burrowed in; and, these areas, though containing scattered patches of open soil throughout with herbs such as Commelina (still in abundance), have abundance of dense shrubs (Maytenus, Alternathera, Prosopsis) such that well-hidden burrows are abundant and it is impossible to search all of them. The difficulty in detecting the other 14, once burrowed, lends credibility to this explanation. In fact, the main reason I was able to keep (Pg. 32) tabs on these 14 and know where they burrowed was due to aid of Jan, Bob Madden, and Sandy Van Kennen all helping watch their activities.
Overall distribution: in addition to 14 seen and their actual locations, took note of tracks, burrows, and droppings. Most notable overall fact is that they have moved only a small total distance further from release point after 1.5 months than had in four days after release in December 1970. Greatest distance moved that could be detected is 150 m from release point to N (on to other side large pond). The animal in this area is #127 and he has in fact only moved a total of 25 m further out to N from release point in total from where he was when last saw him four days after release in Dec 1970. Most tortoises are still quite close to original release area.
Conditions in the area: found availability in the area reflects present (Pg. 33) extent of distribution of young; excluding area to W (rocky, barrancos, dense vegetation and no soil) of release point, small herbs and fallen Opuntia parts become progressively less available from about 100 m more less out from release point as one approaches the latter. In immediate area of about 40 m around release point most of Portulaca is gone or at least only stems remain (leaves eaten already), Commelina leaves all mostly gone and much of Commelina stems have also been eaten, and Opuntia fruits, flowers, and palatable pads have all but disappeared. Beyond these areas where tortoises are still concentrated these plants are again abundant and show no signs of grazing. There is still food available in central area of concentration, but much less than when tortoises were released in Dec 1970, so they clearly have been feasting on these. Remarkable weight and size gains in most of 13 out of 14 young found (over past 1.5 months) is probably due to the foraging on available herbs and Opuntia combined with some rainfall and lots of sunshine. Amount of rainfall is hard (Pg. 34) to judge accurately but at 1000 hr today total rainfall since 15 Dec was 7 mm, Max temperature 80 °F; Min temperature 60 °F. Since this is a 6 in maximum capacity open

topped Taylor clear-vu rain gauge some and probably substantial evaporation has occurred from it; probably rainfall may have been twice as much in actuality. Anyway, the area is certainly not a wet one, but some drinking water has certainly been available to young during past 40 days, at least once in awhile.
The Commelina and Portulaca remaining clearly indicate that area as a whole has dried somewhat since Dec release period because these plants are not as moist as before and are starting to show some wilting and drying. Real test of tortoises' ability to survive here will be over next four months, especially if there are not any heavy rains during this hot season.
Another interesting potential phenomenon is the fact that as plants dry and food becomes more scarce from drought and consumption by tortoises (assuming no heavy rains) the young may move further and further away from release point in search of food and or water.
Tortoises are clearly already reacting to more stringent moisture availability conditions on Pinzon because urine is concentrated, viscous, and amber in color now, whereas at CDRS was clear, very fluid, and abundant. Saw a few animals grazing today, all on Commelina. Examined a lot of droppings, dried and fresh ones and found remains in them to be mostly herb stems and leaf parts (veins, etc.) and fragments of Opuntia parts. Most young began activity between 0800 – 0900 hr before sun was out and sought shade from sun between 1030-1130 hr. (Pg. 36)
22 Jan 1971 – to Nesting Zones C, B, A to check for nests and hunt for tortoises.
Nesting Zone C –
#12,043 ♀ - under a bush sleeping at 0800 hr; same area where was on Oct 1970 trip. No sign of recent copulations or nesting. White growth increments very thin but clear.
#12,046 ♂ - same general area; CL 80.5; CW 75.4; no flaking disease; smooth all over carapace; bits of "painted-on" type lichen (pale grey-green) on front marginals; light green algae or lichens scattered all over, especially in grooves between scutes; in openish area in bushes, eating Croton stems. Fresh droppings full of sticks, stems and leaf parts. White growth increments very thin but clear.
#12,032 ♀ - 75% of way down to Zone B Nesting Area – about 100-150 m above it; resting in shade under a Maytenus; white growth increments moderately thick.
#12,033 ♀ - upper end of Zone B, actually 40 m above it; resting in a rock cave; white growth increments clear and as in previous animals. No sign of mating or nesting either of these ♀♀. (Pg. 37)
Nest #22 – upper end of Zone B; 3 cm loose soil on top; 17 cm to top of uppermost eggs from surface; 28 cm to bottom of lowest eggs from surface. Nest a small hole, only slight flask; five eggs, nearly full; could possible squeeze one more egg in on same layer as five; two eggs at very bottom of nest, three above these about 2.5-3 cm sitting up against them and walls of nest, i.e. wedged in; thus not really two layers. All eggs appear OK; nest older because all dry inside and eggs all obscure. Marked two bottom eggs differentially to see which hatch first; will complete this marking at CDRS during weighing/measuring. Tortoise feces in hard cap, but none in nest. Hard cap about 14 cm deep, right down on top of eggs; loose soil and mostly clods filled in all around eggs – was mud, now soil chunks. ♀ could not dig deeper than 28 cm because flat plate rock in bottom of nest. Eggs (five) to CDRS.
Nest #23 – upper end of Zone B – old, dry, but this year's nest; small hole, about 25 cm deep with normal large hard cap full of tortoise droppings; no eggs at all! Very strange but can not explain why; nest cavity seems (Pg. 38) adequate for three or four eggs in one layer but none laid.
Nest #24 – very strange nest; huge kidney shaped one;

[Diagram of eggs (one broken) in kidney-shaped nest to be scanned later].



No obvious reason for shape and apparently one nest because hard cap all one huge piece covering nest. Hard cap has a lot of feces in it but none in nest. Easily could have held more eggs at one level. Very fresh and moist, at most a few days to one week old I would guess; eggs all full of yolk and no embryos visible yet. [Marginal note - Hard cap very moist and very durable.]
Five eggs, placed as shown above; ♀ apparently had trouble because she broke one egg open in laying (small hole, probably done by foot) and it was nearest to surface, being only 9 cm down; hole full of lots of mud clods as if she knocked many in hole before laying eggs. [Marginal note – one broken egg had no sign of an embryo.] Other four eggs (tops) about 15.5 cm (Pg. 39) down from soil surface; "bottom" of nest being 21.5-22 cm from soil surface. I say "bottom" because she had obviously dug much deeper and then filled in or knocked in a lot of dirt clods into hole before laying eggs. Left eggs for future checking and marked nest.
Nesting Zone A – small zone where found two nests, etc. in Oct 1970 – (just before Zone A proper) – no new nests and no sign of nesting attempts recently. Zone A proper: no tortoise sign of recent two to three months anywhere. Not much new digging; only one new nest, in fact could be from previous period (prior to early Nov) because did not look in exactly this spot before.
Nest #25 – old and dry; age unknown; eggs all look OK and are obscure and dark; one has lost about 20% shell but membrane is still intact and nest otherwise looks OK. Four eggs; not all in one layer; two on bottom, two completely in upper layer on top of these; side view of nest –



[Diagram to be scanned later].

[Marginal note- No rocks or other obstructions at bottom of nest as ♀ must have dug as deep as she "desired" or was able to dig.] Soil on top of hard cap 1.5 cm deep; hard cap 13 cm deep (right down on top of eggs); bottom of nest and lower eggs 27.5 cm. (Pg. 40) Nest small and full of eggs on these 2 levels because of slant and shape. Feces in hard cap but none in nest. Eggs to CDRS.
23 Jan 1971 – to small tortoise release area to check weather instruments – [Marginal note – Tortoises seen on way down - #12,078 ♀, #12,060 ♀, #12,049♀ - all in open area on W rim where usually see several animals; i.e. just before trail descends into upper crater.]
0800 hr – Rain 0.0 mm; Max 78 °F; Min 64 °F. Looked all over are to E of release site and found same as on 21 Jan; tracks (fresh) of a few small ones but no new ones found. Probably still in burrows because of eight of ones seen nearer to release site on 21 Jan and seen again this morning between 080-0900, six were still burrowed in and found with great difficulty. Then to coast to bath, refresh, drink lots of water and wait for boat tomorrow. (Pg. 41)
12 Feb 1971 – to Pinzon to continue checking nest. To first upper camp site at 1000. Dagmar Werner and Camilo Calapucha here studying Tropidurus. She checked nests #12 and 14 on 6 and 7 Feb when arrived here and no exit holes at that time. Today, large exit hole in nest #13; five young escaped; three gone, two were attacked (together probably) just a few cm from hole and

eaten by rats. [Marginal note – so, emerged at night ?] 100% fertility because three more small carcasses found buried in soil inside, rotting; egg shell indicated these three had hatched out and died either during hatching process or soon after – all three lying in egg shells under much loose soil. [Marginal note – probably buried in rubble by escape of first five others resulting in entombment.] These three were bottom-most eggs under nest –flask overhang; five upper eggs all hatched and escaped possibly three together, then two more. Hole indicates two or three could have dug out together; no rat droppings in hole, and hole small for a rat to enter so does not appear they ever actually entered nest. (Pg. 42)
Nest #14 – with instruments; very small exit hole, size of one tortoise at maximum to one side of nest but through hard cap; will wait to excavate nest until after I take temperatures tomorrow and following morning.
Zones D and E and near nests –
Nest #15 – all five hatched and escaped; "hard cap" soft relatively. [Marginal note – opening size of one tortoise plus through hole.]
Nest #16 – other tortoise egg remaining hatched and young is trapped under pile of rubble and loose soil created by ♀ which laid nest #21; obviously would never have escaped and probably one taken to CDRS from this nest on last trip would have been topped by loose soil also. This one still lying in half of egg shell and in poor condition; mud has closed eyes; rear legs and umbilical area covered with mite-like parasites which are slowly eating him up. Will clean it, but very unlikely that it will live. [Marginal note – 17 Feb 1971, died at CDRS too; badly dehydrated and starved.] (Pg. 43)
Nest #17 – all three hatched but all died trying to escape nest. [Marginal note – probably cooked trying to escape because caught near top of nest.] Hard cap extremely durable for Pinzon and simply could not get through it. Related factor is that each one was digging out separately. One had reached point 5 cm from surface and became wedged in a crack in hard cap and died. Another was a bit below and to side of this one and also unable to penetrate hard cap and died; third still in half of egg shell, dead and never moved from hatching site as did first two. Nest #18 – all three hatched and escaped; hard cap as in Nest #15, gravelly and dry and loose – easy to penetrate. Opening the size of one tortoise and straight up through hard cap. Nest #20 – four eggs all there and all OK – feel (seem?) in good condition. Will take to CDRS; marked upper two as I, II, lower two as III, IV to see if hatching times differ. Certainly any hatching would escape because (Pg. 44) hard cap as in Nest #15 which is immediately beside this nest.
Nest #21 – three eggs all OK; to CDRS; young would probably escape this nest also because soil of hard cap is firm but easy to cut through with creating excessive rubble and loose soil.
Nest #19 – two eggs OK; to CDRS if hatched in field no doubt would escape because soil here is gravelly, not mud-forming type, extremely loose and easy to move.
Three other nests in Zone E - all missed previously. [Marginal note – These three nests in yellow-brown soil which forms well-structured hard cap and thus leaves a small air space over eggs toward end of incubation.]
Nest #26 – one dead in third incubation stage; three hatched and escaped; small hole large enough for one tortoise right out through hard cap, directly up.
Nest #27 – four hatched and escaped; two hatched and trapped inside; one only a few cm below surface; another 8-10 cm down; embedded (Pg. 45) in loose soil; probable cause, overheated while trying to dig out, at least in case of upper one; other one just above eggs and perhaps died due to exertion or starvation when could not escape. Hole large (two or three tortoises could pass though it at once) and to side but through loose, dry, but well-formed hard cap.

Nest #28 – four hatched; all escaped; nest and hole and hard cap as in Nest #27 – only a few meters apart.
Nest #9 – all four hatched and escaped through a small hole up through hard cap.
Nest #10 – three remaining eggs all hatched – of four only two escaped as in Nest #9 through a hole in hard cap; two trapped inside and at about 8-10 cm. Nest #12 – all four hatched and escaped as in previous nest.
Nest #11 – all four eggs still in nest – appear OK but none have hatched – to CDRS. If hatched in nest probably would escape.
Interesting that very high fertility and hatching % for these nests but many tortoises trapped in nest and died by overheating during escape – more on this later. (Pg. 46)
13 Feb 1971 – taking temperatures all day at Nest #14. Hot and sunny all day; sun began hitting top of nest at about 0745 hr and became shaded finally at 1745 hr when dropped low enough in sky again so that rays too angular to hit nest surface. Very hot day, breeze only light and very intermittent.
Soil moisture reading –

Depth	Times			
Nest	0800	1200	1800	0600
9 cm	nr	nr	nr	nr
18 cm	nr	nr	nr	nr
Soil				
9 cm	nr	nr	nr	nr
18 cm	nr	nr	nr	nr

Temperature in nest #14; 13-114 Feb 1971

Position	0800	1000	1200	1400	1600	1800	2000	2200	0600
1	27.8	47.4	60.0	57.0	49.8	35.0	26.3	23.7	22.4
2	25.1	43.1	57.2	60.0	53.8	42.1	31.1	27.0	24.2
3	24.7	36.8	49.6	55.8	53.5	45.1	34.1	29.4	25.8
4	25.4	32.3	43.2	50.8	51.2	45.2	36.9	31.8	27.4
5	28.6	28.8	34.9	40.7	44.2	43.9	39.9	35.7	30.6
6	31.9	29.8	32.6	25.3	28.0	29.2	28.5	36.5	33.0
7	32.5	33.0	33.2	34.4	35.4	35.8	36.3	35.1	33.9
8	33.9	33.9	24.1	34.1	34.2	34.2	34.3	34.1	34.1

(Pg. 48)
14 Feb 1971 – after taking 0600 nest temperatures; opened Nest #14 for examination. Found it had contained seven eggs; two on top layer as noted on day of implantation of thermocouples; both of these had hatched and escaped through loose soil to one side of hard cap, thus accounting for small exit hole discovered on 12 Feb 1971.
In next layer were four eggs, three appear OK and will take to CDRS; other one has been completely hollowed out by beetle larvae so was either infertile or died during early stage of development. On very bottom of nest one more egg; I accidentally broke it open in removing soil which was tightly packed around it. Very well-formed and live young tortoise inside but yolk sac about 2-3 X size it usually is when hatch. Will try to get him back to CDRS alive but will be difficult. [Marginal note – 18 Feb 1971, obviously won't live because yolk sac ruptured – chloroformed it and gave brain to D. Werner for D. G. Senn.] It is thus interesting that top three eggs which obviously were receiving more heat because (Pg. 49) of their position in the nest cavity hatched and already dug out, whereas bottom four (three in one layer, one on bottom had not

hatched yet. This would be expected but this offers proof. Hard cap was well-formed and unusually durable for Pinzon nests in this nest, and therefore is notable that two hatchlings were able to escape unaided by any siblings. Three in second layer would probably have escaped naturally after hatching but bottom egg probably would have thatched and hatchling been trapped because egg was crammed into very well hardened dry mud of original nest; escape for it would have been very unlikely.
To upper open area on W rim – en route - #12,091 ♀, at first pile of rocks at very top of steepest incline on trail. Exploring open area of W rim where trail begins decent to upper crater - #12050 ♂ in deep shade in rocky area only 30 m from where last seen. #12,060 ♀ - same ; about 75 m uphill from where last seen. #12,078 ♀, under exact same overhanging rock on top of rim on W side, where saw in mid-Jan 1971 trip. Also in dense shade. (Pg. 50)
#12,049 or 69 – 30 m down toward barranco from where saw last month; sleeping in shade. (Pg 51)
15 Feb 1971 – checking small tortoises in release area.
#125 – still sleeping in a hole in open area, at 0800, 120 m SSE of release point; weight 7.25 lb; CL 31.2; CW 32.0. Cloacal temperature 24.1 °C at 0810; white growth increments clear and very thick.
#102 – 50 m SE of release point in open; still burrowed at 0815; cloacal temperature 25 °C; weight 5.375 lbs; CL 29.0; CW 29.0; white growth increments clear, medium thick.
#129 – 75 m ESE of release point; just active in an open soil site; cloacal temperature 24.2 °C; weight 12.125 lb; CL 38.6; CW 27.8; white growth increments clear and medium below; very slight only on carapace.
#117 – 30 m SSW of release point; still burrowed in hole in open at 0845; sun out off and on last 20 minutes. Cloacal temperature 25.6 °C; weight 9.5 lb; CL 35.3; CW 35.0; white growth increments clear but thinnish.
#113 – 15 m SW of release point; moving into brush from an open spot; foraging cloacal temperature 25.0 °C; weight 10.625 lb; CL 36.5; CW 36.7; white growth increments clear and thickish.
#116 – 5 m NW of release point moving in open at 0900; cloacal temperature 27.1 °C; weight 8 .625 lb; CL 33.5; CW 34.0; white growth increments clear and medium thick. (Pg. 52)
#123 – active in open 15 m NW of release point; cloacal temperature 26 °C; weight 11.75 lb; CL 38.7; CW 39.5; white growth increments clear but medium thin.
#126 – sitting in semi-open sun, in open area, 10 m N of release point; basking (0900); cloacal temperature 27 °C; CL 32.0; CW 33.8; weight 7.625 lb; white growth increments thin but very clear.
#119 – sitting in burrow still at 0915; 10 m N of release point; but in partial sun. Cloacal temperature 25.5 °C; weight 8.75 lb; CL 36.0; CW 34.7. White growth increments clear and medium thickness.
#118 – 75 m ENE of release point – sitting in shade of an Opuntia at 0945; sun out and hot since 0900; weight 8.5 lb; CL 33.4; CW 33.5; white growth increments clear and moderately thick. ENE of release point where was sign last trip.
#110 – in sun at 1000, eating fallen Opuntia joint and pad in open 40 m WSW of release point; cloacal temperature 32.3 °C; weight 10 lb; CL 35.5; CW 37.2; white growth increments clear and moderately thick.

#115 – in shade of a large boulder 45 m WSW of release point near a dry pond at 1015; cloacal temperature 30.2 °C; weight 9.5 lb; CL 34.2; CW 34.1; white growth increments clear but rather thin. (Pg. 53)
#114 – in dense shade at 1030, 85 m N of release point on S edge of pond. Cloacal temperature 31.6 °C; weight 8.75 lb; CL 35.2; CW 35.4; white growth increments very, very thin and intermittent.
#111 – cloacal temperature 29.6°C; weight 8.125 lb; CL 32.6; CW 34.0; white growth increments clear and moderately thick; 100 m NNE of release point beyond E side of large dry pond; in dense shade of an Alternathera bush as was #114.
#112 – in shade in pond at base of large barranco on W of area. Weight 13.625 lb; CL 39.5; CW 39.7; his sign is all over pond area: droppings, trails, beds. White growth increments clear and thick; pond dry and most vegetation dry but still a lot of green grass shoots and herbs for one tortoise.
#127 – could not locate him but are still some recent trails in area where he was found on Jan 1971 trip; he has probably moved beyond here a bit to the NE into more brushy area because some fresh trails there are in small open soil patches, but I can not locate him as it is late morning and sun is hot and high. Thus located 15 of 20 released tortoises today; 13 of these found on Jan 1971 search two others not seen since release in Dec but (Pg. 54) located today.
General conditions, at 1200 hr, took weather: 80 °F Max temperature, 63 °F Min; no rainfall in gauge but clear evaporation has (scum collected on sides of tube) from 3 mm on down, so this is probably a good estimate. Noticeably drier than on Jan 71 trip just a little under 1 month ago. In central area occupied by tortoises they have literally stripped all leaves from Commelina plants and eaten virtually all fallen Opuntia fruits and flowers; Commelina stems remain but they are noticeably more wilted now than in Jan, although still green and somewhat moist. Beyond main area of occupation, there are leafy Commelina plants in same abundance as at release time in December 1970, but these are now more wilted than they (Pg. 55) were in Jan. However, this common herb and favorite tortoise forage has not yet dried enough to begin turning brown. Degree of abundance and grazed condition of Commelina actually slowly drops off as move out from centrally occupied tortoise area into surrounding open areas where tortoises are fewer in number.
Opuntia fruits, flowers and pads are still falling in some abundance and tortoises are greedily consuming them in centrally occupied area, and to a lesser extent as one moves out from this area. Saw two tortoises eating fallen, very fresh, moderately spiny Opuntia pads. Were eating entire pads and seemed to have no problem with abundant small stiff spines. Another one was eating the very moist, fleshy joint of an Opuntia which had fallen; this had almost no spines but tortoise had to penetrate a thin, hard outer reddish-brown bark to reach fleshy meat; no apparent difficulty in doing so. (Pg. 56) No tortoises urinated at all while being handled; this is probably due to lack of almost any water in the area in past month.
Hawks: saw an adult hawk fly down on three separate occasions and land within a few dozen centimeters of a small tortoise in the release area (three different tortoises). In each case, hawk was clearly very curious and a bit unsure of itself with the tortoises. As hawk flew down and just as it landed in each case, the tortoise rapidly withdrew with a loud hiss and sat still on its plastron with the head and legs fully drawn inside. Hawk then sat looking at tortoise from about 30-50 cm away for a period of three to eight minutes in each case. Hawk tried various behaviors in investigating tortoise: 1) occasionally (Pg. 57) would bend over and look under carapace. 2)

occasionally would move with a slight half jump toward tortoise; 3) occasionally would reach out with one foot and rack claws over carapace on top or in front with a "fist-closing" motion. Rarely tortoise would begin to extend its head and then retract it a bit with a hiss, then perhaps re-extend it a bit, etc. In response, hawk would hunch forward a bit, spread wings out a short ways from body and back up half-step or so as if a bit afraid, or perhaps a fear – threat combination type response. See photos Roll #267.
Eventually hawk flew away to a nearby Opuntia in each case and sat looking at non-moving tortoise for awhile (a few minutes in each case), then flew away. Very probable that a hawk would easily and quickly take a hatchling tortoise and probably even one up to two to three years old with relative ease. (Pg 58)
9 May 1971 – returned to Pinzon this morning with Jan and Bennett, meeting Peter Kramer and Fausto Llerena who were already here since 5 May. Spent day ferrying food, water, and equipment to campsite inside old, upper crater. Surveyed situation en route and in old crater. Obviously was a tremendous volume of plant growth here in March and April following heavy rains of first two weeks of March; bare soil is now hard to find where it was so common before. Everywhere there is a dense cover of grasses and herbs on ground. These however have begun drying out already and most grass is dead and dry or drying and only faintly still green; many herbs, such as Portulaca are dead or dying, whereas others are green still and flowering. For a while tortoises obviously had lush vegetation everywhere to eat and still is comparatively lush. Standing water was probably present for only a short time; dry pond areas show only that was water for awhile, especially in small muddy pockets, but must have evaporated in at most a couple of weeks. Old muddy burrows are still evident in all adult tortoise inhabited areas. (Pg. 59)
10 May 1971 – checking small young released tortoises in 1965/66 class. See accompanying map. 0830 hr – cloudy until now and remaining so, very strong cool breeze. Air temperature at 10 cm – 22.5 °C; soil surface in open 29.0 °C; all temperatures below of tortoises with a Schultheis; same for environment. Temperatures above 50 °C with a 0 – 100 °C standard mercury thermometer.
#116 – 0830 hr; still in soil depression burrow in open, situated so that side to wind is well protected. Cloacal temperature 26.5 °C; just now becoming active. CL 35.1 cm; CW 35.9 cm; weight 10.75 lb; white growth increments extremely thick; really growing well; 5 m WSW of release point.
#110 – 0845 hr; still in soil burrow in grass, in open; not well protected from wind. Cloacal temperature 24.6 °C; CL 36.9; CW 38.9; weight 12.625 lb; 15 m WNW of release point; white growth increments clear and well developed and thick.
#115 – 0900; still in burrow in dense grass, near a bush and in a depression; well protected from wind. 35 m W of release point near pond edge. CL 36.1; CW 36.0; weight 10.75 lb; cloacal temperature 26.2 °C.
#117 – 0910, walking in open 55-60 m SE of release point; white growth increments thick (very) and clear. Just out of burrow and beginning to bask. CL 36.6; CW 36.3; weight 10.75 lb; cloacal temperature ?; burrow like #116.
#125 – 0920, just out of burrow and lying in open trying to bask; burrow in open and like #116 and #117. CL 33.5; CW 34.6; weight 9.125; cloacal temperature 27.3 °C. First of all of first 5 found which had a tick, largish one on forelegs of common type. 120 m SSE of release point. (Pg. 60)
#113 – active in open at 0930 hr; 15 m ESE of release point; no ticks; CL 38.3 cm; CW 38.6 cm; weight 12.5 lb; cloacal temperature 27.9 °C; white growth increments clear and very thick.
#119 – 55-60 m E of release point – in open walking CL 36.7 cm; CW 35.8 cm; weight 10.75 lb; no ticks; weight growth increments clear and thick.

1000 hr – sun just out for last ten min; weak radiation before that from 0910-0950 hr. Air temperature at 10 cm 2.65 °C; soil surface in open 36.8 ° C.
#118 – grazing in open on Commelina at 1000 hr; cloacal temperature 29.6 °C; CL 35.1; CW 35.7; weight 10.5 lb; white growth increments clear and thick (very). No ticks. 40 m NE of release point.
#126 – 25 m N of release point; grazing in semi-open on Commelina at 1015. Cloacal temperature 30.5 °C; CL 33.7; CW 35.5; weight 8.56 lb; no ticks; white growth increments clear and thick.
#121 – grazing in partial shade at 1020 hr, 40 m NNW of release point at 1020. CL 34.9; CW 35.5; weight 9.25 lb; cloacal temperature 29.6 °C; no ticks; weight growth increments are very thick.
#123 – walking in open, 40 m NW of release point at 1025 hr; cloacal temperature ?; CL 40.3; CW 41.3; weight 14.25 lb; white growth increments very thick; no ticks. (Pg. 61)
1100 – air temperature at 10 cm 27.8 °C, very little breeze; soil surface 38.2 °C
#128 – in shade resting at 1040 hr; Jan found him 35 m from here in burrow at 0850 hr and was just leaving it; has moved into dry pond below barranco. Cloacal temperature 31.0 °C; CL 35.0 cm; CW 34.9 cm; weight 10 lb; white growth increments thick; no ticks.
#122 – in shade on E edge of pond below barranco; 1050 hr; Jan found it at 0845 in burrow; since left, grazed and now entered shade 3 m from burrow site. Cloacal temperature 32.0 °C; weight 9.875 lb; CL 34.6 cm; CW 35.0 cm; no ticks; white growth increments thick (very).
#112 – in pond near barranco; grazing in shade at 1105 hr; Jan found at 0840 in burrow in cave here. CL 41.6 cm; CW 41.9 cm; weight 15.25 lb; cloacal temperature 30.0 °C; no ticks; white growth increments very thick.
#114 – 85 m N of release point in dense shade of Alternathera (a furrow) at 1115. Jan saw in a burrow near here at 0900; CL 36.2 cm; CW 37.0 cm; weight 12 lb; see photos – #8-12 Roll #302 of shade burrow; cloacal temperature 30.8 °C; white growth increments very thick; no ticks.
#111 – moving into shade of dense brush at 1120 hr on N side of large pond; was burrowed 10 m from here this a.m. at 0845 hr. Cloacal temperature 31.3 °C; weight 10.69 lb; CL 343.8 cm; CW36.4 cm. No ticks; white growth increments thick.
#127 – in shade (dense) at 1140 – 225 m N of release point and 75 m beyond where last seen. Fausto found him in this area at 0915, in burrow still. CL 32.6 °C; CL 34.8 cm; CW 36.2 cm; weight 10.75 lb; white growth increments clear and thick; no ticks.
1200 – air temperature at 10 cm 28.4 °C (almost no breeze); soil surface 41.3 °C. (Pg. 62)
1200 – strong sunlight out only until about 1030; since then warming continually but all through weaker radiation coming through thin clouds; occasionally a very short period of seconds to a few minutes of clear strong sun. Note: remained cloudy and cool with off-on strong breeze rest of day after 1200.
#124 – sitting in shade in semi-open at 1235 hr; Fausto found active 25 m from here at 1045 hr. CL 35.3 cm; CW 36.6 cm; weight 11.125 lb; cloacal temperature 32.4 °C; no ticks; white growth increments clear and thick. 120 m E of release point in fairly dense Croton - Opuntia stand. Abundant beds, burrows, old droppings all around this area for a "circle" of some 35 m. Virtually all tortoises were in shade, resting and sleeping by 1100-1130 hr.
1300 – breeze strong; air temperature at 10 cm – 26.5 °C; soil surface 43.1 °C.
Checked ten tortoises nearest me between 1300-1315 hr; all in shade resting. Examined many droppings in area, very fresh and recent ones; all full of grasses and herb remains; major amounts of Opuntia pads, fruits, bark eaten now and remaining in stool are obvious especially pads and

fruits (flowering virtually completed and finished). Saw #116 devour a fallen Opuntia pad from an adult tree – ate all of it, inside, outside and hairs. (Pg. 63)
Temperatures and associated activities taken after survey period.
#128 – back into open and active from shaded cave at barranco pond at 1345 hr (cool and cloudy now) – cloacal temperature just at emergence was 32.0 °C. Went up trail 8 m and burrowed into soil (protected from wind by a rock) at 1405 hr. Cloacal temperature same.
1400 – air temperature at 10 cm 26.8 ° C; light breeze, soil surface 35.6 °C (burrow in pond area); soil surface 38.1 ˚C (open fields near release point).
1500 – air temperature at 10 cm 25.0 °C; soil surface 32.1 °C (barranco pond area); soil surface 36.3 ˚C (open fields near release point).
#112 – moved out of shade burrow and into soil depression night burrow between pond. 1410-1420 hr grazing a bit in between (two burrows are 1 m apart) – cloacal temperature upon burrowing 32.9 °C; soil surface in burrow site 34.9 °C. Just after 1500, cloacal temperature 32.2 °C; soil surface beneath him 32.3 °C.
Just after re-examining #112 I went out into open area around release point and checked on a number of tortoises there between 1510 and 1530 hr.
Found #113, 115, 116 all walking about in open, 1-2 dm size dry grass.
#123 – grazing on an unknown herb (will collect).
#126 grazing on Xanthoxylum leaves of a low green bush, standing way up on forelegs to do so and stretch neck way up.
#110 – apparently just burrowed in recently into a soil depression surrounded by grass, moderately well protected from wind but not as well as #128 and 112 which are virtually completely out of the wind. At 1530 hr, cloacal temperature 32.7 °C; soil surface around him 35.7 °C. (Pg. 64)
1530 hr: activities same but #113, 116 trying to bask now, lying in open in grass (matted down dead stuff) - (#110 in effect gaining any heat from solar radiation which is available also but solar radiation is very weak now).
Just spotted #121 in a deep depression with dead grass all around sides and even some over him – no wind at all virtually passing by him – down about 2cm into soil. Cloacal temperature 33.8 °C.
1600 – air temperature at 10 cm – 23.3 °C, strong steady breeze.; soil surface in green field near release point – 32.4 °C.
Just at this time #113 and 116 are burrowing in; both in open field but into nice deep soil depressions with dead grass all around tops; both well protected from wind.
#113 – cloacal temperature at burrowing 32.8 °C stopped basking and entered burrow.
#116 – did same; cloacal temperature 32.1 °C.
#115 – after a 40 m winding track during which (1605) ate some green grass shoots and herbs, settled down about 0.5 m from where burrowed last night; another very well protected burrow site – 1.5-2 cm into loose dry soil and covered all around and on top even by dry dense grass. Cloacal temperature 30.8 °C. (Pg. 65)
123 and 126 still grazing ; #126 devouring a fallen "adult" Opuntia pad with great gusto.
1600 hr– apparently I misjudged #110, was basking or became dissatisfied with burrow site. Moved to another more protected burrow nearby with deeper depression and dry grass all around it. Better protection against wind. Cloacal temperature still nearly same 32.5 °C. Still poorest site of seven which have burrowed.
Of all the above, only #113 seemed disturbed by handling and taking cloacal temperatures with Schultheis; all others remained in burrow sites after having temperature taken; #113 moved 30 m after handling and burrowed in again immediately in a deep well-protected depression.

1700 hr – air at 10 cm 22.4 °C; strong wind; soil surface in open at release point field 28.0°C. Just before 1700 hr #123 moved across field and burrowed into a very well protected (no wind) site just about 1700 hr (1-2 min before). Cloacal temperature 30.8 °C. #126 still eating cactus.
1725-32 hr - #126 moved 10 m and burrowed into a soil site with dry grass all around; burrow protected but only somewhat; like #110's first burrow; not in a depression at all, just vegetation dense around (all herbs and grasses) for wind protection. Cloacal temperature 29.4 °C.
1800 hr– air temperature 10 cm 22.0 °C; breeze strong; soil in open release point field 26.8 °C.
Notes about these nine burrow sites and those seen this morning when looking for tortoises (plus three more seen this evening as I was leaving).

1) The soil in all of these burrows had a surface temperature of 31-32 °C at the time the (Pg. 66) tortoises burrowed, save for #126. His burrow site had a temperature of only 28 °C when he burrowed in
2) Virtually all sites but two out of 12 were in open fields, but tortoises chose depressions which are down into soil 8-15 cm or so and which have protective grass and herbs growing all around sides; this puts them completely or largely out of the wind; if exposed to wind (i.e. in shallower of the depressions) only very top of carapace is exposed. [Marginal note – two exceptions: 1 - #28 – at base of a large rock – no wind; 2 - #126 – burrowed very late as described above. Saw #122, 125, 117 as was leaving area, all in open fields in well protected depression type burrows. Thus saw 12 in burrows.]
3) All tortoises in open field depression type burrow go in head first so that the front end is down into soil and or burrow walls and thus totally protected from wind.
4) They sleep with head withdrawn and all four legs about 75% withdrawn, i.e. also protective from wind.
5) Almost all burrows oriented in that deepest portion (i.e. highest wall and most protective side) are facing into wind (breeze steadily from S and SE now).
6) All above comments apply to other burrows found this morning during search period.

Note: about 1800 hr, #126 became dissatisfied with burrow site and moved 5 m and into a burrow like all others – i.e. a well-protected depression in open fields. (Pg. 67)
11 May 1971 – tortoise (small ones) area again.
0600 hr – air temperature at 10 cm 20.9 °C; soil temperature in open (surface) 22.9 °C
0700 hr– air temperature at 10 cm 21.3 °C; soil temperature in open (surface) 23.5 °C
0800 hr– air temperature at 10 cm (light breeze) 22.0 °C; soil temperature in open (surface) 26.0 °C
0900 hr– air temperature at 10 cm (strong breeze) 24.2 °C; soil temperature in open (surface) 31.8 °C
Eemergence times, temperatures, and behaviors (from temporary notebook):
#196 – 0815 hr; just out and moving slowly away from burrow site; cloacal temperature – 24.3 °C; burrow soil surface 26.2 °C; Then basking in open.
#110 – 0816 hr; just out and moving slowly away from burrow site. Cloacal temperature 25.6 °C; moving around afterwards.
#125 – 0830 hr– just emerged a few cm from burrow and began basking on its edge – Cloacal temperature 25.8 °C; burrow soil surface 26.4 °C.
#115 – 0832 hr - just emerged a few cm and began basking on edge of burrow; cloacal temperature 25.3 °C; burrow soil surface 26.0 °C.

#121 – 0835 hr– already out and has moved 15 m and is eating Opuntia pad in open Cloacal temperature 25.1 °C.
#123 – 0836 hr – just emerged a few cm from burrow and is starting to bask on its edge. Cloacal temperature 25.9 °C; (very well made and protected burrow); soil surface in burrow 26.5 °C.
#126 – 0844 hr– just emerged from burrow and began basking in open beside its – cloacal temperature 25.5 °C.
#113 – 0845 hr– just out and began basking at edge Cloacal temperature 26.2 °C.
#117 – 0846 hr – just out and began eating grass shoots – cloacal temperature 26.5 °C. (Pg. 68)
0850 – spotted #122, 112, 128, all in barranco pond area.
#122 – lying beside burrow basking (recently emerged I think); cloacal temp 26.6 °C.
#128 – walking around in bit of very sticky nearly dry mud on pond floor cloacal temp 26.0 °C.
#112 – eating grass in open – cloacal temp 25.5 °C.
[Marginal note – burrows clearly allow maintenance of higher temperatures through night.]
Basking position is interesting – all seen were either lying flat on horizontal surface or titled upwards on burrow edge so that sun's rays coming in more or less perpendicular onto dorsal surface of carapace. All were lying or took up position rather, as I watched, of all four legs stretched out into sun onto ground and head/neck either 1/3 out and "hanging" in air or all way out and lying on ground. Thus they seem to use sun to nearly full advantage to heat up quickly.
Basking did not last long at all; in most cases animals basked for only 10-20 minutes and then began foraging; so not tortoises basking after 0915 hr; last one still basking then was #113 and it became active at that time. (Pg. 69)
Decided to watch 7 closest animals to release point as continuously as possible: #113, 117, 116, 121, 123, 126, 110.
Weather data: temperatures gradually increasing; sun out off and on only, mostly cloudy from 0830-1010 hr; at 1010 hr began to be more sunny, i.e. sun out 50-60% of time in short bursts; very strong breeze from S and then clouds going over continuously, sometimes blocking direct strong solar radiation out, but weak warming radiation coming in at those times.
1000 hr – a. air at 10 cm 25.7 °C ; b. ground surface in open 36.1 °C.
1100 hr – a. air at 10 cm 27.4-28.0 °C depending on strength of strong S breeze; b. ground surface in open 46.1 °C.
1200 hr– a. air at 10 cm 28.8 –29.1 °C depending on strength of breeze; b. ground surface in open 53.2 °C.
1300 hr– a 30.5-31.2 °C depending on breeze strength; b. 56.4 °C.
1400 hr– a.30.0 °c; b. 51.2 °C.
1500 hr– a. 27.6-28.1 °C; b. 46.2 °C.
1600 hr– a. 26.0-26.2 °C depending on strength of breeze- gusts. b. 41.2 °C.
1700 hr– a. 25.5 °C – strong breeze; b. 38.1 °C.
1800 hr– a. 21.5 °C – strong breeze; b. 28.2 °C.
Until 1215 hr sun in from 1010 hr on; from the until sunset, sunny all the time. (Pg. 70)
All seven foraging continuously from 0900-1040 hr in open sun almost all the time.
1040 hr - taking a few temperatures during foraging activity:
1040 hr - #116 – has been in open and partial sun for past hour, razing, walking, grazing – cloacal temperature 32.0 °C
1042 hr - #117 foraging in open – 32.1 °C.
1044 hr - #113 foraging in open 32.6 °C.
1048 hr - #116 into dense shade of an Alternathera and resting; cloacal temperature still 32.0 °C.

1052 - #117 into dense shade of an Alternathera and resting; cloacal temperatures until same almost 32.2 °C.
1105 - #123, 126, 110 continuing to forage – all now eating Opuntia pads and have been since about 1030-1045hr; 126 in shade 40%, front of body in sun; other 2 in sun.
#121 grazing in partial shade (half and half) on herbs and grasses.
1110 hr- #121 back out into sun and moving toward area where #123 is eating Opuntia, but from 30 m away; foraging a bit in route. (Pg. 71)
- See notes below on aggressions for details.
1128 hr - #121 into dense shade after a hurried 15 m race away from #123 after brief aggression over Opuntia pad. Cloacal temperature 32.8 °C.
1129 hr - #110 into dense shade after losing two aggressions in a row, first to #126, then to #123; raced 25 m and went beneath same bush where spent in shade yesterday afternoon. Cloacal temperature 34.0 °C.
1152 hr - #123 and 126 simultaneously (perhaps 10 seconds apart) gave up eating their respective Opuntia pads out in sun and moved into shade of Opuntia trunks and took up rest positions. #123, cloacal temperature 34.1 °C; #126, cloacal temperature 34.1 °C.
Checked #128,112, 122 – all in burrows (shade) at 1205 hr. Left area shortly after 1200 hr; will continue taking temperatures at campsite (ambient) since area equal in structure.
Returned at 1450 hr - noted tortoises just becoming active at 1500 hr and by 1530 hr all active and moving around foraging and grazing in sunlight, but cooling and a strong constant breeze with frequent powerful gusts. Am watching #113, 117, 116, 121, 126, 122, 128, 112, 125, 110. Taking photos so am not getting burrowing in times for most. Rechecked all between 1628 and 1635 hr. #113 and 125 still active, former grazing on herbs, latter on same Opuntia pad he worked on all morning; both in open. All others already burrowed in night time burrows by this time period. Most in well protected burrows, with exposed sides (to N and W) receiving late afternoon sun on carapaces and protected form S winds. (Pg. 72)
1725 hr - will take temperatures for as many burrowed animals as possible for comparison with temperatures early tomorrow morning. 1728 hr - #17, cloacal temperature 32.8 ˚C near where #1113 burrowed first last night (1 m) and 20 m from #117 ‘s last night’s burrow; well protected but wind hitting top of carapace.
1729 hr - #116 – just into burrow this moment, has been looking since 1720 hr; first went into one where was last night but abandoned it after smelling it’s surface on bottom. The one he’s in now well protected; head first into it; no wind except on very top of carapace. Cloacal temperature 32.8 °C. Burrow surface at time of burrowing 34.0 °C
1738 hr - #113 – same site as finally had last night – very well protected. Cloacal temperature 33.8 °C.
1745 hr - #110 – new site, not depression but cloacal temperature 32.2 °C; dense vegetation all around.
1748 hr - #126 – same site as last night – cloacal temperature 33.0 °C; opening faces wind, so not as well protected as most.
1750 hr - #123 – same site as last night; cloacal temperature 32.7 °C;
1752 hr -#121 - same site as last night ; cloacal temperature 32.2 °C;
1755 hr - #122 – near last night’s site but now well protected from wind by rocks; cloacal temperature 31.5 °C.
1756 hr - #112 – same site as last night; cloacal temperature 31.3 °C.
1759 hr - #128 – same site as two nights ago; cloacal temperature 31.9 °C.

These three (#122, 112, and 128) in an area where sun not hitting it after about 1630; thus cooler in total; probably accounts for lower temperatures now. Also, all three only (Pg. 73) on top of bare soil, not down into it at all; all three well protected by surrounding vegetation however. Much green vegetation here so by swiveling they barely get into soil layer; also no real depressions here in barranco pond area as in open fields near release point.
Only #116 and 117 moved after handling, but immediately went to new similar burrow sites.
#125 – 1810 hr - cloacal temperature 33.3°C; burrowed sometime after 1700 hr; well hidden and protected in a deep depression and below much dry grass; no wind at all virtually in hole.
Thus again clear that this burrowing allows maintenance of high body temperature into evening hours when cool air temperatures and high winds would otherwise convectionally clearly cool tortoise core temperatures quickly.
Tortoises all clearly growing very well and rapidly now and recently due to rain and available vegetation; all 18 found were very healthy. Their total spread or distribution covers a greater area than found on any of previous searches, and general distribution is such that are more evenly scattered or in other words are more widely separated than on previous searches, even though great majority of them are within same general area where majority has been since shortly after release.
Conditions here very good still and obviously were even better in Mar and Apr due to rains. Abundant green herbs and semi-green grasses everywhere and all low growing shrubs are green; no standing water but sign dictates there was some for a week or two, probably. Vegetation was even more lush with tremendous of quantities of green herbs, grasses, Portulaca, etc. Much of the grasses and Portulaca now dead or drying. Biggest change is that Commelina though (Pg. 74) green and healthy where it still occurs, does not cover much area now because abundant growth of taller grasses and herbs smothered it after rains. Tortoises still now seeking it out and eating it and Opuntia pads with great relish.. Also eating Xanthoxylum and Prosopsis leaves and several other unidentified green herbs and grasses. Rain here was obviously great enough to cause this growth but not enough to really flood area; the deeply cracked, dry earth appears to have soaked it up.
On 10 May at 0900 hr rain gauge read 87 mm, but obviously much evaporation had occurred.
Temperatures Max 88 °F; Min 63 °F.
10 May - Max 76 °F; Min (10-11 May) 65 °F.
11 May - Max 78 °F; Min (11-12 May) 64 °F.
No rain since arrival.
Saw a series of very interesting aggressions today among young ones involving feeding rights to rights to fallen Opuntia pads (see Pg. 70-71).

1.
2. (1). Earlier in morning, about 0930 hr, #121 was eating an Opuntia pad in same area where he had been working on same the day (afternoon late) before. #123 approached him head on and as came within about 0.5 m #121 stopped grazing and rose up on all four legs also off of plastron. As #123 continued toward #121, the former began to stretch neck out and up with aggressive posture and #121 slowly and somewhat hesitantly followed suit (did it shakily and jerkily). #123 stopped when noses almost touched and they (Pg. 75) remained in this full stretched out and up posture nose to nose and began vigorously gular pumping (i.e. sniffing of each other). After about 35 seconds of this #123 suddenly opened mouth wide and pushed hard forward #11's head. The smaller (latter) fellow rapidly retracted his head, wheeled, and began to run away rapidly; #123 immediately began to chase #121 as he wheeled, with head and neck still out and up, though a bit lower than in full aggressive attack posture. Chase lasted for about 1.5 m, but passing over the fallen, 25% eaten

Opuntia pad and beyond it about 1.3 m. Then, #123 stopped chasing on heels of #121 and let him go (which he continued to do as a run for another meter before slowing down and eventually beginning to graze in partial shade in an entirely different area out of sight of each other), turned back and began to eat Opuntia pad which he had successfully stolen.

3. (2). About 1 hr after above sequence, #110 and #126 independently approached fallen Opuntia pads under the same old tree and began eating on them, facing each other and about 1.5 m apart; apparently aware of each other (occasional looks), but no responses. They are not in line of slight of #123 who has his back to them where he is eating his pad, but are only 3.5-4 m apart. About 45-50 min after began grazing on pads, #110 making good progress and has eaten out about half of his pad; on the other hand smaller #126 has not made any progress at all on his apparently larger and tougher pad and has scraped all over its surface but not even broken skin yet. At this point, #126 raises up and walks rapidly directly toward #110 after looking at the latter for a few seconds. As (Pg. 76) #126 approaches his head and neck go up and out and eventually as he come within only 15-20 cm, #110 responds likewise. Then #126 stops just as noses nearly touch. Then follows about 25 seconds of both maintaining this fully out-stretched posture and rapid gular pump type olfaction of each other, noses almost touching the entire time and heads level. Then for another 50-60 seconds they continue same smelling interspersed with thrusts or very shallow movements of heads toward each other; mouths never opened at all. Eventually #110 pulls head in and turns about 90 ° and moves a few cm away. #126 moves to his rear, sniffs cloacal area, then come around his sides and again heads near and up into full out positions again. This time #110 even gets one front foot up onto lower front marginals of #126 so that #110 has head definitely higher and a height advantage over #126. But then follows another 20 seconds of sniffing and head jabbing (very slight gentle jabs) but no mouth opening. Finally #126 really thrusts hard and bumps into the nose of #110 whose head is above his, causing #110 to retract head halfway and begin to turn, #126 presses attack and begins to lunge head at #110 again; latter turns and runs and #126 chases about 1 m, then lets go. #126 returns to #110's pad and begins eating it.
4. (3) &(4) - #110 continues on around in a loop away from and out of sight of #126; #110 (Pg. 77)

making much noise in crashing through low herbs and brush. Apparently by fortune, he heads directly toward #123's position, the latter having his back to #110's approach. Just before this #121 had left partial shade and is heading toward Opuntia by his usual approach where he fed earlier today before aggressed, and by a blind route (i.e. he can not see #123). #121 just about in view of #123 but still hidden, when #123 hears #110 and looks up and over his shoulder; then he turns back just to see #121 come into view. He begins to raise up on all fours and stretch up neck and head; # 121 takes one look and runs away in opposite direction and then later into shade. #110 unaware of this, comes through brush near rear of #123; his noise causes #123 to turn to face him in full threatening, aggressive posture. #110 is clearly highly agitated and as comes through brush tries to veer to side of #123, the latter opens mouth and lunges head at #110 and he passes to his side, in a biting motion; #123 follows #110 as he passes by, chases him about 10 cm only and as #110 runs away, #123 settle right back down to his pad and begins eating it as he comes up to it in his chase pathway. [Marginal note - #110 also to shade; #26 and 123 continue pad grazing.]

These four aggressions (some defensive, some offensive) all clearly strong involved chases, and were directly over a given, obvious food item. Note postures and attacks; size per se

perhaps not important, nor height of head; rather more important was strength of aggressive behavior displayed by an individual. Open mouth thrust not a necessity. Aggression probably serves to keep them spread out These beasties definitely not territorial for past two days; have seen same animals wandering within area occupied by two, three or even five others and out again; generally drifting about, even though each does have an area of general activity and burrowing. Aggression over food on the spot. (Pg. 78)

12 May 1971 – to area to get temperatures of young before become active.

0600 hr – a. air at 10 cm 20.7 °C.: b. ground surface in open 22.7 °C

0700 hr - a. 21.1 °C; b. 23.4 °C.

0800 hr - a. 21.8 °C; b. 23.8 °C.

Sampling young's temperatures and burrow bottom soil surface temperatures 0630-0700 hr.

#125 – cloacal temperature 25.6 °C; burrow 26.8 °C; very well protected from wind.

#117 - cloacal temperature 24.4 °C; burrow 26.0 °C; partly in wind (top half of shell and rear legs.)

#116 - cloacal temperature 24.5 °C; burrow 25.5 °C; moderately well protected from wind.

#113 - cloacal temperature 25.7 °C; burrow 26.6 °C; well protected.

#126 - cloacal temperature 23.8 °C; burrow 23.5 °C; most exposed of burrows – open side into wind.

#110 - cloacal temperature24.6 °C; burrow 25.5 °C; moderately well protected but not a depression – some wind hitting him.

#123 - cloacal temperature 25.4 °C; burrow 26.0 °C; very well protected; second only to #125's in degree of protection.

#121 – cloacal temperature 24.2 °C; burrow 25.2 °C; burrow like #110.

#122 – cloacal temperature 24.3 °C; burrow 24.8 °C; burrow like #110 but large rock protecting from wind. (Pg. 79)

#112 – cloacal temperature 24.3 °C; burrow 24.3 °C; burrow like #110.

#128 – cloacal temperature 24.7 °C; burrow 24.7 °C; burrow like #110, a bit more protected.

Of all these, #125 and 126 left burrows after I disturbed them to take temperatures and began grazing. Immediately, almost, #126 returning to an Opuntia pad it left unfinished on previous day and only about 5 m from burrow site; #126 began foraging on herbs and grasses and then returned to an unfinished Opuntia pad it left yesterday afternoon. So, even though not active at body temperatures in 23-26 °C range now, can be active at such core temperatures if necessary. Both seem full alert and mobile. All others remained in burrows and were there when I left area at 0805 hr.

Returned and moved camp to western rim of crater where trail passes over. Prior to moving it noted #12,004 ♂ grazing on fallen Opuntia pads at 0825 hr near camp. Jan saw him here doing same at 0730 hr, so active early. He spent night in open beneath an Opuntia tree here. Took many photos of him (last 2/3 of Roll #303 and all of Roll #304) while eating pads. He remained in this area grazing on pads until just about 1030 hr, then moved 70 m across flats to shade of a Cordia lutea where I first noticed him in shade on afternoon on 9 May. Thus went into shade at 1040 hr. He was still there when returned for second trip at 1345 to carry food to new camp. Saw out from 0845 hr on, today – hot, but continuous, strong, cooling breeze. Peter says he has been active all around (Pg. 80) camp area since their arrival here on 5 May 1971. See further notes below on his behavior. His measurements, CL 77.8 cm; CW 76.8 cm. He is very old, worn completely smooth and looks as if shell of carapace has been hammered. Has a clear well-developed white growth increment of moderate thickness between all carapace scutes. No flaking disease, algae, or lichens.

At western rim, saw #12.050 grazing and moving around in flats, usual area of occupation. He went into dense shade at 1125 hr. Very strong, cooling breeze in this area.
1630 hr to sunset - sun still out as has been almost all day; strong breeze continuous. Looking for tortoises along western rim in northerly direction along trail and its surroundings.
#12,100 ♀ - CL 66.0 cm; CW 70.7cm. No lichens, algae, flaking disease. All smooth shell; moderately thick white growth increments present; lots of ticks, apparently just attaching as most are running around loose on her skin of front legs and foreleg pockets, rear leg pockets. A few attached in opening of cloaca. She has no real concealed area where finches could not pick off ticks, except perhaps cloacal opening and notably she has no enlarged ticks on her at all and only attached ones all in cloacal opening. She must have picked up (Pg. 81) most of these today given that they are still searching for an attachment site; 150-200 m W of camp along trail; in shade at 1645hr; in open, behind a rock.
#12,0900 ♀ and 12,077 ♂ - burrowed 3 m apart in very rocky area just W of "Steamboat rock" on outer edge of rim. Probably a mating attempt; can see where ♂ tracks follow ♀'s a ways then a lot of "scuffling" in soil. Will leave alone as do not want to disturb them. Well surrounded by vegetation but both in semi-open.
#12,048 ♀ - CL 62.5 cm; CW 69.3cm. Just below "steamboat rock" to its N a bit. In open but well surrounded by vegetation . No flaking disease, lichens or algae; ticks abundant on leg pockets front and rear and along carapace/skin borders anteriorly; both large engorged type and fresh ones, thus looks to me as if finches not cleaning this animal; virtually all these ticks would be exposed to finches; collected ticks in ETOH (ethyl alcohol).
Of these four burrowed tortoises, last three all somewhat protected from wind by rocks which are on windward sides and which they are lying behind. However, none really burrowed down deep, well into soil or well covered by vegetation. Seems they are not in need of such extremely well protected burrows as are young tortoises. Cool breeze here all day and night.
13 May 1971 – noted #12, 050 already active when looked out of tent at 0630 hr; perhaps active earlier; misted over and strong cool breeze still blowing. Between 0700-0730 hr also noted that #12,100 ♀, #12,048 ♀, and two other unmarked tortoises, a large ♀ and a large ♂ were also active. However, # (Pg. 82) 12,077 ♂ and 12,090 ♀ still resting and sleeping at 0800 hr.
Sun finally came out for awhile at 0830 hr but was cloudy virtually 95% of time until 1240 hr or so when finally became sunny until sunset.
Notes on tortoises examined today for ticks, measurements, etc. Copulations seen but tape recorded and will be entered below later.
[Marginal note – both following ones on outer edge of rim on downslope, 100 m distance below "steamboat rock" to N.] Unmarked ♀ - CL 58.4 cm; CW 62.0 cm; no flaking disease, lichens, or algae; white growth increments moderate and clear; ticks just as in #12,100 ♀ - scattered, few, and all new. Some obvious bloody spots on rear legs and leg pockets where large blood filled ticks were either knocked off, quashed, or removed by finches. Good possibility for finch cleaning. Most of ticks attached on her, but some moving around. Ticks mainly on front and rear leg pockets, and skin along carapace and plastral areas. [Marginal note - no real hidden places for ticks to attach.] Involved in copulation attempt with following animal between 0830-0930 hr, see notes below. Examined for ticks at 0815 hr.
Unmarked ♂ - CL 78.8 cm; CW 81.4 cm. No flaking disease or algae; lichens of pale grey-green painted on type and pale grey-green fructose type common all over rear 25% of carapace and all (Pg. 83) over front marginals (first two or three on each side) especially most common is painted-on type. White growth increments as in previous tortoise. Ticks almost nonexistent; only

scattered ones on rear and front leg pockets and some crawling about in same areas to attach. No real hidden areas for ticks. See below for copulation attempt notes. Examined at 0930 hr after copulation attempt completed.
#12,090 ♀ - examined 1515 hr when resting in shade. CL 60.9 cm; CW 64.9 cm. No lichens, algae or flaking disease. Ticks as in unmarked ♀ below; most attached but some crawling about; all non-gorged type so recently attached. No bloody spots visible anywhere and no real hiding places for ticks; probably a good prospect for finches-tick picking behavior.
#12,077 ♂ - examined at 1530 hr when resting in shade. CL 86.0 cm; CW 86.0 cm. No algae or flaking disease. Lichens, pale grey-green painted-on type only and only a few spots on first two anterior marginals on each side. Ticks, abundant only in a few places; both engorged and recently attached ones in a) a large spot 2 x 2 cm where there is a fold of skin at the base of the neck and b) along skin-plastron border in rear where there is a fold of skin and c0 same area in front. Both b) and c) well hidden places from finches; a) more of an enigma perhaps hidden even when neck stretched out fully because skin fold loose and large here and might not stretch enough to uncover this area, but impossible to say yet. All other ticks are uninflated recent attachments or are walking about on rear and foreleg pockets and skin around head and neck and around tail. A few engorged ones at cloacal opening, i.e. also an area not accessible (Pg. 84) to finches.
All ticks seen so far have been of same most common type; no other forms seen on tortoises examined until now. Especially have not noticed tiniest type, i.e. black pin-point-sized ones which cause us so much consternation; perhaps this is a Tropidurus tick or a smaller form of same common one on tortoises which I am overlooking; doubt latter possibility very much because I have been diligently examining each tortoise. Common type also attacks us but never seem to get in most inaccessible and painful areas like groin and anal opening and never stay on for more than 1-2 days. Both types are more abundant now than have ever noticed before on any previous trips. Have not seen any other species yet. On all above ♀♀ (adults) have seen on this trip have noted scratch marks in regions of carapace which indicate that all have very likely been mounted by ♂♂ recently.
Noted some interesting lack of interaction this a.m. about 0800-0805 hr between a Geospiza fuliginosa juvenile and #12, 048 ♀. (Pg. 85) The ♀ tortoise was grazing on green grasses and herbs and G. fuliginosa landed on a small Croton branch about 35-40 cm in front of carapace of tortoise and about at level of top of tortoise's carapace at very front. Tortoise was resting on plastron and grazing with neck and head out to right in front of gular scutes only. Finch began hopping about and foraging on branch; tortoise caught sight of it, looked up, kept head level and looked at foraging finch for about 40-50 sec, then went back to grazing. Finch flew away to another bush about 15 seconds later. No hint of any mutual interest at all and no tortoise raising behavior at all even though finch was right in front of this ♀. However finch was never on the ground, and perhaps that is an important aspect.
A few more comments on lack of territoriality in young tortoises (see Pg. 74-77). During 2.25 days I was there and from several checks since the release in Dec it is clear that they do not set up and defend an area against other small tortoises; they clearly patrol no borders and often graze, forage, or move within sight of each other, often even only 1 to a few meters apart with no aggressive behavior resulting. Each had a general area in which it burrowed each night (was able to see burrows of three nights in succession for most of these 10-11 tortoises), some using the same exact spot each night. However, this burrow was in no way defended and during each day when active, the tortoise wandered (Pg. 86) about, often considerably, and often in completely different area two days in succession. In doing so they not only did not defend or occupy the same

area two days in succession themselves, but wandered into and through areas used by other tortoises on previous day or even simultaneously on day in question. They certainly seem to have what could be easily defined as a "home range" but clearly no territories. Aggressions seem to be confined to momentary encounters over food items, water, or grazing sites and are obviously specifically useful (operationally speaking) to drive another tortoise away from the immediate area and thus secure one's right to the small immediate area or item temporarily (latter notion is important because same grazing sites or items may often not be defended for two days or even one hour in succession.

Aggressions are obviously infrequent and their onset may be a function, minimally of some distance between the tortoises. This remains to be investigated. It is noticeable and was also on Jan and Feb checks of the young, that one rarely sees them closer than 5-10 (Pg. 87) m apart, although this does happen many times each day; they generally maintain a well spread out type of distribution while foraging. Also have never seen a case of resting in shade together, even under same bush or Opuntia much less small slump of herbs, and have never seen burrowed together. In fact, they are always separated by a few meters at least except when actual engaged in an aggressive sequence. Aggressions probably serve to maintain this scattered distribution, i.e. well-apportioned land use results. Need to investigate further as to what causes onset of aggressions and what minimal distance acts as a trigger if such exists. On previous checks (Jan and Feb 1971) I noted several brief aggressions, three in which two beasties were walking in open soil areas near release point or similar areas near by and when some 2-4 m apart one or both began to move directly toward other one, then a brief aggressive "heads-up" sequence followed with one or other giving in and running away, other just taking a few steps after loser in each case, then watching and letting him go. These all involved open mouth threats by each tortoise and biting lunges. In no case was object of aggression as clear as Opuntia pads. However, in each case, loser continued on to some area many meters away whereas winner continued to walk about and forage in area (Pg. 88) where two originally met.

Copulation attempts witnessed today will be written up later as time permits in this notebook. They are on tapes for now as taken in field while observing the tortoises.

14 May 1971 – my parasites acting badly today so work will have to be light. In morning checking tortoises for measures, ticks, etc. in flat, sloping, open area from camp on western rim down to cliff edge.

Tortoises noted:

#12,059 ♂ - (or possibly, but doubtfully #12,057 ♂) – CL 74.2 cm; CW 77.0 cm. In flat, but sloping planada, about 100 m above cliffs moving through herbs. Very old and worn, beaten, all smooth carapace. Looked very much like #12,044 ♂ in terms of general condition and size. No flaking disease on carapace or plastron. Some green algae scattered in depressions from rear of third vertebral and backwards to end of carapace. Collected a bit of it (scrapings) in FAA. Has clear, well developed, moderate white growth increments. Lichens on carapace are very abundant at least two and perhaps three types are present, probably three; have collected these three types and photographed them extensively, Roll #307, (Pg. 89) #1-15. Most abundant type is very pale grey-green "painted-on" type common here on most large ♂♂, also seen on G. e. chathamensis and G. e. vandenburghi. Patches of it present in slightly depressed areas all over rear of carapace beginning at rear of third vertebral scutes and everywhere behind it. Also a few small patches of it on second and first vertebrals also in low spots. There is a huge patch of it on front left side and first vertebral scute (see photos). Also noted that in most areas of it there are some small pale brown-beige-orange spots which I interpret to be fruiting bodies of same sort. In only one patch of

what I am fairly certain is same lichen, saw the same type of little projected bodies but they were a pale green in color on their tops, not the common pale brown-orange like others. Not able to collect latter colony but did collect some of the rest. Am fairly certain have seen this lichen commonly on smoother rocks all over this area, but after looking intensively today could not find any with these fruiting bodies, but did seem to be same lichen species by other characteristics. Were a few scattered spots of pale grey-green fructose lichen which is so common on G. e. porteri and G. e. hoodensis. These were on rear-most costals and fourth and fifth vertebrals and some on rear marginals. All colonies were very tiny; collected some. This lichen is common on Pinzon on trees and rocks. Also see photos. Finally in rear areas on last costal on each (Pg. 90) side was a possible third lichen type of a pale dirty mud-brown color but with a faint light greenish color coming through from below. Am not even sure it is a lichen; has appearance of a minute patch of a dried cracked mud-bed. Perhaps is just most abundant form covered by mud? - but doubt it because seem to be a few black topped fruiting bodies in the colony. Collected some; unfortunately can not find definitely identifiable example of it on trees or rocks anywhere in this area. Ticks on this tortoise: had ticks of at least three types, all in heavy infestation. Common type, both swollen and fresh attachers were all over leg pockets and skin-scute borders, front and rear; some really largely enlarged ones near cloacal opening and around tail and head regions where skin folds over scute material a bit. Clearly not well hidden from finches so this tortoise may not perform raising-up behavior. Had small tiny black type mentioned on Pg. 84 – first tortoise have found with it. He had a huge area of about 8 x 10 cm in left rear leg pocket that is almost solidly packed and black with these ticks. Other than this area they are only scattered along plastral and carapace junctions with skin. (Pg. 91) Finch types seen only along plastral-skin juncture in front and rear and here and there along interscute junctures of plastron. Could not ever accurately determine if really were attached – almost seemed to be only sitting in these various grooved places. Both of these species also clearly exposed to finches if they were to feed on this tortoise. Collected ticks.

#12,050 ♂ - CL 80,8 cm; CW 82.0 cm; 50 m more along towards cliffs than where first saw on arrival two days ago. Has been wandering all over in upper-mid planada area for past two mornings and late evenings. Has only most common type of lichen (pale grey-green painted-on type) on first two front marginals on each side, overlapping onto first vertebral front edges on each site. No algae or flaking disease; white growth increments as in previous tortoise. Ticks: just realized I mixed notes from temporary notebook – the description under #12,059 belongs here for #12,050 (only portion on ticks); the following on ticks applies to #12,059: had two of three types at least – did not see the smallest black type. Other two types in some abundance, smaller cream-colored type was only along plastral-skin border front and rear and in inter-scute interstices of plastron. Commonest type mainly confined to front and rear areas just below tail and neck where a large fold of skin over plastron keeps them hidden; were both engorged ones and newly attached ones in these areas. Also were some newly attached ones scattered on legs and leg pockets front and rear. Collected ticks. (Pg. 92)

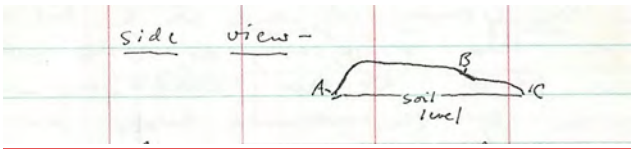
Copulation attempt: saw a copulation attempt between ♂ #12,077 and ♀ #12,090 (see notes below on earlier behavior of these two). Day was very cloudy until just after noon and these two were lying and resting in open near steamboat rock (same areas where they have been since at least 12 May 1971 when first saw them). They were only 15 m apart but separated by some surface boulders so ♂ did not see ♀ and vice versa. Just before 1145 ♀ began moving and came around boulders unaware of ♂; thusly she walked within about 3 m of him and stopped, still unaware and with back to him; she began nibbling some herbs. ♂ saw her and turned 90 ° and came up directly

behind her, holding neck out full and head low. He stopped and settled onto plastron and began rapid gular pumping and smelled her rear area of supracaudal scutes, then cloacal area; ♀ still unaware of him. After only some 35-40 seconds of this he pulled head back a bit, then (Pg. 93) reached out and bit her gently on last marginal to right of supracaudal. At this she stopped grazing and raised head. ♂ then bit her gently on right foot in rear; then she pulled in all legs sharply due to this bite, and immediately after the bite began to move away as rapidly as possible. The ♂ immediately began to follow, head and neck out full and held low, but little gular pumping. She, however got about a 5 m jump on him and he was at this distance disadvantage for entire chase over next 5 minutes; she had open clear pathways over soil and herbs in most directions here, but quickly opted for an area of many surface boulders with dense spiny vegetation beyond it by another 10 m. They rapidly passed through three spots where surface boulders made a narrow passage and then went into dense vegetation. ♂ became hung up at two of these passages and had to slowly and awkwardly clamber up and over them by raising self more fully up and thus dropped further and further behind the smaller more maneuverable ♀; by time he cleared rocks she was well into brush. She eventually got deep into brush, then abutted herself against a large upright rock where she (Pg. 94) was surrounded by thick Prosopsis. ♂ never even reached her because he could not pass under some low thick braches of same bushes. Eventually he gave up trying to plow through these and turned and entered shade and assumed rest position. I returned to area at 1530 hr and both were still resting in same shady spots. Peter saw these in same positions at 1630 hr.

Peter and Fausto were in small tortoise release area earlier today and noted some behavior in relation to thermal conditions. They arrived about 0900 hr. Was cool and cloudy but warming all morning due to weak radiation coming through clouds until about noon; right after noon sun came out strong and temperatures of air and soil climbed rapidly. At 0900 many young just becoming active and basking near burrows; some already active. After becoming active all tortoises they saw (about 8) were actively foraging all morning due to cloud cover. They continued (Pg. 95) to do so but within first 30-45 min of sun coming out full at about noon, all they saw entered shade and took up rest positions. They left the area about 1300. Also Fausto saw two tortoises in Zone C nesting area late this evening (about 1700-1730) foraging and moving around - #12,063 ♀ and a marked large ♂ which he failed to record number of at the time. Peter also found a 3-5 year old skeleton of a dead one on S side about 2/3 way down to Zone C. Apparently a ♀ and a natural death.

Also this afternoon I went over to look for an old fellow, #12,004; see further notes on Pg. 79-80. We have noted some interesting behaviors by this animal during past week which will record now. Yesterday morning Peter and Fausto discovered him attempting to copulate with a rock about 100-125 m W of upper crater campsite along trail. He was mounted in full "normal" position with neck arched over and down and head hanging just as if he was on a ♀; he was also rhythmically thrusting and groaning. Tail was covered with some sticky fluid and same fluid was deposited at "rear" of rock. They do not know how long he had been doing this because (Pg. 96) groaning was not loud and they did not see him until heard him from about 20 m away. He became aware of them almost as soon as they spotted him and raised head and stopped thrusting. Peter was able to take a photo of him while still in position but not before he had pulled neck and head up; otherwise he was just as had been while making copulation movements. Rock had moderately reasonable shape of a ♀.

[Diagram of side view of rock – to be scanned later.]



Curved length of rock A to B 70 cm; curved length of rock A to C 95 cm; curved width of rock (half way between A and B 65 cm). Male was mounted as if A was the rear end of the tortoise. Peter does not recall if front feet were resting on forward, i.e. lower, section of rock or prior to it (i.e. between A and B). Will have to wait and see if photographs show more detail. Rock certainly not (Pg. 97) really shape of a ♀ but it was clear how ♂ could use it for this function. None of us has seen any sign of a ♀ sized animal in this area during our time here (Peter and Fausto camping here since 5 May) so it unlikely a ♀ could have deposited any secretion on the rock recently. If the ♂ has been in this area of the crater alone or has been "stuck" here (for a long time) then perhaps his mating drive is so strong he must release this energy in this way.

There is one other tortoise known to be in the upper crater area now, about 200-300 m to E of this area where ♂ 12,004 has been active, but the other adult tortoise is an even larger ♂ than this old horny fellow. We have not seen him but clear sign of his activity (pathways in herbs and grasses) in an Opuntia stand to E is present and two tourists, Bob Tilman (Line A guide) and Bruce Espley saw him once in period of 6-7 May in this area. As noted on Pg. 79-80 ♂ #12,004 has been roaming about in campsite area of upper older crater at least since Peter and Fausto arrived there on 5 May. They saw him crossing back and forth through camp going along E-W axis and to other areas a short ways to (Pg. 98) N. During our stay I found he had several favorite resting spots for nighttime and to escape daily hot periods. From 5th until sometime yesterday or early today, he confined activity to a huge rectangular area reaching about 150 x 200 m This area is mostly open with a covering of herbs, grasses and scattered Cordia lutea which he uses for shade and a large number of Opuntia trees which he grazes under and forages around regularly in search of fallen pads and fruits. Sometime between yesterday when Peter saw copulation attempt with rock (0850) and today at 1730 when I relocated him, he moved another 200 m to W to base of huge Opuntia tree just at base of steep slope leading up to western rim from upper crater floor. When found today he was resting there under tree, apparently for the night. [Marginal note – Note: on 15 May he was at same Opuntia at 0915 and still there at 1715 when Peter passed by.] Checked him today for ticks and found he had same two types as #12,059 with only a few engorged ones around cloacal opening and under fold of skin up against plastron below tail; both hidden (Pg. 99) areas. Otherwise he was largely free of ticks save for a few recently attached ones of common type on rear and front leg pockets and some of other type along plastral inter-scute junctures.

On two occasions #12,004 actually directly acted aggressively toward humans:

1) One day between 6-8 May (date not recorded) Peter was in camp and saw #12,004 moving through area. He was squatting some 30 m from the animal with camera and #12,004 moved directly toward him (Peter not moving). As came up within a half meter or so, animal raised up fully on four legs, stretched neck up into aggressive position and opened mouth at Peter and made mock, slight jabs or forward movements of head bringing open mouth toward Peter. After some few of these, Peter moved and began to stand, and the tortoise retracted and settled to ground with a hiss and pulled forelegs up tight. Peter left him and he eventually moved on through camp. He never took stretched out posture and held it in stationary fashion as in exposure to finches. The entire sequence from beginning to end was aggressive.
2) Today before examining ticks, I simply walked up to him and squatted at his front side; right away he stretched neck out fully and raised up fully on forelegs and performed same aggressive (Pg. 100) sequence toward me. I remained motionless and let him open mouth and

lunge at me in a short arc a few times, then he withdrew neck/head part way (50%) and I brought up my arm and hand as if they were a tortoise head and neck. He responded by again performing aggressive attack (all "mock" lunges) and by probing my raised hand toward him in similar mock arcing jabs I was able to cause him to duck and partly withdraw almost at will (my hand's position whether level with his head or above it produced same reaction). After each partial withdrawal (25 – 50%) I would continue to hold my hand elevated but pulled back away from him a bit; he then would re-extend neck upward fully and open mouth again and same aggression sequence would be repeated. Finally after about six of these sparring bouts I followed through with hand as he retracted a bit and he pulled all way in with a hiss as I continued to (Pg. 101) push hand toward his head. He then remained retracted and would not come out again while I was moving or quiet. Then examined him for ticks. Finally, [Marginal note – did this because of Peter's observation.] during period of 10 – 12 May, Jan and I tried several times to get him to perform this behavior of aggressive attack by approaching him slowly from front, side, and his blinded rear, both crouching and standing, and even by sneaking up and squatting stilly and letting him discover our motionless presence. But none of some eight attempts produced anything other than either withdrawal and then exit from our presence (if we were moving) or simply rapid exit if he discovered us sitting motionless nearby). On one other occasion (on 11 May) Jan saw him sitting in semi-shade about 1630 and walked over near him because he had been lying there on plastron but with neck stretched fully out. She wanted to see if any finches were near him but saw none in the immediate area, only some G. fuliginosa in trees nearby. She was approaching standing up. As she got within some 2-3 m of him he raised up fully on all four legs and stretched way out, neck up straight and head (Pg. 102) tilted up. He maintained this position also when she continued to move closer and stopped about 1.5 m away. He was stationary and rigid in this posture (and not gular pumping as far as she can remember). She then moved closer and when about 0.3 m away he suddenly withdrew with a hiss and collapsed onto plastron. At no time during this behavior did he ever open mouth or act aggressively, just maintained the rigid posture until he finally withdrew. During rest of stay here we have tried repeatedly to get adult ♂♂ and ♀♀ tortoises to perform either aggressively or with this stationary raising and have had no luck so far – we were always doing this by moving toward them slowly and cautiously, sometimes walking in standing posture, sometimes crouching. Also watched for it while taking measurements or quietly examining tortoises at their sides, while squatting down. Never saw either reaction again in about some 15 trials with (Pg. 103) about ten different individuals,; all simply pulled in with a hiss when approached or when they first saw us sitting beside them.

15 May 1971 – Going early today down onto western outer flanks to check for tortoises and hopefully to see some matings and or aggressions. At 0730 passed by area near "Steamboat Rock" where # 12,077 ♂ and 12,090 ♀ have been hanging about. ♂ was there basking on cool cloudy morning; ♀ has left the area and could not find her for some 40 m round about anywhere. Continued to N some and then wandered all over western slope between rim and nesting "Zones" D and E. Scattered tortoise sign everywhere on upper half of slope, but almost none in nesting zones and below to cliffs; tortoises definitely widely dispersed in the area and most in upper half, on rim area. Plenty of green vegetation (herbs, shrubs) and scattered areas of still green grass (dense stuff) and lots of semi-green half dry grass everywhere. Encountered only two tortoises, both directly above Nesting Zone D where there seems to be much sign of regular movements all up and down upper half of outer flank to Steamboat Rock area and all around it on rim. (Pg. 104) #12,061 ♂ - CL 77.1; CW 75.4. About 75 ft altitude directly above Zone D Nesting Area, resting in shade at 1015. No algae or flaking disease. Pale grey-green "painted-on" type lichen in

scattered spots on rear 1/6 of carapace, on front edges of first vertebral scute and on first two marginal scutes on each side. Well beaten carapace, scutes all smooth. White growth increments clear and of moderate thickness. Ticks: two types (no tiny black ones) in hidden folds of skin around tail. No hidden areas along plastral/skin borders; some few of most common type on exposed area along plastral/skin border below neck, but all but one non-engorged new ones. Not heavily infested but do finches clean this fellow? Ticks collected.
#12,0065 ♀ - another 75 ft altitude above previous animal, in shade at 1045 hr; CL 60.8; CW 62.9. All smooth scutes; no flaking disease, algae, lichens. Ticks: only most common type; mainly confined to hidden area folds of plastron/skin juncture front and rear, below (Pg. 105) neck and tail respectively and most of these non-engorged forms. Some few recent attachments scattered on leg pockets. No scratches on shell to indicate recent attempted copulations. White growth increments clear and of moderate thickness. This evening about 1645 Jan heard a tortoise bumping somewhere close to our camp (noise came from N along western rim) on the western rim where trail goes down into upper crater. Soon #12051 ♂ entered from N into open planada and began to continue S through it more or less determinedly heading downhill toward cliff area. Had some interaction with me while I was taking photos of him (Rolls #308, 309, photos #15-20). Finally he burrowed in "open" at 1730 lying in dying sunlight. He was surrounded by 1-2 dm high grass and herbs and swiveled a bit down into a mixture of grass and soil- some wind protection but not much. At one point was photographing him from about 10 m away, unseen by him (squatting) as he came walking out from behind a bush at full stride; he saw me in motionless position and made a hard 90° turn, heading directly toward me. I remained motionless save for continuing to take photos. He came on and as neared me (about 0.5 m away) he stopped and raised up fully (Pg. 106) on all 4 legs, stretched neck up fully, tilted head up slightly, opened mouth and began to make short more or less slow, jabbing motions or arcs with open mouth at me. Then followed a sequence exactly similar to that performed with #12,004 except that after about three bouts of his head and my hand, (my hand actually a bit lower then his head), he gave up and withdrew with a hiss, settled to ground and pulled front legs in all the way and raised up on rear legs, thus lowering front of shell. Left him alone and after he moved and burrowed I examined him further;
CL 90.0; CW 86.4. No algae or flaking disease; all smooth. White growth increments clear and thin; lichens of common pale grey-green "painted-on" type on first two marginals (front), front edge of first vertebral, and front edge of first costals on each side – see photos: Roll #309, photos #15-20. Ticks: heavy infestations, especially recently attached ones, but also some engorged ones in semi-hidden folds of skin against plastral border below tail and neck. Scattered recently (Pg. 107) attached ones on leg pockets front and rear. None seen except for most common species.
16 May 1971. Up at 0600 hr. Cool and cloudy morning. Noted between rising and 0730 that #12,051 ♂ was not actively moving, lying in overnight position resting on plastron. Legs relaxed and resting on ground but not stretched out. Was alternating between lying neck and head on ground resting and stretching neck almost straight up and out fully, mostly holding it and head stationary in this position, but sometimes slowly turning head slightly and looking around. These periods of stretching neck up last only a few min each and about 6-7 occurrences during the 1.5 hr. Saw G. fuliginosa ♂♂ and some juveniles or ♀♀ (not distinguishable to me) near him on and off, sometimes while neck out, other times when not. Mostly saw them land on his carapace, on top or top –rear, hop about a bit then fly off to denser vegetation along rocky sides of the planada. Only once saw one land (a ♂) on ground at his rear and look around near his rear left leg for a few seconds, then fly off. Did not see the finches ever actually feeding on him or any definite interactions (Pg. 108) between tortoise and finches. However, I was a long distance away (80 ft)

using binoculars and was not able to see his lower neck and lower front area well at all so can not say much definitely.

During entire week was never able to witness any definite tortoise-finch interaction or even simple commensalisms by finches on tortoises at all. G. fuliginosa are present everywhere on island it seems, especially along crater rim, in huge numbers. Many, many dozens of them, vast numbers being juveniles, all around one everywhere on rim. They are still nesting as saw nest with young in it and much nest building activity. Since no mud available to tortoises, I can not say much further as to why finches are apparently not feeding on tortoise ticks, especially since the ticks are fantastically abundant. Perhaps this type of mutualism and/or commensalism is rare anyway and (Pg. 109) reduced when finches have abundant other food as they do now.

Tortoise pre-copulatory and copulatory behavior seen on 13 May (from tape recorded notes):

1. First sequence seen – unmarked ♂ and unmarked ♀ noted on Pg. 82-83 (of 13 May notes): Saw this mating between 0845 and 0920 hr. Had examined ♀ for ticks, lichens, etc. at 0815 and she had continued moving along after I left her, heading slightly uphill in area just to N and downhill from Steamboat Rock. She was moving along in the most open areas available where much open soil paths present. ♂ was resting in open on plastron with head on ground, basking, some 20 m away from her when I spotted him while following her at some distance in a hidden position. She was going up a very slight rise and could not see him as he was behind a large surface boulder. As she came within about 3-4 m of his position (head to head) he became visible to her and likewise he looked up apparently detecting her by sound or soil vibrations. Even before he moved she made a 90° turn and headed away rapidly into adjacent area of dense vegetation and surface boulders. The ♂ immediately began to chase her and caught up quickly so that he was walking along behind her with (Pg. 110) neck and head stretched straight out and parallel with ground; his head was only about 0.5 m behind the rear of her carapace during this short (10 m) portion of the chase before she reached very dense vegetation and he ran into difficulties. Just as the ♂ was getting very close to the ♀ and began to snake his neck up and over her carapace incipient to mounting, she passed easily under a low, thick, horizontally growing Prosopsis limb and the ♂ crashed into it with the front of his carapace at the notch area; for a vital few seconds as she escaped he pushed with all four legs but could not move ahead; finally, he pulled in front legs somewhat and pushing only with rear ones was able to slip under limb and started after her again. She passed under a second similar limb which he also was stopped by; he finally cleared this one in a similar fashion. While he was clearing second branch, she moved some 3 m ahead and directly up to a large flat faced boulder and went directly up to it and abutted her head (Pg. 111) and directly against it and settled down on plastron; legs (feet) touching ground but relaxed and not supporting her. Rock actually undercut very shallowly where she was abutted against it so no space between front –top of her carapace and rock face at all. ♂ came up behind her and for first time sniffed her in supracaudal, then cloacal areas. Until this time, all during chase he never showed any olfactory movements or gular pumping. Entire chase coved about 20 m and lasted more or less 3.5 min. After a few seconds of olfaction ♂ mounted in normal fashion. After mounting ♂ sat still for about 2 min with a brief occasional attempt to re-adjust his position. His position is very poor because rock does not allow him to get quite as far forward as normal (in resting position) because his nuchal notch area rams into rock's upper face; also he can not put head over and down in front of ♀ at all and is mounted with it out more or less straight over forward dorsal part of her carapace. For next 5.5 min, ♂ remained on her trying to shift position a bit now and then, but obviously frustrated by all attempts. Also he began to bite her on 2^{nd} – 4^{th} left front marginals and even to extend his head over and down in front a bit and to "mock bite" at

her left foreleg and almost directly at her head; occasionally he nipped leg a bit but never even close (Pg. 112) to head. Her only reaction to this was to pull in all four legs when he achieved an actual nip on her foreleg. As soon as momentary nip was over she relaxed leg to ground again slowly and smoothly. Other bites and "mock bites" produced no reaction at all and she never moved body position at all and kept head in most of way all the time. In 5.5 min were five of these biting bouts each involving 2-3 nips or attempted nips; first three bouts on marginals only, last two at marginals then to forelegs and head area. After first three biting periods directed at front left marginals he slipped off of her a bit to left side, thus allowing him to stick neck over in front and bite at foreleg and head area. Occasionally during this last period of two biting periods he also ran head/neck up over first two left costals and first two vertebrals and sniffed this area a bit. Then he climbed back on or rather pushed himself back into upright posture centrally on her and for next 6 min mostly sat but (Pg. 113) occasionally bit at front marginals and ran head over front part of her carapace; sort of "looking things over" it seemed. Then he sat on her for another 3 min doing nothing; then climbed off and wandered away and started leaving the area. ♀ remained passive and inactive as he dismounted and left. Notable that ♀ never showed any escape activity once she abutted against rocks but before that she was extremely active in trying to escape. Perhaps ♀♀ sense when ♂ is in a stymied position or rather abutment against rock and closed vegetation all around resulted in her inactivity? ♂ never thrusted, groaned, or even got is tail under her rear; he was set too far back on her carapace even when in best possible position and thus could not get tail under her at all. His tail and cloacal area were just resting in dust when he was centrally positioned on her or raised off of soil when he more fully supported self on legs. Perhaps fact he was never able to thrust and touch her cloacal/tail area with his tail was factor which resulted in her remaining stationary and not trying to escape ♂. After ♂ moved away some meters and out of her sight I examined him for ticks. 15 minutes after he left her she still remained stationary and withdrawn. I then left the area. (Pg. 114)

2. Soon after witnessing this copulation I came upon #12,77 ♂ and #12,090 ♀ just as a sequence was beginning near "Steamboat Rock" This was a long complicated sequence, lasting in total approximately xx minutes. Following notes directly from tape recorder with a bit of editing of extraneous verbage. ♀ lying in open on plastron, legs resting on ground and head and neck on ground; sleeping and basking in weak radiation under a cloudy sky. ♂ moving though area slowly about 15 m from ♀ and saw her. He was behind her and moved immediately up to her rear and settled on plastron. He briefly smelled her cloacal area for some few dozen seconds (notable gular pumping) and mounted directly as normally done (i.e. as seen on Alcedo, and Santa Cruz) and in chathamensis and hoodensis at CDRS). ♀ unaware of male until he began placing forefeet on upper rear sides of her carapace and then when he did this she withdrew legs, head, and neck with a hiss but remained stationary. (Pg. 115)

After mounted, ♂ remained somewhat stationary shifting a slight bit for 55 sec; ♀ passive entire time, neck and head withdrawn but legs relaxed a bit so feet resting on ground but not supporting her.

Then ♂ began rhythmic thrusting movements with accompanying groans. These vocalizations not as strong as those heard in field on Santa Cruz (G. e. porteri) and Alcedo (G. e. vandenburghi) and a bit more quiet also than (G. e. chathamensis at CDRS). These thrusts watched for some 5 min, ♀ remaining in passive position entire time. Nothing really different about ♂ postures and movements during copulation than have seen in chathamensis, porteri, and vandeburghi. Same basic movements to achieve thrust including very rapid and slight lifting of feet in rear for a fraction of a second, thrusting of tail up under her carapace so that its tip probing for her tail and

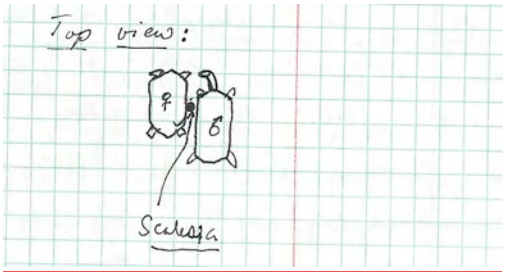
area around it. Forefeet resting on 2nd and 3rd front marginals and 1st costal scute on each side. His head [Marginal note – during and between thrust and rest position.] arched over and down in front of her in normal manner so that his nose is about level with a point some distance below her nuchal notch – i.e. his head visible to her even with her (Pg. 116) head drawn in.
At this point I timed length of some of thrusts and groans which coincide nicely (i.e. thrust length, not intervals between); these timed on stopwatch with a 1/5 second smallest interval.
Results of a timed series (in seconds): 1.2, 0.8, 0.8, 0.8, 0.9, 0.8, 0.9, 0.8, 1.0.
Soon after this ♀ began some swiveling movements under ♂ during a series of thrusts. After she had tried this a number of times under ♂ he stopped thrusting movements and slowly dropped front legs from full mounted position so that they were lying along her costals and reaching down to ground with feet just touching ground; still mounted; this dropped his front end much lower on her dorsal carapace however. He then was able to arch neck over and down in front of her much further than when in resting position of full mounted copulation position. As he dropped head down into this lower position, nose pointing (Pg. 117) down and slightly back toward her head he opened mouth and threateningly pushed it at her a bit. He is not able to actually reach far enough to bite her head but is clearly making repeated threatening movements at her head area with opened mouth. Between threatening movements he leaves head in lowered position with mouth open where she can see it sometimes; he also closes mouth occasionally and raises head somewhat and then repeats mouth-opening threat. ♀ reaction to these movements is to retract head and forelegs somewhat when he moves opened mouth toward her. But as soon as he lets head fall back away from her a bit, she relaxes legs back onto ground. However, she definitely stopped swiveling completely when he started these open-mouth threats. After about 2.5-3 min of these threats he began thrusts again, first few with front legs still down off of full mounted position (i.e. still along front sides of carapace), but then he put them back up on marginal-costal full mounted position without breaking stride and continued thrusting. ♀ quiet during all of these renewed thrusting, completely passive. (Pg. 118)
At 10 min mark (since first thrusting began) I timed length of a series of inter-thrust rest periods in seconds: 6.2, 7.0, 8.0, 6.6, 7.0, 13.0, 8.2, 9.0, 10.0, 6.6, 7.2, etc.
At 13 min mark, she again began frequent swiveling movements during and between thrusts. These occurred several times in rapid succession and ♂ again stopped thrusting, dropped legs down and again began threatening (open-mouth) movements toward her head and this time left foreleg area also. Essentially a repeat performance of previous threat sequence. After a few minutes of this behavior he again placed forelegs up on full-mount position and began normal thrusting. After thrusting had been going strong a while and ♀ had been passive since threats began and continued to remain so during thrusting, I again timed some between thrust intervals in a series (in seconds, with watch): 7.0, 8.0, 3.0, 5.0, 5.5, 6.0, 5.5, 6.0, 6.5, 5.5, 5.0, etc. (Pg. 119)
Thrusting continuing over next few minutes but ♀ has begun swiveling frequently again; she does not move much during these but they clearly irritate ♂ and do throw him off of center (thus his tail not centered directly in line with her tail-cloacal area) a bit often. At 23 min mark swiveling again resulted in ♂ stopping thrusts and dropping down again and making open-mouth threats at her again. Once again she has stopped swiveling; same threats and responses as before. Then he delivered two sharp strong bites to her left foreleg causing sharp withdrawal of the forelegs and head and elevation of rear end a bit by extending rear legs. She relaxed right away back onto plastron fully and relaxed forelegs back until feet touching ground right after each bite.
Then he began thrusts again still in "down" position but only thrusted twice since his tail hitting direct and not going under her rear lower carapace. Remounted fully and began thrusts again; ♀

still passive. Have been noting head position carefully during thrusting when he is in full mounted position. Not making any open mouth threats when in this position. Head is, of course, lowest (Pg. 120) between thrusts, when his nose reaches just to or about 1 cm only blow her nuchal notch and no further; when he thrusts head goes up further and certainly out of sight of ♀. Only time head is well below her nuchal notch is during "down" position.

♀ swiveling more and more again and has resulted in moving them into such a position that right side of ♂ carapace in about middle of body is pressed up against a small Scalesia. This, plus swiveling, is obviously causing him problems in maintaining central thrusting orientation even though total of swiveling until now has only moved them about 0.5 m from original first mounted position.

At 26 min mark ♂ stopped thrusting and began to dismount on left side but stopped after about 1/3 off and remounted to same position; again up against Scalesia; ♀ passive and quiet now. Then he set for about 1 min (Pg. 121) to 27.5 min mark with no more thrusting attempts. Then off he climbs on her right rear side to ground, behind position where both are abutting sides up against Scalesia. He then moved around Scalesia toward her front end and stopped with his nuchal notch about even with middle of her body or actually a slight bit forward of this and then he settled to his plastron and stopped here:

[Diagram of relative position of both tortoises with Scalesia between them to be scanned later.]



To this point ♀ made no attempts to move at all during dismounting or following moves by ♂. ♂ then quickly reached neck and head far forward and bit ♀ severely several times on right front leg and foot. For next 4 min 20 sec, ♂ alternated these vicious bites at her lower foreleg and or foot with brief periods of pulling back after a bite and sniffing around area of her right front leg pocket and some along side and upper side of carapace just behind leg pocket. In this later process ♂ was able to look over her position and see Scalesia. He then rested with head (Pg.122) down low near her front leg pocket for 1 min 55 sec; followed by another severe bite to her lower leg again. Then after briefly smelling and looking over carapace with head just above and behind right front leg pocket bit her again on right front foot. During all these many bites and intermittent periods ♀ has not tried to move body position at all. Only reaction is that she sharply withdraws both forelegs with each bite and raises rear of shell by extending rear legs (thus lowering front of shell at bit); but immediately after bite, hold is released and she again drops onto plastron by relaxing rear legs, and lets forelegs drop slowly back onto soil (feet on soil in specific); she maintains head far in all the time. Seems clear that ♂ is tying to force her to move to left, away from him, and thus away from Scalesia because she is still in exact same position as when he dismounted so that she is up against Scalesia and it lies now (Pg. 123) between ♀ and ♂ along their sides; if he remounted now he would be in exact same problematical situation as just prior to dismounting.

He really seems to be looking over her position frequently between bites when raises head and brushes down over side and top of her shell behind front leg pocket. For next 16 min 30 sec he lay beside her, mostly head resting near front leg pocket of ♀ on ground with occasional sweeps of head and neck over dorsal side of her carapace and along her side. Finally, he began to turn (pivot) a bit to rear until by stretching out head he reached over and began biting (several times in rapid succession) marginal scutes along anterior border of right rear leg pocket of ♀. Again she is not changing basic position; but elevates front by extending forelegs and sharply pulls in rear legs with each bite so that she almost jumps with each bite. Again as soon as bite ends, she drops back to plastron in front and lets rear legs fall back slowly until feet rest passively on the ground. Bit her in this area a total of eight times.
Then he swung head along her side again looking over position and sniffing. (Pg. 124) at her carapace. Then he pivoted back to nearly former position and began biting her forelegs again with same results, withdrawal but still not movement from basic problematical position.
For next 6 min 45 sec he has continued same biting, but alternating between front foreleg and rear and front edge of rear leg pocket. Also "looking" at her position along right side between alternating bites. Finally after a concluding series of three bites, one at rear leg pocket anterior edge, one at foreleg and then return to former , he twisted more than before and is now facing directly into her right rear leg pocket with front of his carapace. He sat in this latter position sniffing of her right rear leg pocket for a few minutes, then turned, walked around Scalesia and is approaching rear of her carapace again. He has clearly been trying to get her to move but with no success. He quickly began sniffing of her supracaudal scute area, his body (Pg. 125) slightly to her side and neck stretched out low; he then lowered head and began olfaction of her cloacal area. The he "snaked" head up over her carapace top and began to mount having some trouble because of Scalesia but soon was fully mounted in same old position with both of them with sides up against Scalesia trunk. As soon as mounted (at 1hr 10 min mark) he began thrusting and continued this for 70 sec. Having same trouble as during end of previous mounting period. Therefore he stopped and began biting at her, first two front marginals on each side, four bites left, four bites right. No reaction by ♀; then thrusting again for 43 seconds; again stopped and biting first two marginals on front right side, then thrusting for another 55 sec, followed by stop and biting again to front right marginals. ♀ now reacting by raising rear of carapace with each bite, then relaxing after bites over.
Then he climbed part way off to her left side; both left feet on ground partly supporting body, and plastron resting along costal and sides of vertebrals. Then stretching head and neck forward and begins biting fiercely at her head area and then front left leg. This clearly disturbed ♀; at first few bites toward head (no actual contact) she pulled in and raised in rear. Then as he continued and shifted to hard bites on her (Pg. 126) left lower foreleg, ♀ began to swivel to right sharply, eventually turning 180° completely under him and then sliding out from under him and taking off rapidly; ♂ turned and headed after her quickly at her rear. ♀ heading for closest rocks and abuts herself directly against a small one head first. Then moved on a bit so she slips very front of carapace between 2 small surface boulders and with nuchal notch and gular projection hard up against a small Scalesia stem.
Chase only lasted 3 min, ♀ passing under a Scalesia limb, with ♂ barreling along right through after her and snapping limb off, the latter ending up caught on his dorsal carapace. He then climbed on her directly with no olfaction then or during entire chase. ♂ seems in well-mounted position; head arched down in front normally. He rested a few dozen seconds after achieving full mount and then began earnest thrusting. Thrusting period lasted only 7 minutes. During (Pg.

127) first part I snuck up behind and watched movements under her carapace, without ♂ or ♀ seeing me.
He was thrusting with tail tip pointing forward and probing at her tail and cloacal area with it. Obviously using it to line up cloacal opening because when not on center he would thrash tail to one or both sides violently when thrusting trying to feel out alignment. Tail has a groove as in G. e. vandenburghi observations and some clear fluid is moving down it but not much; this fluid is a light flow and is not reaching tip of tail so if he inserted tail it would not affect intromission of sperm, I suspect. After a series of six or seven very successful tail thrusts when tail tip hit her tail and near or on cloacal opening, ♂ stopped in rest position and penis appeared for first time. He extruded it very rapidly and it arched up directly for her tail, but apparently because he was sitting a bit too high on her, it struck ♀ just above cloaca and intromission was not affected. He then immediately withdrew it. This whole motion of extrusion and retraction was all one smooth motion and lasted only seconds. Just as his penis was (Pg. 128) disappearing back into his cloaca a large blob (probably about 25-40 cc I would roughly guess) of almost gelatinous, viscous, pale-yellow translucent material came out of it and fell onto the ground, probably ejaculation in effect. He sat a few seconds more, then climbed off, turned , made a big circle and came back to her rear and began sniffing again at her tail. If he tries to remount now will have a problem; as he was climbing off broken Scalesia branch fell from his carapace to a position sitting transversely across top of her carapace so he will have to push it off or mount on top of it. In sum until now (1 hr, 44 min mark):

1) 27.5 min – first copulation mounting.
2) 30 min plus – dismounted; biting to try to affect position change of ♀; ♂ on her right side.
3) 2 min more or less – remount and dismount biting on left causes ♀ to move and break away. (Pg 129)
4) Remount and attempted penis penetration after 7 min of successful thrusting. ♀ entirely passive during all of this thrusting and attempted penetration; but ♀ holding tail curled up flat and tight against her body, cloaca facing downward and inward a bit so not in best position for achieving penetration.

Now ♂ sitting at her rear, gular pumping in cloacal and tail area; still entirely passive. Then after a few minutes ♂ turned and went into shade as it is now nearing 1145 hr and is hot in sun and has been for over 1 hr. ♀ remaining stationary, so attempt over I think.
Most interesting aspect was type of biting and thrusts used; some to cause stopping of swiveling; others to cause movement of ♀ when she is in a bad position. I checked these two again at 1500 hr and 1630 hr and both still in same positions inactive; apparently will remain so for night.
Fausto Llerena saw a copulation on 9 Oct at 0900 hr on western rim just where trail starts steep descent enroute to NW coastal campsite and landing. His description indicates a normal mounted position and thrusting/groaning. He could not say much as to success because left area. Animals were in open soil spot. (Pg. 130)
12 Oct 1971 – Preparing to transfer all of 1966/67, all of 1967/68 and remaining nine of 1965/66 Pinzon young to Pinzon on 14-15 Oct 1971; therefore today Basilio Toro (Galapagos National Park Service Official) and Julio San Miguel (ward) marked, weighted and measured (SL, CL, SW, CW) all of these young. Have this recorded and filed with other typed sheets on tortoise raising program.
Marks:

1965/66 group - #130-138
1966/67 group - #139-158
1967/68 group - # 159-181
One, # (not specified), of 1966/67 group left at CDRS because has a wound on one foot which is open and weeping. No ectoparasites present on any of these young.
13 Oct 1971 – Large adult ♀ Pinzon tortoise arrived today from New York Zoological Society (thanks to Wayne King, Curator of Reptiles) – was taken from Pinzon in 1928 and has been in captivity until now in Bronx Zoo. Will await (Pg. 131) arrival of papers to make it more possible to trace exact origin, etc.
Shell rather sharply raised in front but fairly normal; all moot. Checked for ectoparasites and found none. Extensive pale yellow coloring all over face. CL: xx ; CW xx . See photos #10-end, Roll #373 of tortoise, Mr. A. Rambeck and myself with it. Offered it heirba buena (Puspalum conjugatum [check this spelling] and Commelina diffusa but did not eat or act interested. Then broke a large Opuntia pad in half and offered it that and it immediately stuck head out, sniffed broken edge vigorously and then began eating pad, disregarding small spines. Will be isolated here alone and then later with some of odds/sorts group for a few months to check on potential diseases.
14 Oct 1971 – Left 0200 hr from Academy Bay on Victor Lopez's new boat, the Elizabeth, disembarking on E side port and climbing toward rim of younger crater directly above – group includes Bill Reeder and myself and Pepe Villa, O Chappy, and J. San Miguel with 1967/68 young tortoises to be released today. Arrived at release area, which is in first group of Opuntia trees below rim of small, young crater just below where this rim starts ascending steeply to form higher rim of upper, older crater on E side. (Pg. 132)
Released young there at 0930 hr, still photos Roll #374 and half of #375, spending next 1.5 hr filming release and their subsequent behavior – see 16 mm Rolls #7, 8, 9, and first half of Roll #10 (Rolls #1-6 shot at CDRS on 12-13 Oct 1971 of parts of raising and breeding program and marking/measuring/weighing of young before transfer to Pinzon). This release area is at about 850-900 ft altitude and much like 1965/66 group of 20 release area, but a bit drier. Lots of Opuntia trees, Alternathera , Croton, Prosopsis. Rather abundant herbs on ground, mainly a malvaceous one [check spelling] scattered bits of Commelina (not much) , and Portulaca in some abundance. Almost no Opuntia pads or fruits on ground so knocked down a lot of it in immediate release area to provide some initial food. Immediately upon release young began slowly moving about, many briefly performing "heads up" aggressions, but no really fierce prolonged ones – mouth opening, ran and no chases involved. Most began grazing and browsing, at least tentatively, some in earnest within a few feet of release site. Saw them eating Opuntia, Prosopsis leaves and mainly eating leaves, flowers and stems of mallow. Saw one try a Maytenus leaf, but rapidly left it alone – has very bitter taste to humans. Many Geospiza fuliginosa came in around young, soon after release. Much noticeable hopping about in front of young, but little fellows did not respond, so finches usually moved on after a short time (seconds to a few minutes). [Marginal note – Marked area with a pole implanted in ground. Some open soil filled areas all over release site and below it, i.e. most everywhere in abundant Opuntia stands here. Terrain a mixture of these open spots and small- to medium-sized lava rocks. Below 750 ft more or less, terrain we crossed all jumbled lava. No really suitable nesting areas but soil in release site might serve if necessary – much like soil of Zone C.] (Pg. 133)
15 Oct 1971 – Today went up to Nesting Zone D area at about 0930 this morning. Pepe Villa and wardens released 1966/67 tortoises here, # 139-148, and #150-158. Also left #166 from 1967/68

group here as he was accidentally not taken to his group's release area yesterday. The young were released in part of the nesting area just above what was formerly designated Nesting Zone D. The release site is located at just about 500 ft altitude (Thommens altimeter) in a flat area on what is overall a rather steep slope of about 10°. [Marginal note – Marked release site with a pole implanted in ground.] The vegetation is rather dense in general consisting mainly of low to medium height Croton (30-10 ft), Prosopsis shrubs, and a scattering of other shrubs and herbs. The terrain is mainly of old worn jumbled lava rocks and large boulders with area of surface soil scattered throughout. There is abundant shade and small water collection sites exist in the rocks and lots of smoothed large flattish rocks where adults drink garúa collections. There are nests all scattered through the area. Rats are abundant more or less here and Peter Kramer is setting up a 170 x 170 m rat trapping (and eventually poisoning (anti-coagulants) in the area. There is very little food here for the young tortoises save for Prosopsis leaves, Alternathera, lichens (fructose, on trees) and scattered malvaceous herbs. Garúa is rare here. Starting tomorrow and through the 23rd (23 Oct) (Pg. 134) of this month Fausto Llerena and C. Calapucha will fill five little half pint plastic cups with water each day for the young tortoises.

Looking around in Nesting Area D and 100 m distance above it for tortoises, only 1 hr.

In lower part of D, just above barranco:

#12,100 ♀ - CL 66.1; CW 71.2. White growth increments medium thick; probably came down from above on W side recently as there is not much food here. Has not nested recently as lacks mud in proper places. All smooth, old, worn, dented shell; no lichens, algae, flaking disease. Raised in front, level along vertebrals to nuchal.

#12,076 ♀ - CL 62.9; CW 69.1. Also old, worn, smooth, dented shell; devoid of lichens, algae, flaking disease; white growth increments clear but very thin. Has nested recently because feet and tail have dried mud on them. Raised in front, but very rounded half-oval made by front marginals, i.e. not depressed to form saddle "horn" in front. Also slight down curve from center of 2nd vertebral to nuchal notch, giving a slight rounded appearance to dorsal midline from side view. In same Nesting Area D, but 30 ft higher up in altitude, thus 40-50 m distance (Pg. 135) there are scattered fresh droppings of ♀ sized tortoises all over this nesting spot or area, indicating much recent activity here. Pepe is finding some nests; will record this later. Above this one another 40 ft altitude and 50-60 m is an unmarked ♀, CL 62.0; CW 63.6; in nesting area still; no sign has recently nested; was coming down hill when heard her crashing in brush. All smooth, very worn, dented shell; shape as in #14,100, i.e. slightly depressed outside in marginals and first costals, but saddle "horn" not well developed; first two vertebrals and nuchal notch make one straight line – i.e. well raised carapace in front. No lichens, algae, flaking disease.

#12,099 ♀ - CL 58.8;; CW 62.0. Just above last ♀; all smooth, worn dented shell; no lichens, algae, flaking disease. White growth increments clear and medium thick. Has very old dry mud on feet but has not laid in recent past; mud only in cracks between scales; mud is color of soil in this nesting area rather than redder soil above here toward rim on W side. Shape as in previous tortoise; some straight, slightly rising line from center of 4th vertebral to nuchal notch; well raised in front and lightly depressed on outer sides to from horn.

#12,078 ♀ - CL 59.5; CW 65.5. Above last one about 25 ft altitude, still Nesting Area D. All smooth, worn, dented shell. Shape as in previous (Pg. 136) tortoise. No lichens, algae, or flaking disease. Lacks fresh mud. White growth increments clear and medium thick.

#12,075 or 95 ♀ - #20 notch looks cut but could be an injury. CL 60.8; CW 63.2. Same shape as #12,076, but more depressed (even though very slightly) on outer sides of costals and front marginals to give a suggestion of saddle "horn"; white growth increments clear but thin. No

lichens, algae, flaking disease. In same area as when tortoises' released, i.e. About 500 ft altitude in upper-middle part of Nesting Area D. Has not nested recently.
To now (2.5 hr scanning for nests), Pepe Villa has found 11 nests from this year in total area of perhaps 3-4 hectares where these above ♀♀ are dispersed.
Eventually found a total of 18 nests on W side, mainly in Nesting Areas D and E and areas below and above them some distance. Also found two of the nests more around to SW, beyond Nesting Area E toward large cliff. One of nests found today up very high, at about 850 ft, not far below rim on W side. (Rim is at 900-1000 ft in this area). Villa also (Pg. 137) found 12 nests from last year, all with normal exit holes from which hatchlings had escaped. He opened two of these finding that all young had escaped from one of them and in other all but one had escaped, the remaining one being a fully formed 3rd stage embryo (with scutes) which was decayed in the egg shell. I also found three of last year's nests with normal exit holes from which all young had hatched and escaped, but it was not possible to count number of eggs in either as shells were too decayed.
16 Oct 1971. – In 1965/66 tortoise release area, doing normal sample. Came here late yesterday. Saw #12060 ♀ on rim on W side, at big rocks.
#122 – CL 37.l7; CDW 38.5. SL 32.2; SW 23.7 ; weight 5.8 kg; white growth increments very thin and incomplete; in pond against barranco wall. [Marginal note - In open sun.] Lots of fresh and old sign all around this area.
#112 – CL 44.5; CW 45.0; SL 37.2; SW 27.4; weight 8.95 kg. White growth increments also thin and incomplete. [Marginal note – in open sun.] In pond area also, only 10 m from #122.
#121 – CL 37.8; CW 37.8; SL 31.2; SW 23.1. White growth increments thin but clear. Weight 5.25 kg. 40 m to NW of release point in open area.
#126 – CL 36.0; CW 38.4; SL 31.3; SW 23.9. Weight 5.15 kg; white growth increments clear but incomplete and thin. 25 m NW of release point.
#115 – CL 38.9; CW 39.0; SL 33.7; SW 23.6; weight 6.30 kg; white growth increments clear but thin. 30-35 m WNW of release point on pond's edge; in open.
#110 – CL 39.1; CW 41.3; SL 34.1; SW 25.0. Weight 7.15 kg; white growth increments clear but very thin; 15 m WNW of release point in open. (Pg. 138)
#123 – CL 43.0; CW 44.5; SL 35.7; SW 26.2; weight 7.55. 30 m NNE of release point in open.
#116 – CL 37.6; CW 37.8; SL 31.7; SW 23.7; weight 5.45 kg; white growth increments very thin; 40-45 m SSW of release point in open; was drinking water here collected in small rocks this morning after light garúa in pond.
#117 – CL 38.8; CW 38.8; SL 32.3; SW 23.4; weight 5.65 kg; white growth increments clear but very thin. 30-35 m SW of release point in open.
#102 – CL 33.5; CW 24.7; SL 28.7; SW 21.2; weight 4.10 kg; white growth increments clear but very thin. 50 m SW of release point in open area.
#113 – CL 41.1; CW 41.8; SL 34.0; SW 24.7; weight 7.15 kg; white growth increments clear and medium. 50 m S of release point in open area.
#125 – CL 36.6; CW 38.5; SL 30.9; SW 22.9; weight 5.30 kg; white growth increments clear but thin; in open; had been eating fallen Opuntia pad. SE of release point about 120 m.
#124 – CL 38.3; CW 40.2; SL 33.4; SW 23.3; weight 6.90 kg; white growth increments clear and medium thick; 120 m ESE of release point in small open area; area with a group of Opuntia trees and soil; eating Opuntia pads; he apparently had pulled top three pads off of a sapling and eaten 2nd leaf and started on one of upper two. Two upper pads with only hairy, flexible (Pg. 139) spines,

but other one (2nd) with scattered sharp spines, hairy ones, mixed. Lowest, thick pad with mostly spines of medium length. He avoided the lowest one and snapped off upper 3.
#118 – CL 37.8; CW 38.6; SL 32.2; SW 23.7; weight 5.70 kg; white growth increments clear and medium.
#119 – CL 38.0; CW 36.8; SL 31.2; SW 23.2; weight 5.2; white growth increments clear and medium. Both in small patch of grass, soil and Opuntia beyond rough rocks, about 65-70 m E of release point.
#129 – CL 43.7; CW 43.8; SL 37.4; SW 26.7; weight 8.7 kg; white growth increments clear but thin. 65 m SE of release point in open; when found was grazing on a dried up piece of rat skin with hair still on it. Mostly just gnawing on it, attempting to get some of it broken up.
#111 – CL 38.1; CW 40.7; SL 33.0; SW 24.8; weight 6.65 kg; white growth increments thin and incomplete. In center of large pond (earlier) then later on its NNE edge. In open eating Commelina.
#114 – CL 39.1; CW 39.8; SL 32.8; SW 24.2. Weight 6.4 kg. Southern edge of large pond; white growth increments clear and medium to thin. Eating Commelina.
Much sign of rats in the area, several dead, dried out ones; a number of owl kills also with head/shoulders missing. Rats have been chewing on plastic coverings of camera equipment in hole where we have placed equipment in one side of pond up against barranco wall of (Pg. 140) small pond. Rats are obviously everywhere in the area, but their sign is most dense (fresh droppings, pile of refuse, freshly cut Commelina leaves and stems) in more rocky, densely vegetated areas which surround open areas where tortoises all concentrated. None of tortoise show any definite signs of rat molestation. However, #125 has two small wounds, one on lower leg and one on upper leg in rear; these are small open wounds but could well be from rubbing against carapace marginal scutes when breaking through dense brush or from rubbing against spiny vegetation. Each night have seen short-eared owls in this area, three last night, two this evening.
Tortoises are obviously well hydrated as many urinated when being handled today and urine was almost clear in color and feces are very wet and moist, almost diarrhea like in consistency. Old dropping from months past to recent are scattered all over the area. (Pg. 141) The older drier ones are mainly full of grasses and some Opuntia, the more recent ones of mainly Opuntia and herbs; the freshest ones have some Opuntia, but mainly Commelina remains, which appear to very well digested. Except for few tortoises noted today (all above) eating Opuntia pads, all the others were grazing in Commelina patches when found. The latter is abundant all over the area and forms large, low, more or less dense mats in places. There are also lots of other herbs, including several vines, a Lantana like herb, a Portulaca like herb, and several others. The Prosopsis is flowering abundantly and very green as is Alternathera. But almost all grazing sign is on Commelina and Opuntia parts, so they are showing a clear preference for these two. In central tortoise area, around release site for some 50-75 m in all directions, virtually all fallen Opuntia pads and fruits have been wholly or partly eaten; under most trees can be found only old dried up almost completely eaten pads. This contrasts with areas of Opuntia trees just beyond tortoise area (Pg. 142) where there are scattered pads in various stages of decay under virtually every tree; most pads are rotting or even dry but some are fresh falls. Clearly however, main period of their falling was during and just after rainy season.
Most tortoises have mud on feet, tail and undersides and many of small rocks with hollows in them show muddy imprints where tortoises have been passing over and around them to drink collected garúa in morning but small amounts collected and were drunk by several tortoises I watched between 0830-0930.

Most tortoises not active until between 0900-0930 hr and remained active all day until between 1500-1600. By 1600 hr every one I could find (ten) was burrowed in for night. Was very windy and overcast all day but quite warmish at times (especially 1030-1400 hr) due to weak, scattered light coming through (Pg. 143) misty cloud cover. But no period of afternoon shade-seeking at all. They all grazed virtually all day. Saw a few aggressions in which one tortoise, while eating Commelina was approached by another; in each case first turned to meet approaching one, raised up fully, opened mouth and approacher turned and ran away a few feet after feebly raising up body and stretching out neck, but not really ever opening mouth in display.

Furthest dispersal observed – covered a huge area in search today – way beyond where any tortoise seen.

Furthest sign seen –

1. To W – only to medium pond up against barranco. All areas beyond this rocky and with dense spiny vegetation.
2. To S and SE - #125's area at 120-130 m – no sign beyond him. More soil and Opuntia area – very open spots with lots of Commelina beyond him.
3. To E and ESE – clear sign ran uphill almost directly to E of #124's position, along a pathway of soil mixed with scattered rocks and with scattered Opuntia trees. Saw old and some fairly recent scats all through (Pg. 144) this area which extends some 45 m beyond #124's present location. Beyond these last Opuntia and soil all surrounding area is rocky and with more or less dense spiny vegetation. No sign in these rocky areas. This tortoise (probably #124 as trails and scats and pathway of soil and Opuntia lead directly from where he is to these other areas) clearly selecting using more green, easily traversed area where there is more Opuntia and Commelina. Rocky areas have some spots of dense Commelina but mainly a heavy covering of low-growing almost dwarf, decumbent Maytenus, Alternathera, Prosopsis, and scattered Xanthoxylum.
4. To N – last sign seen is about where #127 was found in May 1971. Plenty of Opuntia, semi-green, soil covered areas with Commelina patches and soil beyond this area to NE and N. But he seems to be furthest out here. There is abundant food within (Pg 145) area of tortoises' main concentration so perhaps thus no urge to move further. Checked most of tortoises for ticks, found that three of them had none, but most had at least a few in total, up to half dozen. Most had two, three, five or so of small stage of common type of tick and a few at most of tiny black types. Both of these types mainly in interior leg pockets, especially of rear legs; none of these engorged. So no large common ones on any, nor even medium-sized ones. A few tortoises had one to three of translucent type, darker grey phase, some swollen fully and of medium size, others smaller and not very engorged. These were all in interior leg pockets. A few of common ticks occurred on legs, usually upper legs, or around tail. None in hidden areas. In summary, most have ticks; saw no mites, but ticks are very few and scattered; nothing like infestations adults have. To my knowledge no adult in last 6 years, so ticks must have a long dormancy capability. Geospiza fuliginosa, adults of both sexes, and juveniles are abundant all over this area and flocks of 10-20 are (Pg. 146) common, feeding all over ground all day and picking up seeds, eating Commelina flowers and Alternathera flowers and seeds, picking at Opuntia pads on ground, etc. Saw numerous instances today (about 12-15) of a couple to many finches hopping about on ground very close (10-20 cm) to a moving, sitting, or grazing small tortoise; finches (Geospiza fuliginosa) really seemed to be just hopping in front of tortoise in a display-type fashion. Yet, not once did we see a tortoise respond to these and we saw none of the young tortoises ever in stationary de-ticking posture. Likewise, however, never saw finches land anywhere on a tortoise or attempt to do so, no even to attempt removing a tick or seed or other object from a tortoise; however, also should note

that besides ticks being very few on tortoises individually, most have grit and areas of mud on their skin, especially little pebble-sized balls and clods of it and these (Pg. 147) make seeing ticks for us rather difficult. We had to examine undersides of tortoises very carefully and pull legs out to see almost any of the ticks. Question of learning versus instinctual behavior thus remains moot.
By accident, Basilio Toro (misunderstanding) released 3 of 9 1965/66 young from group which remained at CDRS in this area yesterday at 1100 hr. This morning at 1100 found #135 and 136 each only about 20 m from where he had released them, although late yesterday they were about 30 and 40 m respectively from their release site. Caught these and Villa and he took them to be released with other 6 in Nesting Area C today. Then about 1245 today found #133, 120 m to E of release point in a very rocky area and caught him; obviously really traveled yesterday and this morning as he crossed much rough, jumbled stones and spiny dense low-growing vegetation Their release point is about 50 m due NW of last Dec release point, also in open main soil and Opuntia area. (Pg 148)
17 Oct 1971 – Looking for three other young.
#128 – CL 38.1; CW 38.6; SL 33.1; SW 23.9; weight 6.15 kg; white growth increments extremely thin, but clear; just other side of N corner of pond. One tiny black tick inside each rear leg pocket.
#127 – CL 38.2; CW 40.6; SL 32.9; SW 24.0; weight 5.8 kg; white growth increments very clear but thin; along same soil-Opuntia route where was last time, but a bit further to N; huge area nearby of about 0.5 ha covered with his old Opuntia and grass-filled droppings and burrow sites. Found still in burrow at 0900, under large end of a fallen Opuntia tree in deepish soil. One tiny black tick in interior of each rear leg pocket and in one of front ones also. A medium-sized, partly engorged common type (Amblysoma) on skin and scutes border in rear – latter not hidden; 235 m to NE of release point.
Spent rest of the day filming various activities of young tortoises – Rolls: last half of #10, 11, 12, 13, 14, 15,16, 17, and 18. Includes shots of resting in burrows in early a.m., basking beside burrows just after emergence, locomotion, eating Opuntia fallen pads, aggressions (between #115 (Pg. 149) and #110 - #115 victor, and #115 and #133, #115 again victor. Also two sequences of finches, all G. fuliginosa save for one G. magnirostris bathing and drinking collected garúa water out of natural cups formed in fallen Opuntia pads. Again today saw numerous instances of G. fuliginosa hopping around front ends of tortoises but no responses from tortoises. In one case, #115, who had just before been eating Opuntia pad material, raised up on all four legs and began to walk, but then stopped and craned neck and head way up to look at us; standing stationary. Just after he did this, a G. fuliginosa which had been foraging on ground 2.5-3 m away from tortoise, quickly flew over and landed in front of him facing him and looking at his front end and in an "interested" fashion. But tortoise held position for only a few seconds after finch landed and was clearly watching us and ignoring the finch, even though he must have seen her fly in. He then began walking forward and finch ♀ flew away and began foraging on ground in nearby shrubby vegetation.
Aggressions – These were staged – i.e. #115 was eating Opuntia pad (had been for some 1-1.5 hr) in area only 10 m away from his usual burrow site (used by him past two nights). I brought #110 from his (Pg. 150) normal area of activity (20 m away from #115's area) and released him facing #115, but some 2.5 m away. #110 walked straight toward #115 who was eating and did not see him until two were only 0.75-1.0 m apart. Then #115 saw him approach, stopped eating and rose fully up and craned up neck/head; #110 then doing same with neck. Came together with heads almost touching and inclined slightly upward, nostrils to nostrils. Encounter lasted only a few seconds, when, with no mouth-opening at all, #110 suddenly drew in neck and began to turn to

side. #115 following and chasing #110 from behind in a tight half circle, then #110 kept on going away and #115 returned to pond and began grazing again; chase only covered a couple of feet and #115 never left Opuntia pad site; #110 went only 3 m away and began poking around on ground sniffing herbs. Tried same again, but this time after barely putting neck up in response to (Pg. 151) same action by #115, #110 immediately turned and scampered away, #115 letting him go and returning to eating pad. Then tried same with #133 who is new to this area and certainly had not met #115 yesterday or today at all. This time events proceeded as before, until after heads were raised and a few seconds of nose/nose and gular pumping occurred; both opened mouths and a few seconds of thrusting lunges occurred by both. Then #133 suddenly withdrew neck, closed mouth simultaneously, turned 15° and began to scamper away rapidly, but with #115 right behind him in hot pursuit. For next 15 min #115 continued chasing #133 from behind over some 25-30 m total distance and up to 15 m straight line distance away from Opuntia pad. Several times #133 turned and raised up neck and opened mouth sort of back over his shoulder in a threatening posture toward #115, but each time #115 finally was victorious in these bluff displays and #133 gave up threat posture and ran. Eventually after winning one such bout and chasing #133 some 8 m, #115 returned to Opuntia pad. Later # 110 and #133 met within #115's area (in fact only 10 m from #115 (Pg. 152) and Opuntia pad) and fought a brief open-mouthed heads-up duel, with #110 victorious and #133 moving away several meters; #110 chased him only some 25 cm and then let him go. #115 was eating in full view of others all through this and in no way defending his burrow site which the other two were almost on top of. Then two others went separate ways and #115 continued eating Opuntia. In all aggressions victorious animal did not necessarily seem to win because got head above other's; in most cases heads were even and in one case #133 was even above #115 due to terrain, but still gave up and moved away first with #115 then in pursuit. We left area at 1430 hr taking #133 along to release him in Nesting Zone C where others of #130-138 group were released yesterday. [Marginal note – Took Rolls #375 (half), #376, and #377 of young tortoises in this area – aggressions between #115 and #133 and #115 and #110 eating Opuntia in particular.]

At 1630 hr arrived Nesting Zone C and measured #133 at same point where others released yesterday. This site is at about 760-770 ft on (Pg. 153) S side of the island, on trail which runs over the southern rim of the upper crater from central camp in the latter area.

Terrain here is rocky, but boulders not large, with a few riverbeds of larger rocks, and soil-filled pockets scattered all over; parts of the area are about 70% soil and 30% surface rocks and these are the areas most frequented by the tortoises. Slope is about 5-8°; tortoise have trails, well-used and marked, running up and down the slope and main one follows the largest riverbed or encañada. Very few Opuntia on this entire slope, and the few trees present are well–cleaned around bases from tortoise foraging and tortoise trails lead to and between each tree to others. No pads or fruits on ground now, only eaten-out remains of pads of which tortoises have disposed. Other vegetation is mainly low shrubs, Croton, Maytenus, Prosopsis, Alternathera, with scattered tree-sized (6-10 ft) Maytenus and Cordia lutea. Herbs and grasses more abundant here after heavy Mar rains as their dried-up remains now indicate. Not much available food on herb level – mainly the mallow species, with scattered others. Other main greenery on level of nine young tortoises are Prosopsis leaves and Alternathera clumps. Garúa here must be moderately frequent, probably about as in 1967/68 group release (Pg. 154) area, but certainly more than in 1966/67 group area and less than in 20 of 1965/66 group in upper crater. Lots of large smoothed plate rocks with water collection pockets scattered all over the area; these much used by adult tortoises in the area

and many of them accessible to the young. Release point is marked with a pole surrounded by rocks at base as in other areas.
18 Oct 1971 – Arose early a.m. and found a tortoise in the area right away, #12,043 ♀ and a large ♂ #12,XXX – he has what may be cuts in scutes # 20, 40, and 2 – but all of these somewhat rounded out and could be natural injuries; however, #40 "cut" least convincing in appearance; #12,000 cuts clear. Spent all morning (0900-1200 hr) trying to get photographs of these three moving about and hoping for shots of finch/tortoise mutualistic behavior. Saw latter only once, when first found #12,xxx ♂ at about 0930 hr, but movie camera was not ready so we (Pg. 155) missed our only chance. Came upon him, anyway, in full raised posture with neck nearly straight up and three Geospiza fuliginosa perched on his forelegs (probably ♂, two ♀♀ or juveniles) looking for and occasionally removing ticks. However, about 25 sec after I arrived 3 finches flew away and soon after ♂ retracted head and settled to ground. He then began noticing me. We did get some footage of this ♂ and ♀ walking in the general area, Rolls #19 and just beginning of Roll #20. Quit at 1200 hr because tortoises inactive in shade. Later in afternoon we again began watching ♀ #12,043 as she became active at about 1540 hr and remained so until almost 1800 hr when she burrowed for night. While I was off checking for other tortoises, Bill Reeder saw her and several G. fuliginosa in a more or less lukewarm mutualism and filmed it – Rolls #20 and #21. Will not write up notes as he did not accurately take any due to need of running camera. He did definitely note finch hopping in a display type fashion in front of tortoise some 20-25 cm to which tortoise responded by raising up somewhat after seeing birds. The ♀ spent much of 2.5 hr of activity eating organic debris from floor under Croton, Cordia, Maytenus "forest" and from small holes in flat lava rocks. This debris consists of dry organic matter of (Pg. 156) a blackish color, mostly fallen leaves stems, soil, fruticose lichens, and rat droppings. She seemingly preferred this even though are Alternathera, Croton, Prosopsis, Mallow, and a few other edible plants in leaf in the area. During this time I was taking measurements, etc. of two tortoises uphill at altitude of about 750 ft in this same general area; both in burrows for night at 1630 hr; ♀ just entering, ♂ just entered.
♀ #12, 063 – CL 62.2; CW 67.3; all smooth, worn, dented shell; no lichens, algae, or flaking disease; white growth increments clear and medium thickness. (see Roll #378 Photos # 15-26 of her; taken 19 Oct 1971); saddle horn only slight, but well raised at nuchal notch, with slightly elevated line from 4th vertebral to notch. #12,xxx ♂, see Pg 154 – CL 76.9; CW 78.3; all smooth, worn, dented shell; no algae or flaking disease. One large patch of pale grey-green crustose lichens on his left 1st front marginal. Measuring some 5 x 4 cm at largest and widest points. White growth increments clear and of medium thickness. Shape is more or less normal, with well-elevated nuchal notch (highest point of carapace) and ascending line from 4th vertebral to notch. Saddle better formed than in ♀♀ by more (Pg. 157) pronounced depression or concavity of marginal and costal scutes on each side. Ticks more or less abundant on both of these tortoises; have same types in same distributions so will describe only once. Tiny black tick dense in interior of leg pockets and on neck and chin and around area of skin above neck and head. Translucent ones (few in total) scattered in interior of leg pockets. Common ones: smallest forms here and there on legs and leg pockets but few in total. Medium- and large-sized ones only in hidden spots, i.e. greatest density in folds of skin just inside cloacal opening and along plastron/skin border formed by anal scute where lose skin hangs over and protects ticks. Only in this latter site did each have engorged medium- and large-sized ticks of both engorged and depleted types. Each had some bloody spots at peripheral area of these skin folds and along plastron/skin border beyond the

sites – some fresh, others only dried spots, apparently sites here finches removed ticks as were not sites where abrasion would take place as tortoises move around.
These tortoises active from more or less 0700-0900 to 1000 hr (seen out 0915 hr and until 1600 hr). Again active 1540 to 1700 to 1800 hr. Based on above two and ♀ #12,043. (Pg. 158)
19 Oct 1971 – Began watching #12,043 in her burrow at about 0715 hr. She was lying in a nearly open spot, wedged down into surface soil and with dry grass covering up her sides to about 1/3 of her dorsal-ventral straight line distance. No finches tried de-ticking her for first 45-50 minutes we watched, while she was sleeping/basking and slowly looking about moving only head and neck. She then began to move slowly out of burrow and immediately a G. fuliginosa flew in and landed in front of her and hopped up/down moving slightly toward her with each hop, only 0.5 – 0.25 m away. This resulted in her immediately responding by going into fully raised posture in front with legs and neck/head stretched out and up. She did not elevate rear but a few cm. She did this after clearly looking at the hopping ♂ finch. We were able to film this with Aeriflex (check spelling), Rolls #22, and part of #23. [Marginal note – Also still photos of this – Roll #378, Photos #1-9.] These rolls show whole sequence from front end of tortoise, outset of behaviors, finch's (Pg. 159) examining and cleaning front skin covered areas; same finch also worked on her rear end area out of view of camera and one clear view, but one could see enough to detect that finch was cleaning and inspecting lower legs, upper legs, and inside leg pockets. The whole sequence with the bird's approach until bird left lasted only a little over 2 min. Bird was clearly pecking at ticks now and then but most of actual time was spent in inspection. Tortoises in this area have no seed or other plant debris on skins now so must be after ticks specifically. No other finches came during the sequence. Earlier, while ♀ was basking, sleeping, and looking around, G. fuliginosa came in around her in groups of one, two, and three clearly looking interestedly at her and often hopping around her front end, but even when her eyes were open she did not respond. Finches promptly left after only a few to few dozen seconds in each case. After ♂ fuliginosa left, the ♀ did not settle back to relaxed position for about 1.5-2 min. She then did this and a short while later (5 min more or less) she turned and headed into shrubs to a shade spot. I then examined her for ticks, etc. – (continued in next volume). (Pg. 160 – unnumbered)
Photos – Rolls #301-309 (latter only #1-20) taken on Pinzon 10 – 15 May 1971; see notes for details. Roll #374-383 taken on Pinzon, 14-20 Oct. 1971 – see notes for details.

[Transcription completed 13 November 2006, by T. H. Fritts – CGM Pinzon2.doc]
End of Notebook.

Isla Pinzon Volume #3.
Field Notebook of Craig MacFarland

(Pg. 1) #12,043 ♀ - CL 58.2; CW 64.5; all smooth, worn, dented shell; no lichens, algae, or flaking disease. White growth increments of medium thickness and clear. Shape more or less average for the race, with only slight concave depressions on outside of front marginals and costal forming vague "horn" of saddle and more or less straight, slightly ascending midline on dorsal carapace from 4th vertebral to nuchal notch – i.e. well elevated in front to nuchal notch. Roll #379, #7-19 of her shape and tick distribution in the hidden areas at rear of her shell (ventral view). Ticks: tiny black forms rather dense in leg pockets, especially interior of rear ones, on neck, and more scattered on area of skin above neck and head. Very few scattered translucent form also in interior of leg pockets, mainly rear ones. Scattered small common ones, un-engorged, here and there on legs and leg pockets and around tail; only some 10-12 in total. Medium- and larger-sized common ones, un-engorged , only in hidden areas formed by folds of (Pg. 2) in rear, i.e. along anal scutes/skin borders and inside cloacal or anal opening a short distance. Only one really engorged tick, a large common one in first named hidden area in rear. Several bloody spots on skin around tail and adjacent area, on outer margins and just beyond hidden folds of anal scute area and one on inside edge of cloacal opening, just in open; i.e. good evidence that finches are getting a few of large swollen ticks in marginal hidden areas. Are also a few bloody spots on hidden folds area of very central area of anal scute/skin border. These, however, could be caused by squashing of the ticks when the tortoise "sets down" on a rock and thus puts pressure on the skin folds against the plastron. She also has a few scattered small- and medium-sized un-engorged common ticks along the plastral midline and in cracks in the plastron where the skin is exposed. Just before examining her took some footage of a Dromicus caught on (Pg. 3) Pinzon three days ago, see end of 16 mm Roll #23; stills of the snake also, Roll #379, #1-6. It had no detectable ectoparasites, upon examination when first captured.
Also, this morning during filming of this ♀, I was walking through the area where nine 1965/66 young were released on the 16th of Oct. Came upon one of them and when about 2.5-3 m away from it, I knelt down to take photos of it and habitat. As they usually do at such distances, the tortoise, which had been walking along in normal posture, stopped and raised up higher till forelegs nearly fully stretched out and extended neck out further and upwards with head tilted up at 50-60° from horizontal and began gular pumping and carefully watching me without moving any further. During short time, 20 seconds more or less, before this when tortoise had been moving though the area undisturbed, I had noted several G. fuliginosa in the area, but all at a distance of at least 5 m from the tortoise, and (Pg. 4) all foraging on the ground and not responding or apparently even looking at tortoise at all. Within a few seconds, however, of the tortoise's raising up, almost before the raising movement had ceased, a ♂ G. fuliginosa flew directly to the tortoises front/side and landed some 25 cm away and then began exaggerated hopping towards tortoise until there remained only a few centimeters between their bodies. The finch then began to specifically look at the foreleg and foreleg pocket which it was standing beside with obvious intent. However, to this point the small tortoise behaved as if it had not even seen the finch and continued to look directly at me and pump gular area. Then finch hopped once more until was almost touching tortoises left foreleg and with

this hop caught tortoise's attention; in response the tortoise suddenly (Pg. 5) jerked head away sharply a few cm just as finch completed hop and then began to slowly turn head toward finch; the latter saw this movement and fluttered away to a position some 30 cm from same foreleg. Tortoise was now again stationary but continued looking at finch. Finch then hopped directly upward again toward tortoise's head/foreleg area and in response tortoise rapidly withdrew neck about 1/3 to ½ way and pulled head back and away from finches approach. In response to tortoise's movement, finch again flew away to roughly same position. Then followed same behavior, with finch this time flying onto carapace just behind nuchal notch and tortoise again retracting head/neck in response and finch finally flying away to forage on ground several meters away. Then, tortoise returned to looking at me and gular pumping. Thus, tortoise never responded to finch's presence by performing mutualistic up-raising posture even though at least 3 definite separate chances to respond (Pg. 6) to finch's clear enticement occurred. Last two opportunities were most suggestive ones because tortoise did not appear to be watching me nor responding to me during these two attempts by finch, i.e. unlike first case. Tortoise, of course, could have been well aware of my presence but did not appear to be paying any attention to me. Finch was clearly attempting to get mutualistic response out of tortoise; yet tortoise gave none, thus perhaps indicates that phenomenon of tortoise's response is learned and that these naïve small ones from CDRS have not learned behavior yet. Of course, this is only suggestive, not a real demonstration of the point. Behavior could well have genetic base and simply not develop till later in the tortoise's life when it is of a larger size. There is also the point that the young in this area had no ectoparasites when introduced here on 16 Oct 1971 and this particular fellow had only a few of tiny black ticks in interior of leg pockets when I examined (Pg. 7) him just after the above described behaviors. Also, tortoises, at least up to the size of the largest young so far introduced on Pinzon (circa 45 cm curved length) are sufficiently small such that in the full raised posture used by the adults in the mutualistic behavior, the young would not really expose much more area to the finches than is exposed when they are lying on plastra with neck and limbs extended during basking/sleeping periods in early morning and when in shade during hot parts of the day. If fully raised only the most interior portions of the leg pockets and upper portions of the legs would be exposed more adequately to the finches than in stretched out basking or sleeping postures; also lower area of neck would be more exposed in raised posture. In these smaller animals there is the question of whether the finches could even use the upper legs as perches to work over the leg pocket interiors during the fully raised posture – (Pg. 8) it appears in the field as if the finches are too large for these sized tortoises to do so adequately, whereas in adult-sized animals this is clearly advantageous to both finches and tortoises in full raised posture to give maximum exposure area for both species. Should also note that in adults we saw numerous examples (far more numerous cases than those seen of actual mutualistic behavioral response by tortoises) of a finch or a few finches [Marginal note - G. fuliginosa to be exact.] hopping about around front end or on carapace of a tortoise obviously attempting to induce a response, but without getting one from the adult tortoise in question. Most of these cases involved tortoises which were lying about basking or resting in the shade, but clearly looking at the finches or at least seeing them at some time during the initiation behavior of the finches. In some cases, the tortoise actually was clearly following (Pg. 9) the behavior of the finches a bit as his head would turn with

their movements, thus a visual following response on the part of the tortoise. Some of these cases occurred, however, when tortoises were actively moving, or resting on plastron and browsing or grazing. Also, despite all these numerous cases of tortoises clearly looking at finches without giving mutualistic response, we never saw an adult tortoise flinch or pull head or neck away from fluttering or hopping finches – i.e. no fear or disturbance response – even when finches came within only centimeters of the tortoise's head in many instances.

Facultative grooming – we also saw numerous instances of G. fuliginosa hopping about on, or on ground, near tortoises, inspecting and de-ticking them on front legs, rear legs, around tail and that general area, even on neck, into leg pockets, and on carapace and leaning over from a perch on carapace to (Pg. 10) reach adjacent skin above neck and head in large arch. Most of these instances involved tortoises which were flat on plastron, resting, basking or sleeping, with legs partly or fully outstretched. Sometimes neck and head were also laid on ground, i.e. in sleeping and or basking situations, but also often neck and head were out and up part way and tortoise was slowly looking about around him, often watching the very finches that were inspecting his own carapace or front appendages. In other words, if the tortoise was largely immobile and quiescent, i.e. at most moving only head/neck then finches (G. fuliginosa as in all previous discussion) often took a facultative advantage of this to groom them. In none of these cases did we see either tortoise or finches act fearful or disturbed by movements of the other species, as long as those movements by the tortoise involved only slight slow motion of head and or neck. (Pg. 11)

In some instances tortoise slowly began to move away, or rise up to change grazing spot, at which time finches would flutter away and land nearby, sometimes returning to groom the tortoise again after it again became immobile; sometimes to not return but just drift into ground foraging. In some instances tortoises would fortuitously stop in a position that was particularly advantageous to finches for facultative grooming. For example, several times tortoises stopped with rear of plastron resting on a rock and then stayed resting in this position with rear legs just dropped down onto soil or other rocks below more elevated supporting rock. Finches could then groom all over rear legs, up into leg pocket interiors, all around tail and that general area.

If the tortoise in question, however, moved the head/neck sharply or began moving any of legs, finches always would flutter away some distance, obviously disturbed by the movement. They often would return to the tortoise if it became (Pg. 12) quiescent again. If not, they would often flutter and hop around in front of the moving tortoise or on its dorsal carapace, sometimes inducing it to perform mutualistic raising, but usually not successfully doing so. Often, they would simply return to foraging on ground or in vegetation after initially leaving tortoise.

Another definite trend we have noticed is that finches most often approached tortoises (either by flying in and hopping in front of it or onto carapace) and attempted to induce the raising behavior when tortoises were moving and active, less often if they were largely quiescent, i.e. resting on plastron on ground, but grazing or moving the head/neck about, and least often if they were lying about completely quiescent – e.g. basking, sleeping, resting in shade. In these latter situations finches simply usually began inspecting and de-ticking tortoises with no inducement behavior preceding this activity. They very clearly most often approached and began inspection/de-ticking of quiescent

immobile tortoises which had a great proportion of skin area exposed, e.g. legs, neck stretched out or rear elevated on a rock with rear legs hanging down (as (Pg. 13) described above.)

I should note that all discussion here pertains only to Geospiza fuliginosa. This species was clearly the most abundant finch in area where tortoises were watched so far on this trip, probably making up well over 90-95% of finches in these areas. Were occasional scattered G. fortis, Certhidea olivacea and G. scandens and a rare G. magnirostris (in 1965-66 20 group release area) in these areas but we saw no signs of these species either attempting to initiate mutualism, facultatively feeding on, or inspecting tortoises, inspecting or de-ticking tortoises already in mutualistic, raised posture, or in any way being involved in such behaviors. Flocks of G. fuliginosa were scattered all over the areas visited, in numbers from a few up to one dozen at times; also many especially adult ♂♂ also were seen often feeding and foraging alone. Flocks were mainly made up of juveniles with some adult ♀♀ included and more rarely adult ♂♂.

In all, on S side in Zone C Nesting Area we saw the following numbers of occurrences –

1. Three clear mutualisms with tortoise raising involved (one by ♂ #12,xxx in which did not see initiation, two by ♀ #12,043 – both filmed – once resting on plastron and grazing, but just moving when occurred, (Pg. 14) in second case she had been lying in overnight burrow basking and just as she began to leave it, actively moving, finches caused her to go into raised posture.
2. Many cases, approximately 5-6 of finches hopping near her when she was moving but no response. (♀ #12,043).
3. Many cases of long periods when finches hopping near her when she was either grazing, sleeping, basking, or resting in shade – no response probably 8-10 cases in all (#12,043 ♀).
4. Another 8-10 cases of finches hopping on her inspecting and de-ticking somewhat while she was in one of same positions described in 3.

In afternoon, moved to high area of western rim where trail starts down into old upper crater. Enroute saw Onan, #12,004 ♂, in old crater in Opuntia grove at campsite and took some photos of him Roll #379, #20-end, Roll #380, #1-9, 17-22. In same area noted a phenomenon of Opuntia growth which have seen here on Pinzon before, notably in 1965/66 release area of 20 young. Found a (Pg. 15) large Opuntia tree which had collapsed and died and six of its mature older spineless pads with only filamentous hairs, none of which were rooted and all lying separately on the ground had each put up tiny new sprout pads of 9-10 cm height (four of pads had one sprout each, two had two sprouts each). All these sprouts were moderately, heavily spined with several 5 or 6 cm long sharp stiff spines. The spines were not as dense as on seedlings of same and even larger sizes which result from seeds, but were definitely too spiny for tortoises to eat. This latter statement based on observations of pads which tortoises select to eat. See roll #380, photos #10-16 of this phenomenon. Also, noted no sapling to tree-sized Opuntia here which had mature, hairy armed pads which tortoise could eat lower than 1–1.5 m above growing surface (pad distance). This is interesting, because adult tortoises do feed in this area. Saw (Pg. 16) same situation on S side in upper part of Zone C Nesting Area and in other areas of upper crater where Opuntia groves or stands are visited by adult tortoises (three other stands

examined). In contrast in both 1965/66 20 young – group release area and in 1967/68 group release area, where Opuntia are dense, noted some trees with fully barked trunks, yet with hairy, nearly or completely spinulous pads hanging down to within 60-80 cm of ground – i.e. clearly within reach of adult tortoises. Also in these areas there are scattered sapling-sized Opuntia (not barked trunks) of 4-6 ft in height with many pads, often even whole branches full of many pads in which the pads are mature and hairy and yet almost touching the ground or at varying distances above ground well under 1-1.5 m and easily reachable by adult tortoises. This is most (Pg. 17) interesting because no adult tortoises have been seen in these two areas for minimally last 8-10 years (according to O. Chappy and information of M. Castro and T. deVries who have all been there on numerous occasions) and probably much longer. Saw no sign in either area; no bones in 1967/68 group area at all; and only very old, crumbly bones of tortoises in 1965/66 group area. This could mean a regression of growth form to a more decumbent pattern by Opuntia, or simply that where tortoises occur in Opuntia stands, one does not see this form because tortoises keep such growth forms trimmed back by browsing.

Continued on to W side, arriving at 1330, and resting about 2 hr afterwards. #12,050 ♂ and #12,060 ♀ both in shade near trail when entered area, inactive and resting – very hot and sunny. G. fuliginosa somewhat active in area, but not in large numbers or large flocks, probably due to heat. No indications yet of mutualistic behavior or facultative de-ticking by finches. About 1600 began (Pg. 18) through area for tortoises, finding four, two adult ♂♂, two adult ♀♀. All were already in burrow sites for night. Bill Reeder found one ♀, (we did not get near enough to obtain number, but clearly marked), a large all smooth-carapace adult, at burrow site she eventually used, but standing up in fully-raised stretched-out posture with head/neck nearly straight up and 4-5 G. fuliginosa on her legs and neck de-ticking her and several others hopping around on ground inspecting her lower legs. His approach around a "corner" of bushes before he could stop himself resulted in finches all flying away and ♀ settling to ground immediately afterwards when she saw him. We checked her 1 hr later and was in same place behind a bush, burrowed into loose soil a bit. Other tortoises noted, all also in loose soil, under or near shrubs, #12,060 ♀, #12050 ♂, #12051 ♂ and #12,061 ♂. All adults with old, worn, smooth shells and all previously recorded and examined. We then set up Aniflex behind #12,050 ♂ so that we were getting a good view of his rear area; he was lying under a (Pg. 19) Scalesia shrub with head and neck down and on ground and legs out in front to side and posterior legs out and resting on feet straight down on ground. We watched him from about 1630 to 1730 hr. During this time there were many G. fuliginosa feeding and foraging on ground in nearby shrub covered areas, often only 0.5 m away from him but saw no attempted inspection/de-ticking of him either facultative or initiation attempts. He was mostly sleeping but occasionally raised neck/head up and looked around; several times he was actually looking at finches and following their movements with his head/neck, but did not respond, even when they were very near his anterior end (0.5 m more or less). Finally about 1730 hr, he rose up and began to slowly move into denser brush and another soil wallow. As soon as he began to rise and just move, G. fuliginosa, about six of them flocked in and began to hop around in front of him only 20 cm away from head which was out straight. He continued to

move to new position; this attempt at initiation by finches lasted about 90 seconds and ended when he settled down in new position for night. We continued watching for another 15 min, (Pg. 20) but he clearly was now in for night and G. fuliginosa were displaying no further interest.

20 Oct 1971 – Other ♀ found here yesterday is #12,149. Arose early this morning to watch #12,050 ♂ and #12,049 ♀; already at 0630, #12,049 had just "stood up", turned and was starting out of her burrow into open planada; she had walked only some 1.5 m when one ♂ and several ♀♀ and juvenile G. fuliginosa, flew in, landed in front of her and began exaggerated hopping. She saw them, stopped, lowered head a bit and looked directly at hopping finches and then went into fully raised posture. The G. fuliginosa immediately flew onto her forelegs and neck and began inspecting and occasionally de-ticking. Several more ♀♀ and juveniles flew in from ground and branches from several meters away where were previously foraging and began to inspect and de-tick rear legs, rear leg pockets, general tail area, and upper arch anteriorly from on top of nuchal notch area. Some were also inspecting grooves of dorsal 1/3 (Pg. 21) of carapace, i.e. scutes juncture lines, but apparently not finding anything. This process continued for almost 2 min, and then finches began flying away to forage in bush again and in some 10-15 sec from first ones leaving, all were gone. Tortoise held position, legs all full extended, neck out fully and up at an angle of 50° for another 25-30 sec and then slowly settled to walking position and continued out into open area. I watched her move another 4-5 m but finches did not return, so I left.

While we were getting movie camera gear set up, saw #12,050 ♂ go through a whole sequence, essentially like that of one just described. We had observed him off and on over previous 25-20 min while still in burrow, but with neck/head up and looking about. Were lots of G. fuliginosa in his area foraging on ground and in low shrubs while he was still stationary, but saw neither initiation attempts or facultative (Pg. 22) grooming by them. However, he then began to rise up and walk out toward planada and then about a half dozen G. fuliginosa flew in, one onto carapace and others on ground near carapace and outstretched (level) head and began hopping. ♂ went into fully raised posture with head/neck up at an angle of 70-80° and finches began inspecting and de-ticking in both anterior and posterior regions, including some additional G. fuliginosa which flew in after ♂ went into stationary, raised posture. Whole period of this activity lasted some 150 sec and then ended as in previous sequence. ♂ settled to ground after this and stretched out neck/head and forelegs and began sleeping and attempting to bask in semi-open spot. We were unable to film this because were not set up and also was extremely misty and with light steady garúa.

The ♂ did eventually move out towards us several more meters (Pg. 23) into complete open, but stopped some 10 m away on a slight rocky rise, settled down, laid stretched out, forelegs to the side and raised neck and head up about 2/3 way and began to look at us. He stayed in this position some 12 min during which time several attempts at initiation were made by individual or several G. fuliginosa hopping about on ground near his front end and on anterior dorsal carapace; but although he looked at these "displaying" finches occasionally, he never responded. In each case finches left soon to return to foraging in brush nearby. Finally,

apparently due to our moving about in his visual field, ♂ turned 180˚, stopped, laid down on plastron, stretched out forelegs, stretched out neck and head, and laid them on ground, and just dropped rear legs down till feet resting on ground. Rear of plastron raised up a short distance on a large rock, so dropped posterior and sides of rear legs rather well exposed to finches, as is tail and skin region all around it. Skin folds are clearly covering supracaudal and first marginal on either sides in part – i.e. scale (Pg. 24) skin junctures and same for the anal scute/skin junctures. We then got into good filming position for this rear area and watched tortoise and filmed facultative inspection and de-ticking by G. fuliginosa over the next hour. Were numerous instances of this at both posterior and anterior ends involving both individual and groups of finches. Tortoise was more or less asleep most of time and never showed any reaction to finches hopping and pecking on him. Several times noted finches hopping about on ground at his head end when he had head/neck up but even though he looked at finches he did not perform mutualistic response. Films of this in Roll #26. (Also, just prior to this sequence on Roll #26, we put water in several of large, flat, smooth-rock, collection sites here to see if could lure tortoises into the area: Took Rolls #24 and 25 of finches and doves drinking, bathing and performing aggressions in these water puddles.)
Then watched #12,050 for another 30 min, seeing several more facultative de-ticking sequences by G. fuliginosa but getting no response by him and no movement. Mostly misty during all this time with short periods of warm scattered radiation and even full sun; ♂ simply lying in open basking position. So in desperation, I moved this ♂ to one of large flat rock water puddle sites and we waited only a few minutes when he, apparently ignoring our presence completely, moved forward and began drinking out of rock pockets; this behavior continued for next 35-40 mi with G. fuliginosa taking advantage of his exposed forelegs, front leg pockets and neck/head to facultatively inspect and de-tick him. Several times G. fuliginosa individuals also tried hopping about on rock in front of him or on his carapace to initiate mutualistic response but he never responded or even appeared to really look at them. Films of this: Rolls #27 and 28. I also took stills of much of this: Roll #380 - last of it – finches/doves drinking and bathing. Roll #381- first part finches/doves drinking and bathing; #12050 drinking and with facultative feeding G. fuliginosa. Roll #382 – drinking by #12,056 and with G. fuliginosa. End of it of same (Pg. 26) tortoise leaving rock after drinking all water and moving off through low brush. After taking last photos, inspected #12050 ♂ for ticks and took photos of tick positions (Roll 383, entire). He has clear medium-thick well developed white growth increments as do # 12,051 ♂; 12,061 ♂, 12,049 ♀, and 12,060 ♀. His ticks show an interesting pattern compared to observations in May 1971. They are many fewer in total numbers – saw only five of translucent type – two in each of interior rear leg pockets, one in a front leg pocket. Tiny black ones fairly dense in most interior parts of leg pockets, on upper neck, and scattered on arch of skin above neck. Small common ones scattered here and there in interior of leg pockets, and scattered along scute/skin borders in rear, top and bottom. Medium-sized ones and a few small ones on plastral midline; former also inside anal opening hidden by skin folds, and inside skin folds formed by supracaudal/skin juncture line and anal scute/skin juncture line; fewer numbers of these on margins and just beyond skin folds of (Pg. 27) scute/skin borders just beyond

anal scutes and supracaudal scute in rear. Only really one large engorged tick and a few engorged medium-sized ones, all in hidden areas; former in anal scute/skin border area and latter in same place and supracaudal/skin border area and just inside anal opening. Marginals, just barely exposed areas in these three hidden areas, showed dried blood splotches and some fresh, bloody, tiny spots, presumably sites from which finches had recently removed ticks of common type. Most interesting that medium- and large-sized common ticks completely absent from exposed areas of scute/skin borders, front and rear, arch above neck, neck, head, around eyes, all around tail and on it, legs, leg pocket interiors. Some of this, (i.e. legs, plastron could be due to abrasion but most areas protected from abrasion. Also a large patch (see photos) of flaking-off skin and exposed fresh skin on neck not far behind head where were a few tiny common ticks and lots of tiny black ones, and many dried (Pg. 28) bloody spots suggesting de-ticking of common ones here also. Found one semi-engorged medium-sized common one between two of toes on a rear foot (see photos). Then checked #12,051 ♂, #12,061 ♂ ,and #12,049 ♀ and found tick abundances and distributions on them essentially same as on #12,051 ♂; all had very few (5-10) of translucent type and common and tiny black ones distributed by size and degree of engorgement as with ♂ #12,050. Each had bloody spots on margins of rear hidden skin areas, but none of others had a patch as on #12050's neck; also #12,049 ♀ lacked a real hidden area on supracaudal/skin border area.

Packed up, returned to coast at 1300 hr and arrived Santa Cruz, Academy Bay at 1830 hr.

(Pg. 29)

Nests found by Pepe Villa and wardens.

Found 15 Oct 1971

Nest #	Location	Condition on surface
1	W side camp near trail	dry
2	Zone D-E Area	dry
3	Zone D-E Area	dry
4	Zone D-E Area	dry
5	Zone D-E Area	dry
6	Zone D-E Area	dry
7	Zone D-E Area	fresh - ♀ #12,076 nearby
8	Zone D-E Area	very dry; herbs in hard cap.
9	Zone D-E Area	very dry; herbs in hard cap.
10	Zone D-E Area	fresh
11	Zone D-E Area	dry
12	On top of barranco to S of Zone E.	? #12,085 nearby
13	S of same barranco	dry
14	S of same barranco	dry
15	Near same barranco	dry
16	S of same barranco	dry
17	S of same barranco	dry
18	S of same barranco	dry

(Pg. 30) Found 16 Oct 1971

19	Near barranco (same cliff) On S side W of Zone C	very fresh – laid by ♀#12,096, is beside it
20	Zone A Area	fresh
21	Zone A Area	fresh
22	Zone A Area	old and dry
23	Zone A Area	old and dry
24	Zone A Area	very fresh

(near #14 found a nest from last year – all young hatched and escaped)
(two unmarked ♀♀ here, plus #12,011 ♀)
(#12,037 ♀ higher up in same general area)

25	Zone A general area	very dry
26	Zone A general area	very dry
27	Zone A general area	very fresh

(♀ unmarked in same area; #12,015 ♀ here also – dead naturally – dead some time)
(Pg. 31)
Found 18 Oct 1971

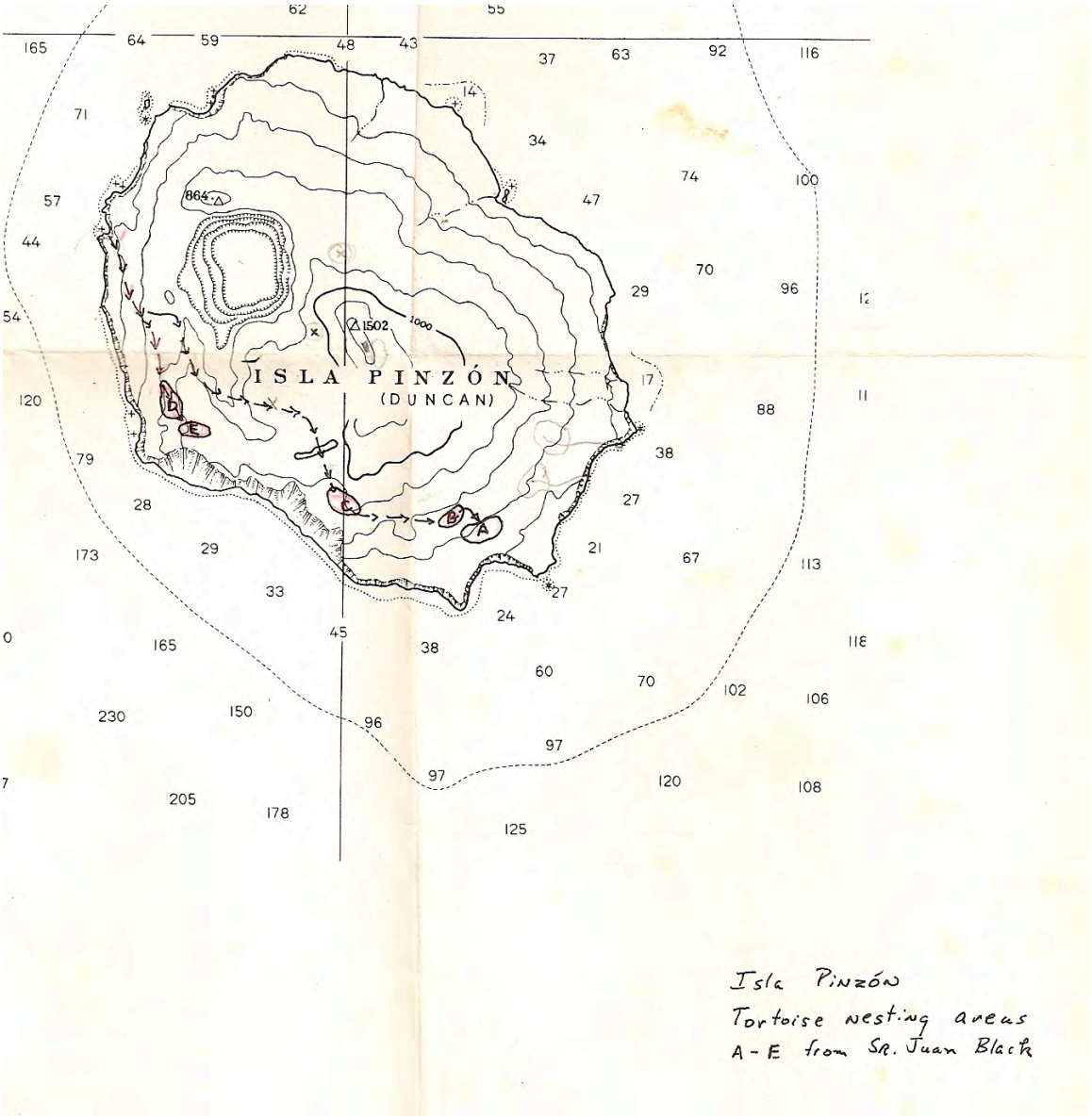
28	Above Nest # 13	very fresh - ♀ #12,084 nearby
29	higher up still near rim on W side;	very fresh Above here some distance #12,069 ♀, a marked but unidentifiable ♂, and #12,075 ♂; also 1 unmarked ♀.
30	Same side but lower down	very fresh – below here #12,074 ♀
31	On 2nd barranco around to S on W side beyond Zone E	dry
32	Above campsite by Trail on W side.	?
33	W side somewhere	?
34	W side somewhere	?
35	near Nest #31	dry - #12,055 ♀ near it.
36	W side somewhere	
37	W side somewhere	

(Pg. 32) 19 Oct 1971
P. Villa, B. Toro opening nests on W side to take them to Santa Cruz; will leave fresh nests.

Nest #	Number of eggs and condition	To Sta Cruz
14	5 eggs – says nest old but some moisture in very bottom of nest	5 eggs
13	3 eggs – very fresh nest – left and refilled	0 eggs
34	4 eggs – very fresh nest – left and refilled	0 eggs
35	4 eggs – very fresh nest but will take eggs	4 eggs
12	2 eggs – very fresh nest – left and refilled	0
15	4 eggs – as with #14	4 eggs
2	very fresh – not opened	
18	6 eggs - ?	6 eggs
3	5 eggs – 5th has small hole in shell; fairly fresh	5 eggs
11	2 eggs - ?	2 eggs
10	5 eggs – fresh – left	0 eggs

4	5 eggs - ?	5 eggs
5	5 eggs - ?	5 eggs
(Pg. 33)		
6	opened - # of eggs?; fresh, left	0 eggs
17	4 eggs - one broken and full of maggots	3 eggs
8	5 eggs – one broken and rotting?	4 eggs
16	5 eggs - ?	5 eggs
32	7 eggs - ? – one broken	6 eggs
33	2 eggs; one broken and rotten	1 egg
36	very fresh; not opened	0 eggs
27	1 egg - ?	1 egg

Of opened nests with eggs counted :
Total number of nests 18; total number of eggs 74.
Total number nests from which eggs taken 14.
Total Number eggs in these nests 60.
Total number eggs to Santa Cruz 56 - four broken by ♀♀ in laying.
Changes in numbers on this page made later – P. Villa miscalculated or recorded information incorrectly first time. [Editorial changes made in transcription – thf]
[Map by J. Black in flap of back cover depicts location of all Nesting Zones named (A-E) and routes to them – inserted below.]
[End of Notebook, CGM Pinzon 3.doc; rest of ledger blank except for some incomplete informal notes on last page.]



Isla Pinzón
Tortoise nesting areas
A-E from Sr. Juan Black

CDRS [Charles Darwin Research Station], Isla Santa Cruz Volume #1.
Field Notebook of Craig MacFarland

Observations made at Charles Darwin Research Station – Vol. #1

(Pg. 1)
7 Sept. 1969
Saw #36 ♀ digging in Santa Cruz pen at CDRS, also some brief aggression sequences; see Book #3, pg 40-52 for details. Also, while watching these sequences noticed some interesting behavior by a juvenile to sub-adult sized ♂Tropidurus albermarlensis around some tortoises (2) near where #36 was digging. In brief, he was essentially using the tortoises as a feeding area. He was mostly in two characteristic positions. -- 1. while the tortoise were up against some lava rocks which came up to about 3/4s of their carapace height he was sitting on top the rock to one side of the tortoises' head and forelegs. 2. While the tortoises were backed away from the rocks somewhat he was on the ground to the tortoises' side, moving occasionally forward near the foreleg and head region. From these two positions the lizard would sit motionless usually watching for some small gnat-sized insects which were buzzing about the tortoises' head, neck, and foreleg region -- especially around the tortoises' eyes and nostrils. Then periodically the lizard would appear to catch sight of a potential . . (Pg. 2) . . prey and dart forward and attempt to capture one -- he usually appeared to be successful but saw some misses. Most interestingly, sometimes the lizard would actually get up onto the top forward region of the carapace and feed briefly in that region. However, this never lasted very long -- only 10-20 seconds at most, and he never seemed to actually use this position as a stationary observation post - only foraged there briefly. Also, several times he actually used the side of the forward region of the carapace as a surface to jump onto and glance off of in attempting to capture an insect. This enabled him to jump from the ground, spring off the shell sideways and capture or attempt to capture the flying insects which were otherwise . . . (Pg. 3) . . . at heights and angles which could have been more difficult to attain. He seemed successful at this also although it was harder to specifically determine successes and failures.
14 Sept. 1969
Talked to Tjitte DeVries at lunch - he says that Rambeck reports that Hood females #1 and #6 have both been digging recently, but no nest yet found. He apparently saw them digging in the morning hours (i.e. probably about 0800-0900) 3 days ago. The #1 female has been seen digging each day since then up till and including today. She is the one which laid a nest recently according to Rambeck. This nest is still in place, surrounded by a rock wall.

Checked on them around 1700 today; #6 sleeping - no digging evident. At 1735 noticed #1 moving toward one of the centrally located, artificial, red soil filled areas of the pen. She moved into the edge of the area and sniffed the surface briefly twice with nose to the ground (neck outstretched and head bent at 45˚ angle downward on the neck). Then probed the area briefly with right forefoot, next to a rock along the border. Dug just at the surface using nails and fore part of base of foot (under the nails); 2 strokes only.
(Pg 4).

Then she moved off of this area to her left a bit and over toward center of the filled area; sniffed again twice at the ground; tested this area about 4-5 cm. beside where she sniffed with left forefoot as above; again 2 strokes; then moved over this area and positioned cloaca above area where she had been sniffing and immediately began digging.
1737 Digging commenced.
1845 Still digging -- have been quietly watching from 7-8 feet behind her- good clear view; started using flashlight at 1815 digging sequence is the same as in S. Cruz #131 basically; alternates feet very regularly and has so far only had 3 brief (20-30 seconds) rest stops. Forefeet are in fixed positions and partly extended - are at right angle to body as in walking and are supporting weight of body . . (Pg 5) . . at least in part. She is up off of soil - plastron 1 ½ - 2" above the ground.
The digging stoke is the same as in S. Cruz #131 - foot in is at a 45˚ angle (turned outwardly) to normal walking position and makes 1-3 short strokes in bottom of hole each time - usually makes 2 and uses nails mostly in a partly curved fashion.
Changing of feet and other movements are essentially same as in #131 except for two main and notable differences.
1) When removing digging foot from hole is not cupping soil on bottom of foot and curved in nails at all - in fact is not using his upward and backward stroke of the foot as a follow through to digging motions at all - instead is sliding foot from digging stroke position simply in a "lazy" arc upward and slightly forward - out of the hole - most of the time no soil is removed in this way; on some removal strokes a bit of loose soil is caught on the top portion of the foot and along the contact surface between the anterior surface of the leg and the sloping, loose "wall of the cavity". At other times the leg and foot are simply lifted out in this fashion but not appressed to the loose wall - in these cases . . . (Pg 6) . . .no soil at all is pushed out -
In sum, the whole cupping of soil and dumping process is not being used as it was seen in the case of #131 in the Reserve.
This stroke may be a type or race difference or simply an adaptation which any race can utilize when the wall of the cavity that is being excavated is made of loose, crumbly soil which is sloping in and falling as in an ant lion's hole. It would seem adaptive in that it does tend to scrape some soil out on occasion and keeps the bottom of the nest at least minimally free of excessive loose soil. It would be interesting to see what would happen if she dropped some cloacal fluid and made the soil easier to . . (Pg 7). . . work with.
She now has the hole about 10-11" (estimations) below the original surface and about 3-4" beneath the point where she has some resting platforms made for the non-digging foot to rest. The problem seems to be that this soil is so loose, dry, and crumbly that she is making a great massive excavation in which the whole back half of the plastron and carapace is slowly working it way down, so that her feet when resting are never more than 3-4" above the bottom of the cavity in which she is digging - still is continually falling back into the hole and she has essentially not gotten any further with the central cavity construction since reach the present relative construction point about 10-15 minutes after starting to dig.
2) The second difference is related to this loose crumbling structure of the whole excavated area also - seems so anyway - again could be adaptive movement any race can us or a racial difference (??). Anyway at the start of the movement of the resting foot in preparation for inserting it into the hole she is sweeping it upward as did #131 at the

Reserve, but is doing so with a . . . (Pg 8) . . .much more notable forward movement so that soil is being cleared upward and to front of the foot rest area - this results in another "ant lion wall" slope of crumbling soil which is continually dribbling back down toward the resting spot - this stroke is like that just previously described in that the soil moved up the slope is being trapped between the anterior face of the leg and the top of the foot and the wall itself.
1900 - Still digging - no progress.
1920 - Still digging - no progress; now getting worse - occasionally rear part of plastron knocks some loose soil into hole when it rubs on edge of cavity - Also resting rear foot (weight supporting one in other words) knocks a little loose soil . . . (Pg 9) in with every digging motion of opposite foot; this resting foot also occasionally slips down ½ - 1 cm fro its rest and knocks soil into hole.
1930 - Same; no progress; resting occasionally for 10-15 seconds.
1940 - Same; no progress; but whole area is getting torn up into a large open topped ant lion like cavity - continually enlarges and become more precarious to maintain bottom of it cleaned out.
1946 - Rest stop - 35 seconds - longest yet.
1948 - 35 second rest again. The right foot in and digging for 30 seconds , then stopped as is for 30 seconds, other stopped as is for 67 seconds; slowing down noticeably all of a sudden.
1950-55 – intermittent “half-hearted” digging
1955 – stopped digging – right foot in hole; forelegs at rest;: plastron on soil.
2007 – still no digging; same resting position; now began a short series of 10 2-3 cm. Lifts of right foot in hole – up and down – probing ?? – can not tell exactly.
2009 – Rose up – plastron off of soil – on all 4 legs; centered cloaca more exactly over hole and dropped down again – all legs now at rest and partly drawn in –
(Pg 10)
2054 – Between 2009 and now moved very slitghtly twice quickly but immediately returned to relaxed position each tiem.
2100 – snuck a look at her head; it is out about 2-3 inches beyond gular scute – eyes open but not moving. Am leaving – she seems definitely done for the night.
2230 – looked at her again – asleep in exactly same position as at 2100

15 Sept. 1969
0730 checked #1 Hood again; exact same position as last night, but alert and stretching neck out and looking around.
1600 Jan was checking on Hood females and spotted #1 digging up near front wall in area of natural brown soil; rock area but good bit of loose soil – there was a bit of
(Pg 11) cloacal fluid or urine pilled apparently but infetisimally small – only a small mud clod of 1 x 3 cm resulted.
1610 Jan returned to get me and we went up at 1610 – she had moved off of the hole and was about 3 meters away just sitting. She saw Jan before and may have been disturbed, except that she kept on digging while craning neck to watch Jan. Also, while we were watching her and vice versa, she moved back over the hole, oriented herself 180 degrees to previous position (after sniffing in hole and area at its tip, and began (1620) digging

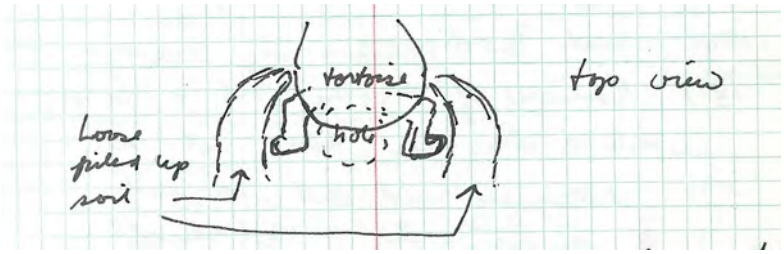
again; hole looks about as successful as one of yesterday – same exact slippage and other conditions prevail – no more cloacal water – it would certainly help!
Has another hole of 10-12 inches below surface, but only about 4 inches below where foot rests are.
1630 Also complicated by 3 fist sized rocks in the bottom. By noticeably digging behind these she has loosened all three and then by catching their front edges with her claws has knocked all 3 completely loose with single back strokes. But once this is accomplished she seems to have no ability to get them out of the . . . (Pg 12) . . .
1635 hole – one was removed fortuitously in a stroke coming up out of the hole – she is using the same stroke as yesterday to clear soil out of the hole – very ineffective; no signs of backward –upward soil removal stroke of #131 in Reserve.
* One very interesting thing learned from this digging however =her left foot when going from resting position to insertion into hole is just as described yesterday – and she is up against a smooth, loose wall of soil with this foot when it is resting. Thus the stroke is functional – it pushes loose soil up and forward away from the resting position.
The right foot however is in a resting position such that (Pg 13) . . .
Such a sloping wall of loose crumbling soil is not in front of the foot rest area – and as she lifts it to insert into the hole she does so without the exaggerated upward –forward stroke used yesterday and simultaneously right now by the left foot!! The lifting of the right foot is not discernibly or grossly different from that used by #131 in the Reserve!!
1640 – quit and moved off
1714 – moved to an artificial red soil area – same sequence of sniffing, testing with forefoot and immediately started digging over area where had been sniffing.
1800 Dug just as yesterday till now – quit, spread out legs, rested on plastron and I think is resting for the night.
1810 - Moved a few more times slightly but immediately went into resting each time.
During this entire digging sequence we are almost certain that she did not ever detect our presence about 20 feet behind her.
2030 – checked again – same position – asleep
Next morning (16 – Sep – 69) checked at 0730 – same position – alert and looking about with out stretched neck – repeat of 14-15 Sep 1969!!
(Pg 14) 16 Sept 1969
0730 – see previous page
1645 – Went up to Hood pen and found #1 digging in a red- fill area in central –rear part of cage.
Immediately noticed that she had apparently defecated into the cavity and latter scooped this out, partly coated and mixed just slightly with a little of the red soil. Two defecations were noticeable each about 8-10 cm long. I think she had done this well after having begun the digging beause these were just on top of the pile of removed dirt on her right rear side. The piles of dirt are in front of and to the sides of her leg – resting position – one pile for each leg – in other words she has the similar problem of loose, crumbling soil which was evident in other recently attempted nests.
1715 Left to get camera, notebooks, etc. –
(Pg. 15) 1730 – Returned, still digging – watching her from behind – about 3 meters – she has not detected me at all yet. Noted that she is basically using the same 2 strokes

described on 14 sept. 1969. Still no evidence of dirt removal techniques used by Santa Cruz female #131 in the reserve area.
Also have now noticed that some of the soil in the piles is made up of small wettish clods of soil. Must be result of dropping at least a little cloacal fluid.
Also have now noticed that she is (and perhaps has been all along –hard to see without using binocs) depositing small drops of cloacal fluid into the cavity – usually only 2-6 drops at a time in fashion of a very slow leaky faucet – total volume very small.
1800 – She just noticed me – afraid I was moving a bit also getting a notebook. Immediately stopped digging and craned neck out to side – watching me and sniffing. Then straight away moved off of cavity and down a rock incline, looking back at me twice – then up against a rock and settled for night. –
2030 – checked again – exact same resting position as at 1805 - I'm afraid I may have caused all this.
(Pg. 16) 17 Sept 1969
0915 Checked Hood #1 – only a few meters from last nights resting place; sitting still on some plates of lava. No digging activity evident in hole where quit last night or anywhere else in pen.
1715 Went up to pen and found her digging, essentially right next to spot where was digging last night. Is turned 90 degrees to the side of last night's position – more in middle of the artificial fill area.

1735 Returned and am watching dig – Is about as deep as was last night when quit. Having same old problems as before with loose, dry soil. Has obviously dropped some cloacal fluid because some of dirt out beside leg resting spots is in form of wet clods. No feces obviously evident, but may be some – Am 15 meters behind her using binoculars.
1745 Is continuing to drop a few drops of cloacal fluid, mainly into the bottom of the hole with almost every digging sequence. However there are no gushes of fluid and not standing fluid at all in the bottom of the hole. Sort of like very slow leaky faucet drip. Some drips are (Pg 17) . . . more out to the side since she lets them go when one leg is in and body is thus swung at bit to one side of center of cavity.
1750 Is down to level where soil forms loose clods which are occasionally removed with her leg movements into and out of the hole – very inefficiently I should add!
Still very slow cloacal drip – drops are coming at rate of perhaps 20-30 per minute – sometimes 5-6 in rapid succession. Cloacal area is wet and so is end and uppers side of tail – red soil sticking to tail. Also soil on feet and ant. Face of lower legs.

1800 – She is in familiar difficult situation with the soil – it is so loose that she must be now 9 –10" below surface (original) at minimum but leg rests are part way down only 5-6" above bottom of hold. Also are two great piles of loose sliding earth – each one in front of its respective leg rest.

[Diagram drawn of tortoise carapace and legs relative to hole from top view showing piles of dirt referred to above]



Instead of getting a good pile of wet mud behind foot rest, she has these loose piles in front and around to sides – they slope outwards, forwards, and upwards.
(Pg 18). 1810 Conditions largely same; still digging; diggin with feet is as described previously so far – at 45 degree angle to walking position – Front feet planted firmly, but sometimes she rests down on forelegs and plastron when diggin; virtually no rest stops yet seen.
When lifts resting foot to begin changing sweeps forward just a bit as well as upward to accomplish pushing the loose soil up onto the pile and away from the foot rest – is doing with both feet – see previous notes on this animal and these cage conditions in reference to this stroke.
1816 First noticeable rest stop
1817 back to digging
1818 Removal of digging foot is largely unlike other day; not really sweeping it out to side and removing dirt; instead after digging with 2-4 strokes of nails and bottom of foot in a backward direction she begins to bring the foot upward and backward, but about then reaches level of (Pg. 19) foot rest or even a little before (1-2 cm) she simply slides whole leg a foot horizontally into leg rest- this destroys what little dirt removal power = the bottom of the foot seems to have ; as a result only the tiniest fraction of the damp soil which is only tenuously adhering to the bottom of the foot gets to the area behind or on the foot rest – a bit more gets scraped to front part of foot rest (i.e. eventually inot the pile of sliding, crumbly, dry soil and damp clods; most of it ends up still in hole or at best on upper back edge of tit where a third tumbling pile is slowly being accumulated – very small till now.
1823 – Suddenly quit – moved forward off of the nest =- am certain she has not detected me at all !! The nest (cavity) is in (word unclear) virtually no better than that of last night and perhaps a bit worse. Maybe she is just tired – Since about 1800 have not been able to see whether or not is still dripping cloacal fluid – Am convinced the soil condition is one problem, even when some cloacal fluid (some = small amounts so far) is added. –
(Pg 20).
1830 – moved away 4 meters and is starting a completely fresh dig in an area of more red fill just below the previous one – in fact exact spot is just 5 inches beside where she was digging on 15 Sept. 1969.
1840 – leaving for supper damn it! No cloacal fluid at new nest yet at all – not even drippings.
2015 – Returned = she has turned 180 degrees around and is asleep with all 4 legs stretched out and head hanging out and appears to be resting on one fore leg.
19 Sept. 1969

0745 – Checked on Hood tortoises; Rambeck says #1 still digging yesterday – I examined all likely spots and there were no indications of any nest and actually no obvious sites of digging from yesterday.
#1 was lying in the pond of h20 with about ½ of body under water; no scum notable on surface as suggested as (Pg 21) . . .

being present after laying by T. DeVries and Rambeck). Did not see #1 drinking at all during the 15 mintues we were present, but Rambeck was in cage near her and she was watching both him and us.
1800 = Mr. Perry says he just noticed #1 Hood female digging in area of soft soil just to north of the pond.
1820 – Arrived and checked; she was digging in typical fashion – no cloacal fluid or feces obvious, but is about 6- 8" deep already. I would guess – however excavation not better than on previous days. Soil here id dark grey –brown and is dry loos and crumbly and has more rock (small pieces) in it than the red soil filled areas; I do not think this is an artificial fill area, but is instead natural soil of the cage site; soil however is of smaller crumbles and pieces in consistency and not as apparently hard to dig as although she is as deep as in some of her attempts in the red soil, she has not 1) sunk down as far in digging and 2) does not have nearly as large a piles of loose soil in front of leg rests – in part they are about ½ the size for this depth as in comparison to the red soil areas. Digging patterns about same –
(Pg 22)
1830 Left to get equipment
1850 returned – has left first hole, moved 2 feet (about 180 degrees turn from former position) and is digging again; am going to supper!!
2015 Returned = crawled just a bit forward of second hole and has quit – resting for night it looks –
2045 Has not moved – leaving –
20 Sept 1969
1600 Jan saw Hood #1 female digging with rear right up against wall of enclosure. There was another hole, apparently just previously made which was ¾ meter from the one she working on and about 1.25 meters from the wall. In the latter hole whe had apparently had to clear a considerable amount of dead vegetation and decaying organic matter (sticks, leaves, catus 'skeletons" - of pads amost entirely; Jan returned (Pg. 23) to get me.
1800 Returned to spot and found WGR watching her; The 1st hold dug was about 6-7" deep from the surface. The one Jan had seen her digging has been abandoned and was apparently onl 3-4 " deep. WGR says when he arrived at approx. 1700 that she was just starting on a new hole – thus it is likely that she had been digging on the one against the wall for about 1 hour plus. As we were watching just after arriving (1813) she gave up this 3rd hole. (i.e. dug 1 hr. 14 minutes approx.) and started off a short distance. WGR reports that when starting this 3rd hole she approached the areas which was covered with a layer of dead vey of perhaps 1 ½ - 2 inches thick , some of it still partly rooted – dead catus pads – skeleton, dead dry sticks, old mostly dead scutia spicata plants; she sniffed the area in typical fashion and then made a 180 degree revolution on it with the plastron appressed to the soil and the legs partly out, the eges of snow plows. By this scooting in a half-circle and using the forelegs

particular in slight half-strokes, fore –aft, she cleaned most of the vegetative debris off of the underlying soil immediately. Then began digging in typical fashion. About 3O minutes after starting did another 180 degree turn similar to the (Pg 24).
Above ones. This one accomplishing additional removal of dead vegetation and half-dead stranding veg near the hole she was digging {marginal note says "bullshit!" apparently inserted by CGM at later time}
1820 – moved off from former hole only 3 meterrs or so and began sniffing a very clutter up area in amongst the superficially embedded lava rocks – the area was covered with dead and semi-dead vegetative debris as in abo ve case. She moved over the area where been sniffing and b egan to scratch with forelegs in fore-aft half strokes from in front of body back to just behind anterior sides of the carapace; also twisted plastron, which was appressed to the ground, in about 20-20 degree arcs; thus cleaned some of debris away. Then began digging and almost immediately hit plate lava at only ½ - 1 inch down. {Mariginal note: "No cloacal fluid visible at any time during these digging sequences"}
(Pg 25)
1825 – quit and moved away – only 5 minutes total for clearing and digging; seems to have responded quickly to lava blacking her digging.
1830 retired for night – nearby –
21 Sept 1969 –
0630 Checked Hood #1 female – still in same place – awake and looking about, but not active.
1715 – WGR noticed her digging just a few meters further south along wall from areas where she was active last night – still in this general very poor soil coveed with stick, small rocks, and other debris.
1735 – Jan and I saw her climbing up onto small lava hill just above where she settled in for the night last night; she walked about in this area for awhile (see notes below). She then came down off of this hill after making a tight semi-circle such that she was ending up only few feet from where she began – she came off of the 45 degree lava slope just above where the 3 diggings of last night are located; she came down head first, head and neck stretched way out; parallel with and in front of body and with head only a few inches above the ground; she appeared to definitely be looking over the debris covered are in front of her as she came down, including holes #1 and 3 from last night which are only 2 feet apart – she then approached 31 hole which was (Pg. 26) . . . a little closer to her and entered it so that ended up pointed down into the excavation at 25 degree angle with fore-half of plastron and forelegs in the cavity. She bent head down to the ground and sniffed – the side and bottom of the cavity noticeably. The she moved virtually entire body into the cavity and turned approximately 190-200 degrees around with front edges of carapace and plastron and forelegs digging deeply into the bottom of the excavation and the front ½ of it wall – as she turned her carapace (top) in fact was lower than the top of the cavity (ground level)and her head thus was retracted into the shell – as a result a lot of soil and debris was pushed out of the excavation over the top and out of one side. She then crawled partly out of the hole and ended up with forelegs out of hole and on the lava rocks above and about ½ of body also out of the excavation. She then began digging in (Pg. 27) fashion. Previously described sweep stroke not being used to get soil out of hole

– in fact no visible attempt to get soil out of hole at all; just dgging up and loosending bottom. She was however using the upward forward stroke in lifting the resting foot to put it into the hole this is doing some "good" in that there is much loose soil in front of each leg's resting position. The area has at best maybe ½ soil in structure – considerable amount of old pieces of sticks, other dead vegetation, small rocks etc. mixed in with the dark brown – grey soil. No cloacal fluid dropped yet.
1800 – still digging - am leaving till after supper – no cloacal fluid visible yet; digging dong with good after first 10 minutes – has about reached level of yesterday – 6- 7". Digging is hard – small rocks in bottom.
2010 – Returned – hole is about same condition; no cloacal fluid or feces seen at yet – rock in hole are small.
She has probably just quit as she is moving off and was about 5 meters away from the hole walking slowly when I arrived. No othe diggings are evident and ttther than those made yesterday and today, so assume its safe to regard her as having just left the excavation in question. It seems to me that this area will never be adequate for a nest. (Pg 28).
2020 – She has moved up against a lava black relaxed and retired for the night.
22 Sept 1969.
Jan observed Hood #1 yesterday from 1630-1800. When jan arrived she was lying in the pool of the pen relaxed. Jan observed her from behind the fence and does nto think the female was aware of her except tht she noticed Jan upon her first approach. She left the pool about 1700 and walked up the 45 degree lave slope to the rear of the pool. Once she was up where this levels out to a more flattened area of plate and block lava she began moving slowly around over much of the area; Jan says se was just ambling about "looling at the ground" and occasionally sniffing it {marginal note:'Jan says not pausing or brobing at all during this walking about'; c. fluid *}
Also while walking along slowly a while directly over some solid lava, she
(Pg. 29). Dropped about one cup of cloacal fluid or urine (?). This came out while she was slowly moving along and Jan saw no indication that she stopped and placed or placed it in any particular fashion. Also Jan observed that it rather gused out (like in cattle) and did not slowly dribble forth as we have seen before in this female when she is digging. Could this be fluid drawn up into the cloaca while in the pool and "accidentally" released or released because of an overload soon after leaving the pool? She came down off of the rocky area and started digging about 1730 behind a log (up against it) in a small patch of natural soil. I went up at 1830 and she was digging in this area- no cloacal fluid and no feces; also I doubt it will be successful - many rocks and very little soil.
Returned at 2030 – stopped digging and at rest in same position and same place.
(Pg. 30)
23 Sept. 1969 –
1758 – Jan saw her (Hood #1) digging in same location as previously dug on 15 Sept. 1969. There was a large amount of wet soil behind her and 2 mud piles, one on each side, thus Jan came to get me.
1830 – Began observing here – Digging is very interesting –
1840 – She obviously began digging as on previous days, if the soft pile of earth can be used as a criterion – there is a pile of dry, loose brown –grey soil in front of each

leg rest – as before these slope forward and upward – these piles reach a max. height of about 4" above the bae soild surface (i.e. perpendicular distance). However, on top of each of these piles is a thin layer – maybe ½ inch of wet sloppy mud and behind each leg rest is a neat semicircular pile of wet mud as seen in (Pg. 31) the case of S. Cruz. #131 in the reserve. In other words it appears as if the following event transpired.

1. cleared area some
2. began typical digging using the 2 swap strokes previously described for this tortoise when digging in loose dry soil which tends to form ant lion holes. She did this for awhile without dropping cloacal fluid – until hole was probably 4-6" below basic soil surface
3. dropped cloacal fluid. And kept digging in fashion same fashion for a little while; however soon changed to #131's style, as she was doing when began observing her at 1830 – is using backward –upward lift stroke using base of foot and somewhat curved nails to convey mud to the piles behind the foot rest and then dumping in similar fashion to #131. the times for these events are unknown of course.

Note; We are watching her from 3 feet away (Jan and I) in open; no sign of disturbance – do not think she is aware of us yet.

1917 Note: since arriving no more cloacal fluid; when arrived there was none in bottom of the cavity – in fact cavity walls (Pg. 32) are damp and bottom is damp; no free fluid or any mud thre and probably has not b een any fluid or mud for last 3-4 inches at least – hard to say –

1920 – she is in a tight spot – only 10 inches to left of nest (her left) there is a lava bank – allows little moving room. Also cavity is oblong – in her ant –post direction – forced to be this way because there are lava rocks on its right and left walls. She is having trouble getting much deeper – she has a small overhang of about ½" at very front end; but nothing more - yet again rocks making it hard.

1923 – She is obviously having a time of it - she is spending many strokes – for last 20 minutes or more trying to scrape . . (Pg 33). These rocks in the 2 walls – loose – but to no avail as yet. She uses opposite foot on the rock on the opposite side –uses outstretched nails and digs in along side of rock – cant' get under it.- almost no resting so far

1924 – One drop (literally) of cloacal. fluid into hole' center.

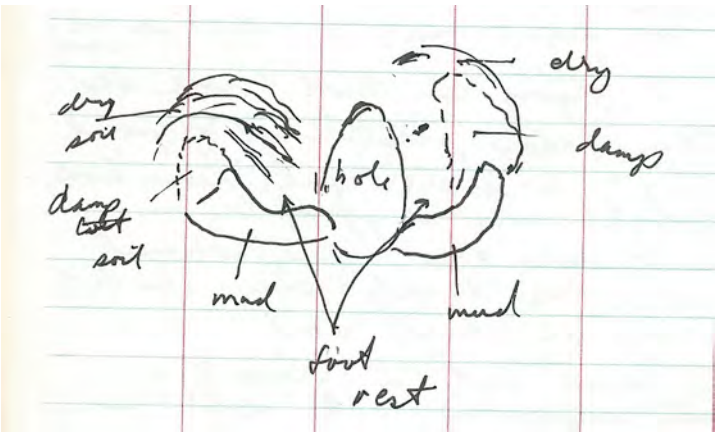
1927 – In trying to move rocks she often raises plastron off of ground 2-4" to exert full rear body weight onto digging leg – have seen this before commonly when this female when she hits rocks or hard soil.

Has front feet in groove and is partly supporting body with them – bent at right angles out to sides. All of plastron back of front legs is on ground except when changing legs (raises up on all 4's) and when exerting pressure (see above). When exerts pressure is up on 3 feet – leaves resting foot in normal position – bent leg resting on ground in sideways position. –

(Pg. 34)

1935 Whole scene –same- making little progress in bottom of hole in fore part – rarely scoops loose soil out of rear portion –

[Diagram of dirt piles, nest hole and relative position of feet.]



Hard to describe – will take series of photographs - some retroactive - photos numbered sequentially
Roll #18 KOD II and Honeywell Strobe unti 4-5 feet.
1928 - #1 Whole scende in between legs in –
i.e. changing digging legs
1930 #2 same
1942 #3 bringing left leg b ack out completion of digging got no soil
1944 #4 same
(Pg 35)
1945 - #5 same = right leg –
1946 - #6 – same – right leg –
1947 - # 7 – digging – right leg – plastron down resting
1948 - #8 – digging – right leg – raised some to give wgt of body on leg
1950 - #10 - inserting left leg into hole
1951 - #11 – lifting right from rest to insert into hole –
1955 - #12 = digging – left foot – in resting position.
2000 - # 13 – left foot – just rasing from resting position at beginning of insertion sequence.
2003 - #14 – just at end of insertion of left foot and leg
2004 - #15 – middle of insertion sequence of left leg and foot – ie.e. swinging across
2006 - #16 just between changing legs= also should show fore part of cavity and slight overhang she is trying to make – also rocks down each side of cavity to its oblong shape –

(Pg. 36)
Stop pictures for awhile – no reaction to flash detectable at all
2010 – she is still trying to get around those 2 rocks – one is a plate along the entire left wall (her lefe) and the otherf is in the center and bottom of the right wall – making leittle progress – may ¼" deeper in center of cavity ((between the rocks) in the last 45 minutes – occasionally takes a little dirt out of rear of cavity and under overhang in very front – the overhang is now 1 – 1 ½ " in depth. {Marginal note: Two more hootos on roll #18 , #17 – left foot in digging; "resting" form. #18 – right foot

in digging; “resting form. In both cases taken from right rear of shell.} Very rarely rests – almost never and only for 10 seconds or so – rest with one foot in hole and down on lastron – ie.e. just before begins digging after changing feet – changing very regularly – have seen her use (Pg. 37) same foot and leg twice in a row yet and have been watching for such.
Almost no caving in at all – no problems of that sort – c. fluid certainly helps in this fine grained notive soil to this area – hangs together when wetted and does not cave in (but red soil fill?) of aritificial areas ?)
Dropped a few drops of cloacal fuid several times while was taking photos – at 1945, 1950, 2010 noticed some – probably digging just a bit every so often – most of it lands on sides of hole because happens when she has one foot in hole and is digging.
2016 = She saw us for first time – put head out to side and looked at Jan – stopped moving for 4 mintues = but then turned head back in front and resumed digging.
2020 – 2022.5 - Rest = right foot in –
2023 – 2024 – Rest – left foot in –
2026 – Has been only half –heartedly digging – a few strokes with each foot in all – looked at us 2 more times; once from each angle.
2028 – slowly moved off of the nest and off to the right. Looked back at us – we got up and out of her view rapidly – (Pg 38) . . . am almost certain that seeing us caused her to leave, but since she has behaved thusly (i.e. quitting abruptly) before it is rather difficult to determine – also, she had been digging to no avil against the 2 lave claocks in the bottom of the hole for approximately 1 ½ hrs. On the other hand , she had obviously dropped more cloacal fluid today than ever before – estimate probably dropped 1 pt. – 1 quart at least. (Cloacal fluid *) It is interesting to note that she was seen in the H20 pool yesterday afternoon and 5 days ago (18 Sept 1969) in the morning.
Returned to area near where she was digging at 2045 (but am outside fence (wall) where she can ot see me – has moved off 5 meters and is resting up against pen wall.
2200 Returned – asleep in last recorded position - I thing she is done for the night (Pg. 39)
24 Sept. 1969 –
0630 – Hood #1 still at rest in the same position as where she was left last night.
1830 – checked on Hood #1; digging in centrally located red soil – artificial fill area – just started it appears because piles of soil in front of leg rests are very small
2030 – checked again – asleep over very small hole she made – no cloacal fluid or feces and appears she quit after digging only a very small while – at east very small hole and solid piles are all that is visible now. .
25 Sept. 1969
1420 : Jan checked Hood female #1; moving about on central raised lava area of the pen – then rested for 5 minutes on plastron on lava blocks.
1425 : moving about again; eating cactus pads on ground ; nibbling on bite or 2 here and there from them – is moving around and encountering pads on ground.
1430-35: resting on ground, head and legs stretched out; then raised neck and head way up; Jan says she thinks she was observing her – probably saw here by one wall.-
Other tortoises seen in Hood pen (2) were asleep, with heads and legs out and on the ground –

(Pg. 40)
#1 did not appear to be prospecting for a digging site and no digging was seen during this period of observation.
1630 – I went to pen – found her resting in same artificial fill area as one she was in last night; but turned 180 degrees around and on roughly the same spot in the filled area. She had been digging at least a little as there were obvious foot rests and small piles of soil in front of them. Watched her for 5 minutes, however, and no movements seen – I think she has probably quit for night and will simply rest here – has legs stretched out flat and is down flush on soil on plastron. No cloacal fluid or feces in the area. Also checked most often potential digging sites and found no traces of digging today. Hood male (Pg. 41) . . . .was lying asleep on top of the area where she had been digging on 23 Sept. '69 when we took series of photos – he had his head and neck stretched out on the soil over the area and was asleep (perhaps attracted to areas by odor of female?)
26 September 1969
1145 = checked Hood female #1 – resting in shade in a rocky and brush covered part of the pen – checked all likely spots and no signs of digging except that from last night. Saw all other Hood tortoises in process. Both other females were resting under bushes; male was in opten eating catcuts pads; sun has been irregularly out in full or partially shaded off and on all morning – actually probably covered more of the time than not.
1730-1800 – in same area as at 1145; still resting ; all 3 others in pen area bedded down for the night I think – 2 scruncheddown into soil covered areas and the other is up under a small bush and against a rock. Has been cool and completely cloudy sinc 1400 with occasional brief periods of very light garua; some widn (3-5 mph I would guess) making it "feel" cool. I doubt she will dig tonight. (Pg 42)
27 Sept. 1969
0630 – Hood #1 soaking in pool; could not determine if drinking or not.
1300 – WGR filming #1 Hood – in H20 when he arrived and crawled out and wandered over rocky area above and right of pool.
1830 – Hood #1 digging along wall but not in good place at all.
2030 – Stopped digging – settled for the night.
28 Sept. 1969 Hood #1 digging
29 Sept 1969 Hood # 1 digging each night at 1830 when checked, but stopped by 2030 – neither time in good place – along fence.

10-22 Oct 1969 – Returned to CDRS for only overnight and while there checked on tortoises in captivity. No more young died since late Sept '69; Female #1 in Hood cage is (Pg. 43) . . . . still digging and Mr. Rambeck says all 3 females from Hood have been digging for the past week or so. (This report may be questionable for the new animal). On night of 10th No. 1 was digging in central artificial fill area, but next a. m. only a dry hole and at 0900 she was in the pool, sitting and occasionally drinking till about 1000 when she climbed out and started making intention mavements toward the otoy stalks left by A. Rambeck. Mr. Perry says he had seen #1 himself digging up till at least 5 Oct., every day, which is the last time he checked.

On morning of Oct 4, 1969 Rambeck found 5-6 eggs lying on the surface in the Hood pen; female #2 (14002) was sitting next to two recently laid ones and what he described as a swet spot which he interpreted as the remains of another egg (?). She was between two blocks of lava and had only a small 5 x15 cm area bit of lousy surface soil lying on top of antoher plate of lava (aoil only 1-2 cm deep and with a lot of plant debris mixed in and on tope of it). Rambeck found 3 more eggs, two lying 4 (?) and then antoher 3 meters in a direct line from this area – they were on open lava. A fifth egg was another 20 meters beyond and also plate lava, but this one was even on a 15 degree sloped piece of plate –shaped lava. All but 2 of them were rather badly smashed and or cracked when he found them at 0730 on the 4th of Oct. and were perhaps additionally eaten by mockingbirds. He had seen her digging the previous night in an artificial fill area near where these were finally laid at abot 1700-1730 hours. (Thus probably laid previous night).

This is interesting because she laid 4 "soft-shelled" (?) eggs during night or early morning of Aug 27, 1968 when in old pen. – These were also (Pg. 45) . . . exposed on the surface. I have in fact not seen her digging at any time while checking Hood animals and Rambecks idea that she has been diggin may be due to his finding many holes each morning (which could all easily have been made in all case by #1). Anyway, it is a moot point for the present, the male did apparently harass both of these females badly in the old corral so that T. De Vries and Rambeck think they had trouble even attempting to dig. But the male has not been noticeably harassing them this year as far as I have seen.

Checked the 2 eggs which had only small holes broken in them – preserved in 105 formalin they are very odd shaped, being oblong and somewhat the shape of an albatross egg but with more rounded ends than the latter.

Measurements

#1 7.1 cm long x 5.07 cm x .06 cm thick

#2 7.1 cm long x 5.28 cm. Long

(Pg. 46)

#1 egg however has a small indentation at one end and this decreases the size oby about 2 mm in length. Each was cracked open when found, #1 1 rather severely on the "long"side and #2 with a 1 c. diameter hole at one end. Each egg is only about 4/5s full, there being an air space of perhaps 1/5 the volume in each; this space is closed off from the rest of the egg contents by a substantial and fairly durable membrane. In each case the air space lies such that the cracked space opens into it and thus this could be in part a dessication effect with the membrane bulling away into the egg as it dired somewhat. Alternatively the air space could be normally present and the cracking occurred there simply because it is a weaker point on the shell surface. (Pg. 47). . .

The eggs are white and the shell brittle, but it appears thin and has a granular surface to the touch – the shell material itself is a bit mushy to the touch if pressed between the thumb and forefinger.

The eggs previously laid on the surface were normally round and smooth in appearance according to T. DeVries.

I opened up #1 egg and checked contents – most of mass is yolk, maybe 3/5s of eggs contents and rest is a very thick albumin the clear material. The embryo area is distinguishable as in a chicken egg, but virtually no development has taken place and the

area in question is only very faintly discernable by a slightly different look under a strong desk light.
This is interesting in reference to the embryo collected by O. Chappy at Cerrito in late August, 1969. See Note book #3.
(Pg 48)
Oct. 21, 1969
Came to CDRS again Briefly; A. Rambeck says no more new nests in Hood or any other pen. Says little actual digging for past 1-2 weeks at all; the only female he mentioned as having noticed at all this past week was the new one, #6 (14006).
Oct 22, 1969
A great pile of data obtained from Sr. Black on nesting on Duncan from his recent trip of Oct 15-17, 1969 and information on incubation of 14 eggs be brought back; also info on tortoise measurements of Sept 28-30, 1969, and preserved specimens of embryos from Duncan. All this is summarized on typewritten data sheets and reports and filed under "Duncan Island", CDRS Tortoise.

(Pg. 49)
Raising Program 1969/70 -
*Note: A large quantity of information has accumulated on the Duncan, Hood, and San Cristobol Islands eggs and young incubated at the CDRS for the 1969\70 nesting - hatching season. This has all been summarized induplicate on the data sheets mentioned above and need not be repeated here.
Today Anders Rambeck told me that he has noted that the Santa Cruz and Duncan Island tortoises began mating about 2 weeks ago and are continuing to do so at this time. For Santa Cruz he has specifically seen the largest male mating with the largest female several times - these are:
#35 male CL 131.5 cm; CW 138.5 cm
#36 female CL 93.2 cm.; CW 100.0 cm
Measurements taken on 2-6 Jan. 1970.
(Pg. 50)
For the Hood animals he recalls specifically the male mating with one female twice, another once, and that he has not seen him mating with the newest one #14006 female. He says she seems to specifically avoid the male and takes off when he comes anywhere near her. He has seen other hood matings than these in the past two weeks but does not recall any but these comments. (The reaction of #14006 female to the male makes me think that the male has certainly at least tried to copulate with her).
The Hood animals are:

Number	Sex	CL (cm)	CW (cm)
#14001	female	61.9	66.0
#14002	female	65.5	66.6
#14005	male	87.7	84.0
#14006	female	63.1	67.5

No signs of any nesting activity. . . .
(Pg 51) . . . have been seen at all yet.

7 May 1970 - Gerry (McGraban) [check spelling] and Jay (Sumner) saw the S. Cruz and Hood tortoises mating today while we were away from the CDRS - but did not know of numbering system so did not get #'s - however, was biggest male and female in S. Cruz corral.
9 May 1970 - I saw #35 male and #36 female G. e. porteri mating in corral this morning at 0900; looked unsuccessful.
11 May 1970 l- I saw #14005 male and 14006 female (Hood) - G. e. hoodensis mating in corral in pool at 0830 today - could not tell if successful but did not appear to be likely to be so because at odd angle up against one side of cement wall of pool - female was part way out of pool and thus on an incline which caused substantial lowering of the rear of her body and thus made successful intromission unlikely.
(Pg 52)
Anders Rambeck says that both Hood and S. Cruz tortoises have been mating almost daily all through April 1970. He says most mating occurs between sunrise and 1000-1100 hours with a second period of less activity between 1600 and sunset. He does not remember any specifics, but he has seen nearly 1 mating every day for the entire month.

He (Rambeck) also recently saw 2 tortoises in the Odds and Sorts pens mating. #20003 M CL 102.5 cm, CW 113.0 cm and #20012 F CL 73.0 cm, CW 81.0 cm. He mentioned having seen an occasional mating in these pens in past years but only very rarely. It is at least interesting that some matings occur here and brings up the clear possibility of inter sub-specific crosses and the possible (& probable) lack of any isolating mechanisms on the behavioral level between subspecies, races, or whatever one wishes to call them.
The exact origin of these two tortoises is unknown - on the cards at the CDRS the following information is given as to the source of them:
20003 -- was in captivity on Isla San Cristobol at home of Sr. Segundo Serrano - he reports it as having originated from N. Isabela 16 years previously. (this is information given on August 4 1965). Brought to CDRS O & S pens on Dec. 12, 1965.
20012 - "from captivity on San Cristobol," brought to CDRS O & S pens on Dec 12, 1965; origin therefore appears to be unknown.
15 May 1970; Pg. 54.--After checking the cards on 4 animals from the odds & sorts pen Juan Black and I decided that it was about 99% certain that all 4 of them came from the San Cristobol population (G. e. chathamensis).
These are:

Animal #	Sex	CL	CW
20007	M?	68.8	73.3
20039	F	75.7	80.0
15070	F	88.0	92.5
15071	F	81.5	85.9

[Note added in margin adjacent to 15070 entry: "Note, definitely a F, laid eggs at CDRS on 7 July 1970 and 17-18 (night) Aug, 1970.]

There is some question about the sex of 2 of these as noted above, so we will have to wait and see if either or both of them attempt nesting. The problem is that both of them have rather intermediate sized (width and length) tails. As will be noted later, one of the larger

males from (Pg. 55) San Cristobol has repeatedly tried to mate with #20007 so perhaps it is in fact a female, although this activity is not a determinant because I have seen homosexual mountings on both Alcedo and Santa Cruz in wild populations.

The two San Cristobol males already in the Cristobol corral are:
#20004 M CL: 92.2 CW 89.7
#208 M CL 114.1 CW 118.8

Today at approximately 1500 hours we moved all 4 of these from the Odds & Sorts pen #3 to the G. e. chathamensis pen. The behavior which followed was very interesting -- #208 M was near the entrance to the corral when the 4 animals were placed just inside of it; #20004 M was about 20 m away.
Soon after placing them inside, 20007 moved off toward $20004's location. Immediately #20004 raised his neck and head up & took note of the approaching tortoise. As the (Pg. 56) smaller one passed by, #20004 began following rapidly behind it but without ever showing any overt sign of trying to sniff the rear area of or the soil over which #20007 passed. The larger male finally caught up with #2007 and immediately mounted the latter from behind. #20007 scooted a bit till it was up against an Opuntia tree trunk which made an effective mounting difficult. There commenced about a 90 minute period of mounting, circling, and mounting by #20004 without ever successfully copulating. Half the mounting took place on the side of the smaller animal. The major problem seem to be the abundant large lava rocks in the area and the Opuntia trunk - these made a good position hard to accomplish finding. For about the first 40 minutes 7 for countless (Pg. 57). Mountings, dismountings, mountings again 20004 did nothing other than scramble up onto the shell of 20007, never once stopping to smell the animal's rear cloacal area, never biting or ramming the smaller one, etc.
During the latter 50 minutes or so of the whole period of activity, the larger Male would occasionally sniff the rear cloacal or rear legs area of #20007, and occasionally bit the rear and or forelegs of the smaller animal. This latter activity occurred when #20007 was essentially passive and resulted in that animal simply hissing and drawing further into it shell. During the total time, except for the scooting during the very first mounting, #20007 remained entirely passive with head and all 4 legs drawn in and off of the ground, thus resting more or less flat on its plastron -- it seemed to be "scared" and offered neither aid or obstruction to #20004's attempts. The smaller animal never showed any aggression toward
(Pg.58) #20004.
During this period #208 M and 20039, 15070, and 15071 Females were doing even more interesting things.
Aggressions: First off, all 3 females started wandering about in the immediate area of the pool and gate very animatedly exploring this new environment. As they did so the(y) frequently met head on, as for as I could tell completely by chance. In every case the immediate response was to stick the neck out and up as far as they could, tilt the head down at 15-45 degrees from the horizontal and try to bite down or toward the head of the other tortoise. This was typical of the aggressions I have seen in the Alcedo and S.Cruz wild populations and among the 4-5 year old Duncan tortoises at the CDRS. These sequences never lasted more than a few seconds and almost (Pg. 59) never involved any

actual contact between the tortoises. -- just threatening mouth openings and slight lunges. This almost always resulted in one of the 2 tortoises in the aggression immediately withdrawing the head and ambling off quickly. Occasionally the "winner" would chase the other a very short distance and ram into its rear with the gular projection once or twice. - This resulted in the pursued simply going on even more quickly. In one case the 3 tortoises involved were neither bluffed and then bit at each others head the jaws interlocked momentarily, they both tugged back with their necks and then they let go and both retreated and moved away --no harm was inflicted in either case. Once, all 3 females came together and a 3 way aggression of the typical kind occurred -- after a few seconds all withdrew, turned and moved way. This all happened so quickly I was unable to make (Pg. 60) accurate notes and observations of which individuals "won" which aggressions and which ones were draws, so any study of hierarchical relationship was not possible.

Mating Attempts: into this fray of 3 females, #208 M plunged very excitedly almost from the first. He would chase, mount, and try to mount one female, be unsuccessful or get in a bad position up against some vegetation or a wall, dismount and then chase another. At one time or another he mounted and tried to mate with all 3 females (or 2 females and 1 male - #15070 still indeterminate). He never was successful in copulating with any of the 3 but this is not surprising given all the movement, aggression, about 5 human spectators looking on, etc.

(Pg 61). Several notable things about this behavior and the response of the females.

1. Sniffing - in many case he sniffed the cloacal and back legs' area of the females before mounting. Sometimes this lasted but a few seconds, sometimes up to ½ minute. He almost always ten immediately clambered up and onto the female from the rear. Especially at the first few mounting (but not at all of the first 4-5) & occasionally later he would simply start mounting from the rear or rear-side over the rear leg pocket without any sniffing beforehand.

2. Agression - several times a female who he was chasing from the side or side-rear, would stop turn her head and "look over the shoulder" and then turn sideways a bit to meet the male head to head - the female would then begin a typical aggression posture with (Pg 62) stretched out neck, open mouth, and head tilted down a bit - the male would immediately respond likewise and give a reasonably vicious lunge with mouth wide open and try to bite the female's head. Every time with the male's first lunge the female would quickly retract in fear, hissing, and turn and try to walk off quickly. The male would then begin mounting, or sniffing the rear, or chasing, or biting the females fore or rear legs.

3. Biting and ramming -- In a number of mating attempts the male would first sniff the female a bit then begin biting her rear legs rather viciously. This caused the female t at least temporarily retract both rear legs and thus either caused her forward locomotion to stop (Pg 63) or decrease greatly. Sometimes on first approach without any sniffing the male would start biting the rear legs first, then after the females stopped moving he would mount. Occasionally, even, the female would be stationary resting on her plastron and he would start biting her as soon as he approached. The mount after she hissed and withdrew. Sometimes this activity caused her to withdraw all 4 legs and her head. Also occasionally the male would approach a moving or even resting female from the front-side or front and start immediately biting at her forelegs and head. This always caused an immediate withdrawal of these parts by the female. Sometimes the female

would afterwards venture to stick the legs (but not the head) back out and pivot away from the male, but he would see this and quickly bite one of the forelegs harshly. This always resulted in a quick re-withdrawal (Pg 64) by the female and thus effectively stopped her movement.
Sometimes the male would ram into a female he was pursuing with his gular area against her rear carapace. This did not occur frequently.
In sum, biting did not always stop a female from moving further but it always clearly cowed them somewhat and slowed them down at least temporarily. This temporary slowdown was usually enough time for the male to then clamber up onto the back of the female whence his weight prevented further successful escape. One interesting aspect was that the male appeared to become so engrossed in biting at times that he did not even attempt to mount the female who in turn began to move off after the first few bites. The male then had to (Pg. 65) resume his chase to bite her again or attempt mounting her.
4. Female interference - The females all attempted as often as possible to get away from #208 Male. They never did any fancy raising or lower of the rear of the plastron to aid or prevent mating but they would try to move away from him as rapidly as possible and would often head into brushy vegetation where it was almost always at least very difficult if not impossible for him to mount. These attempts were often in fact the majority of time, eventually successful in causing the male to give up on one female and go after another one which was passing by.
The most common sequence of events was as follows:
1. sniffing; 2. biting; 3. mounting
The biting become more and more frequent in his repertoire after the first mounting attempts as the females (Pg 66) kept getting away from him by moving along.
5. The mounting techniques and positions - there appeared no difference in any obvious ways from what I have seen on Alcedo or S. Cruz in the wild. Once in position the male would arch his neck out and over full and thus hang his head down in front of the females head area. This I have also seen on S. Cruz and Alcedo to be almost always present in a sequence. However, one new thing had not seen before - This male G. e. chathamensis would open his mouth and threaten the female with this display occasionally when mounted if she began to stick her head out of its pulled in position. The male groaned very typically, and only when (Pg 67) mounted and actually making a thrust movement with his tail and cloacal area.
The thrusting movements, etc. are the same as I have observed for S. Cruz tortoises in the wild - at least as far as these brief observations today allowed me to determine such.
Hood and S. Cruz males both mating with females today

16 May 1970 - 1600 hrs.
G. e. chathamensis - #20004 trying to mate with #20007 in corral - looks unsuccessful.
No activity at this time in Hood or S. Cruz pens.

17 May 1970 -
G. e. chathamensis - 1000 - 1100 - watched #204 male chasing #'s 15071 and 20039 females in pen. No successful copulations. No activity observed directly in S. Cruz and Hood pens but male groans from both.

18 May 1970 -
1230-1330 hours - same activity in G. e. chathamensis pen as yesterday; some chasing around in G. e. hoodensis and G. e. porteri pens also.
(Pg 68)
June 11, 1970
A. Rambeck sys mating has been continuing almost every day all through May and early June in all 3 subspecies pens.
"Last week" (i.e. June 1-5) Bob Silbergleid [check spelling] saw S. Cristobol large male mating with one of the painted animals (i.e. 15070, 15071 or 20039).
On June 8 T. DeVries saw # 35 Male S. Cruz and # 36 Female mating. On June 10 Kenny saw Hood tortoises mating.

Today I found #20004 trying to mate with #20007 (G. e. chathamensis) at 0900. But smaller one was up under brush and a good position was impossible - certainly unsuccessful. At 0915 I found #14005 male mounted on #14006 female in G. e. hoodensis pen (Pg.69) but again, at least while I was there it was definitely not successful. However he dismounted soon after I arrived and was not groaning ever, so perhaps a successful copulation had already occurred. I did note him biting her forelegs and had area after dismounting however - she then ran off as he was going around toward her read as if preparing to remount. He saw me and took off and all was thus over.
Today I asked Anders Rambeck to record mating seen for next month approximately (in tabular form) for all 3 subspecies in separate corrals at CDRS- G. e. porteri, G. e. hoodensis, and G. e. chathamensis. He and I checked all the animals in these pens to make certain he could distinguish them individually, which he demonstrated he can do to my satisfaction. Therefore I will leave the next two pages blank to record this information when he finishes these observation. He will not be able to determine success or lack of it for these copulations so I have asked him only to record any and all obvious copulations attempts (=mountings at least).
(Pg. 70)

Date	G. e. porter		G. e. chathamensis		G. e. hoodensis	
1970	Male	Female	Male	Female	Male	Female
June 16	35	36	208	20039		
June 17	35	36			14005	14001
June 18			208	15071	14005	14006
June 19			20004	15070	14005	14001
June 20	35	36	208	20039		
June 21			208	15071		
June 22	35	36	20004	20039	14005	14002
June 23						
June 24	35	36				
June 25	35	36			14005	14006
June 26						
June 27	35	36	208	15071		
June 28						
June 29	35	36	208	20039	14005	14002
June 30	35	36				

July 1			208	15070		
July 2	35	36	20004	15071	14005	14002
July 4						
July 5	35	36	208	15070	14005	14001
July 7	**see note below		208	15071		
July 8						
July 10	35	36				
July 13	35	36				
July 15	35	36				
July 17	35	36				
July 21	35	36				

Other dates between 10 - 21 July checked but none seen.
(Pg 71) ** till July 1970 occupants of Espanola (G. e. hoodensis) pen were -
Females # 14001, 14002, 14006; Male # 14005

San Cristobol pen were -
Females #20039, 15070, 15071; Males were # 208, 20004, 20007 (sex not absolutely certain)
In the afternoon of 7 July 1970 all these males (including 20007 were removed and isolated together in a new holding pen (see further notes below). Therefore from this date on Rambeck's observations have significance only for G. e. porteri corral. Males (some) were later returned with interesting results (see notes below).

In G. e. porteri (S. Cruz) pen no animals were ever transferred. Only copulations Rambeck has ever seen were always between largest female #36, and largest male #35. Interestingly there are 2 other males in this pen (and possibly 1 female) all of possible ?? breeding size and age. I.e. #'s 1 and 999 males and #998 female (sex of latter in some doubt). However none of these 3 showing any signs of mating or even attempted mating this year so far (or in previous years to anyone's knowledge). Admittedly, all 3 are considerably smaller than larger #'s 35 male and 36 female but one wonders how large and old must be to breed. After 21 July A Rambeck saw no further mating attempts in S. Cruz pen for over 1 month at which time I obtained his notes and told him to stop daily observation in detail.
(Pg. 72) July 7, 1970
Today (on this date, rather; I was not here and obtained these notes from J. Hack [check spelling], Rolf Sievers, and Daniel Weber after returning to CDRS), all G. e. chathamensis males (# 208, 20004, 20007K) and #14005 male G. e. hoodensis were removed from respective pens to a new isolated pen in order that females could attempt to lay eggs in place without constant harassment of horny males.
Apparently as soon as #14005 Hood male and #208 male large S. Cristobol sighted each other they approached each other rapidly and began a severe aggression. No one could describe the sequence of events or postures, etc. accurately for me, but apparently it involved the normal attempts of each male to stretch his neck and raise up on forelegs so that he could get above the other combatant and bite down on (Pg. 73) top of his head. They rapidly succeeded in actually biting each other a few times on the head and eventually even licked jaws and pulled and bit so fiercely that they both started bleeding

around the mouth. At this pint the men present separated them by force and moved them a short distance apart. The G. e. hoodensis male then moved away from the area rapidly and the combat ended. Anyway it was an interesting example of clear and strong aggressive behavior between males of two quite dissimilar looking races.
In following few days, G. e. chathamensis male tried to initiate battle again several times with #14005 male but the later always rapidly moved away from the former and avoided him. No other aggressions were seen between other males or them and these 2.
D. Weber has given me a b/w photo of initial fierce fight.

November 24, 1970
Notes below were originally kept in a special temporary notebook. Am condensing (all details exactly as before - straight copies) them by tortoise race now up to this date in this notebook for permanency.

Española - (Hood) G. e. Hoodensis

7 July 1970 - male 14005 removed from Hood corral and isolated in another with males from S. Cristobol corral; to allow females peace to lay eggs.
10 July 1970 - Noted #14006 female digging - poor sites
12 July 1970 - Nest #1; female 14001; 7 eggs; to incubator and measured same day; see nest sheet for details. Some eggs look very poor and abnormal.
31 July 1970 - Nest #2 - 14006 female; 6 eggs.
3 August 1970 - Nest #3 - 14001 female; 5 eggs
28 August 1970 - Anders Rambeck notes that only #143006 of 3 females has been digging and prospecting for nest sites for the past 2 weeks plus or minus. Other two are mostly lying about inactive except to eat each day.
1 Sept. 1970 - Removed egg #VI, nest 1 and egg # VII, nest 1 (latter on this date, former on 27 Aug. 1970) because fairly obvious that shell are too thin; eggs dehydrating, size and shape abnormal, etc. Sent to Madison, Wis. (J. J. Hickey [check spelling] for DDT and pesticide general analysis.
2 Sept. 1970 - Returned male to corral with females to see if further breeding activity occurs.
11 Sept. 1970.
#14001 female seen digging a hole by A. Rambeck this A .M. In afternoon he found an open hole in same site with 3 eggs in it, 2 broken (fertility or lack of it indeterminable); 1 good one to incubator - Nest # 6. Before today he had seen her digging elsewhere for a few days.
14 Sept. 1970 - 14001 female still digging but with no success. Male removed from corral once again and isolated from females. No copulation have been seen since 2 Sept, but A Rambeck has seen him chase or otherwise disturb females when digging or resting several times.
21 Sept. 1970 - Nest #4, 7 eggs; by female #14006
25 Sept. 1970 - Nest #5, 7 eggs; by female $14001
15 Oct. 1970 - Male returned to corral with females

12 Nov. 1970 - Nest #7; very probably female #14006. 7 eggs. Mr. Rambeck things female 14002 probably laid this but J. Black is fairly certain was #14006. (Rambeck says female 14006 digging still (as of 18 Nov. 1970).
(Pg. 76) __ Nov 1970 - Nest #8; female #14001; 6 eggs **[editor's note - date not clear but potentially same date as 12 Nov. note preceding this entry on new page].**
18 Nov. 1970 - A. Rambeck says has seen no mating or attempts at it for past month in Hood corral. Female 14001, 14002 not digging; 14006 still nest prospecting a bit he thinks.

San Cristobol (Chatham) - G. e. chathamensis.
15 May 1970 - #15070; 15071; 20039; 20007; all to corral when males #208 and 20004 already located. Former ones from "odds and sorts" pen after almost certain placement as being from San Cristobol race.
7 July '70 Males (208, 20004, 20007) to new corral to separate them from females for a while to allow digging in peace and in hopes of nests.
Nest #1 laid same day plus or minus but not located till 14 July when removed. Female #15071; 6 eggs.
10 July 1970 - A Rambeck says no females digging now.
18 Aug. 1970 - Nest #2; female #15070; 7 eggs
28 Aug. 1970 - Anders Rambeck says only female #20039 is digging some now and not very intensively; other 2 females not showing any signs (Pg. 77) of nesting activity.
14 Sept. 1970 - biggest male back to corral (#208) with females; other 2 remain in enclosure separated.
15 Sept 1970 - #208 males already chasing females plus saw several copulation attempts today; slightly less active than when first placed with females in May and on through June, but very interested in them.
26 Sept. 1970 - Nest #3; female 15071; 12 eggs
14 Nov. 1970 - Nest #4. **[attributed to 20039 below]**
18 Nov. 1970 - A. Rambeck says little mating activity in San Cristobol pen now - a bit of chasing is all he has seen for past month or so.
Nesting - he says females #15070, 15071 have not been digging for past month at least and perhaps longer but he can't remember for sure. Only recent digging he has seen was by 20039 female (just before she laid nest #4 - see above)
22 Nov. 1970 - #208 male chasing female #15070 in pen - probably a mating attempt!

(Pg 78).
25 Nov. 1970 - Moved 20 of 2965-66 Pinzon young to a separate corral near sea for special treatment and (from T House). This is in order that we can provide them with special treatment prior to taking them to Pinzon for release on about 9 Dec. 1970.
Treatment: From this date till 5 Dec. 1970 no water; on 5, 6, 7 Dec. water ad libitum; Food continuing as normal - Cryptocarpus, Commelina, cactus (Opuntia), other herbs, grasses, all depending upon availability.

6 Dec. 1970 - Weighted, measured, and permanently marked young tortoises destined for Pinzon today. Weights taken with field scale - 40 lb. Max. Chatillon [check spelling] spring balance, readable to 1/8 of a lb. Measurements taken, only curved length and curved width, with a standard Lufkin 3 meter metallic tape, same as V have been using in field for all such measurements. (Marginal note: Curved length and width as I normally define them - by system of Rothschild). See Duncan Vol 1 for this data.

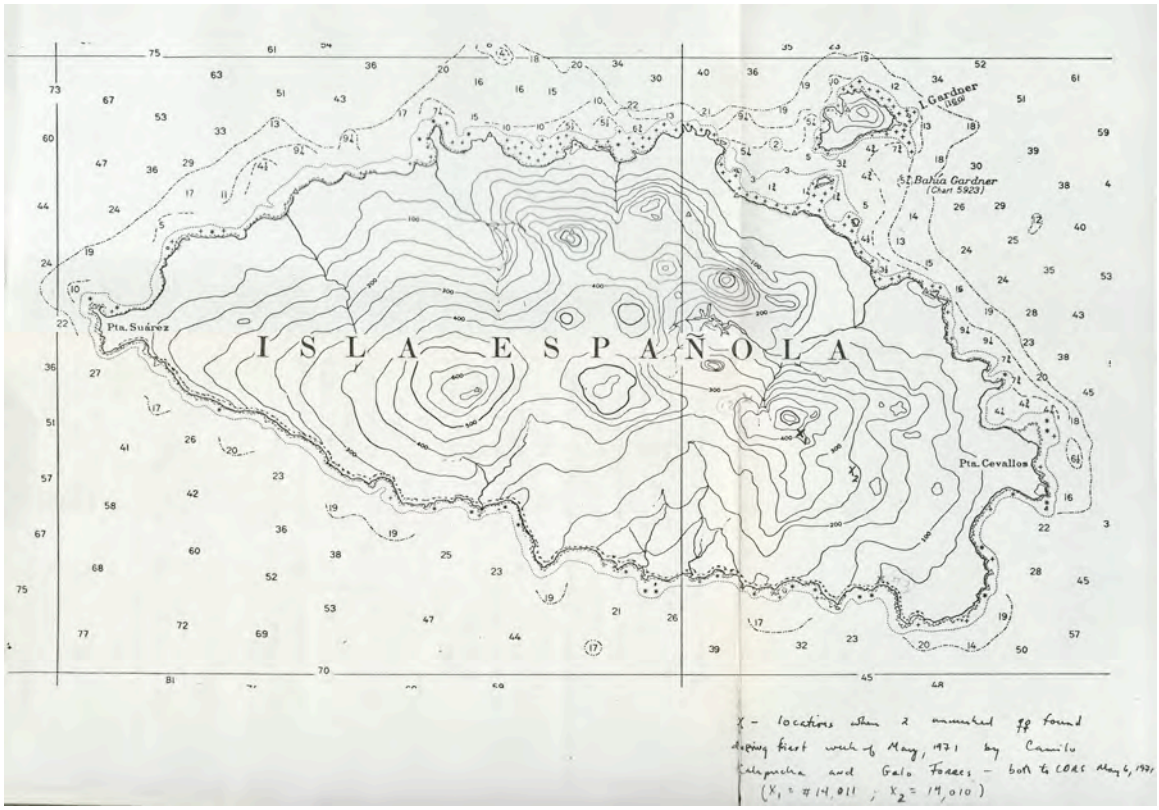
(Pg. 79)
17 Dec. 1970 - Anders Rambeck says saw male #208 G. e. chathamensis mounted on a female for first time (today) since discussed same with him on 18 Nov. 1970; no mating activity in Hood pen; no females acting at all as if going to lay in Hood, S. Cruz, or S. Cristobol pens.
11 Jan 1971 - Anders Rambeck says Hood tortoise male has just begun chasing and mounting 3 females in past few days; also Chatham tortoises are beginning to mate in earnest now whereas December activity was milder.
15 Feb. 1971 - Mating activity continuing among G. e. chathamensis males and females and also in G. e. hoodensis according to A. Rambeck.
27 March 1971 - Two unmarked female tortoises found at Hood and brought to the CDRS by National Park wardens 26 March 1971. Upon arrival I carefully inspected both all over external areas for ectoparasites; could not find any at all even in protected areas where it would be impossible for finches to remove ticks, mites (Pg 80) or other ectoparasites.
Both had abundant lichens of two types all over rear area of carapace (supercaudal, 4th and 5th vertebrals, last costal on each side) and on first three marginals scutes in front on each side. Collected and preserved some of each of these. Both same as have collected on other races of tortoises.
Type I - very pale grey-green frutuciose [spelling] form; have found on nearly every other race of tortoises examined to date.
Type II - pale green fructicose form; less common than above but have found on other races.
(Marginal note: One of these females also has a few patches of pale grey-green crustose form on back of carapace also).
No flaking disease on either tortoise. Will measure and mark them later. Both with all smooth carapace scutes. (Marginal note: These 2 found in "central part of island- highest and greenest- on 20 and 24 March 1971" a.t. Pepe Villa 27 March 1971).
Will include a map as to where these two were found originally at a later date.
(Pg. 81)
April 17, 1971 - Talk to Ramos and A Rambeck and they say in all 3 captive groups (G. e. hoodensis, porteri, chathamensis) that mating activity has continued steadily and strongly all through March and April 1971; they have seen frequent chases, mountings, etc. on an almost daily basis.
May 8, 1971
Today finally marked 2 hoodensis females brought to CDRS on March 27 1971. Marked the as:
14008 female CL 70.0 CW 74.8
14009 female CL 62.5 CW 64.0

Also completed marking of #14007 (marked only #7 prior to today) and checked measures CL 66.4, CW 69.7. (Marginal note: Found between 8 - 15 Jan. 1971 in central area - to CDRS on 15 Jan. 1971, P. Villa.

Camilo Calepucha found 3 further unmarked females on Hood recently and they arrived today at CDRS via Golden Cachalot. Immediately upon their arrival I examined each carefully over entire bodies for tick, mites, or other ectoparasites but could find none at all despite presence on each one of well hidden spots under folds of skin nest to scutes where ticks could certainly survive and not be found by tick hunting finches, if the later occur on Hood. Also marked tortoises and placed them in corral:
#14010 female CL 57.7; CW 57.6 Not too markedly saddle-backed - quite like some forms from San Cristobol Island. This female is very interesting because is smallest and clearly youngest of all tortoise found (Pg 82) on Hood to date. Although her carapace is worn somewhat, many of growth rings, almost to the center of each scute, are still clearly visible. She shows no signs of any flaking disease, algae, or lichens, on carapace or plastron. She has clear, well-developed moderately thick white growth rings (increments).
#14011 female CL 64.4; CW 67.3 - A very saddle-backed old female: carapace scutes worn completely smooth except for a few faint growth rings at very outer edges of some of the carapace scutes. She also has moderately thick well-developed white growth increments. She had no visible flaking disease or algae anywhere on external surfaces. However, she was covered with abundant lichens of same two types collected from 2 females brought March 27, 1971. Using same nomenclature as on page 80 of this volume the distributions was as follows:
Type I - all over rear ¼ of carapace; also dense on first 3 marginal scutes in front on each side; scattered also on forward edges of 1st vertebral scute and in low places of 2nd, 3rd, and 4th vertebral scutes.
[Separate piece of paper included here details as follows:]
Tortoises at Wittmer's 8 April 1971
1. #20000 female CL 99.0 CW 110.0
2. #20000 female CL 92.0 CW 95.5
3. #20000 male CL 96.3 CW 95.0
4. #20000 female? CL 89.6 CW 100.0

Casa Cruz
1. 20009 CL 113.0 CW 117.0
2. 20111 CL 72.0 CW 76.5

(Pg. 83) Attached map of Espanola with X showing locations where 2 unmarked females found during first week of May 1971 by Camilo Calapucha and Galo Torres - both to CDRS May 6 1971, (X1 = #14011; X2 = 14010).



(Pg 83) Type II - also on front marginals and scattered in rear ¼, especially on rear marginals. Am not sure that these are not just different growth phases or slight color variations of same lichen species because "colonies" often after at least mixed if not fused and growth form is almost exactly the same, only Type II being a bit more diminutive. Took photos of lichens on this female - Roll 301, Photos 5-22. Collected same in separate boxes.
See map for locations where these two found.
May 5, 1971. (notes from temporary notebook).
0745 hrs.-- 15071 female (G. e. chathamensis?) grazing on a pile of Commelina diffusa in pen at CDRS. #200039 [Is this really 20039?] began approaching her from about 8 m. away, after noting here while walking along; 20039 came directly at her in normal walking stance. #71 continued grazing; when #29 was about 1 ½ m away 371 noticed her approach and rose up of off plastron in fully raised aggressive posture. 329 continued on and stopped when raised heads/necks only a few cm apart. Heads nearly level, at same height, both fully raised up. Opened mouths simultaneously as #39 drew up to stop position. No jaw
(Pg 84). "trembling". They then made a few faint lunges with open mouths at each others heads but without any contact. #71 finally lunged prominently and almost bit

head, jaws of #39. Later abruptly closed mouth, retracted head/neck, turned, and began to move away quickly, not stopping till over 10 m away from #71 and pile of food. #71 closed mouth and slowly settled back down on to plastron as #39 turned and moved away; she watched the latter for some few seconds as moved off, gave no chase, and then began grazing on Commelina again. Very normal heads-up aggression.
0805 - male #208 (probably G. e. becki and not G. e. chathamensis see notes on captive populations). Began walking toward #15071 Female where she was grazing from some 20 m away. When male was still some 8 m away and coming (Pg85) toward her front end steadily, she noticed him, stopped grazing, turned and swiftly moved away with male in pursuit. He continued to close in and followed directly behind her, neck out straight and head slightly down. When he was only some 15-20 cm to rear of her with head noticeable gular pumping by male commenced. Chase continued till she entered pond in corral and abutted herself, anterior end first directly against rock -cement wall in side of pond. She was ½ -1/2 submerged in this position. Male followed her into pond, sniffed around on her 4th and 5th vertebrals (supracaudal and ½ of 5th vertebral not above H20). For some seconds, then turned and left pond. This would have been a nearly impossible mounting position. Female seemed to know exactly how to avoid the male.
0815 - brief chase in hoodensis pen. Male 14005 chased 14006 female a short ways but she was 20 m ahead when noticed him and escaped easily.
(Pg. 86). May 7, 1971 (From temporary notebook).
Tried some transferring of tortoises to "odds and sorts" pen today to test whether subspecies will try to mount and copulate and aggress among on another or not.

First moved #208 male (from G. e. chathamensis pen) - but probably a G. e. becki or at least an unknown) into "odds and sorts" corral. Just as he entered he and male 20003 saw each other and headed directly together to become engaged aggressively. Aggression was normal "heads-up" one but unlike those in natural populations was extremely fierce. The finally after initial few dozen seconds of raising up and sparring with open mouths, locked jaws and began to bite each other fiercely on jaws, then would release and (Pg. 87) try biting at each other heads, then bite jaws and lock them again. Fairly evenly matched. Eventually after several minutes of this fierce combat #20003 gave up and retreated rapidly. #208 is larger, stronger and was getting head a bit higher and biting more fiercely than his adversary. #20003 jaws were clearly scratched and cut and was bleeding from these cuts. #208 was also injured but not as severely. Filmed this on 16 mm with Anithex - KII [check spelling] See Roll #1; first 53 feet.
Just after this aggression, #208 moved near 2 smaller ones #20007 (male prob) and #20019 (male prob.) and tried briefly to mount #20007 but with no preliminary sniffing and with no success because too small; also tried chasing #20019 and mounting him, also unsuccessful. Also filmed this. - Roll 1, last 47 feet +-. Jan took stills of all above Rolls 298-300.
(Pg. 88).
We then brought in the Hood male (#14005) and directed him toward #208's general position. When some 12 m apart they directly moved toward each other and went into fully raised "heads-up" aggressive postures. The entire aggression never went beyond each trying to stretch neck up higher than the other and bring head down on top of others with mouths open; i.e. bluff-like thrusts with open mouths. Lasted only some 30-40

seconds and then #14005 gave up and turned and ran with male 208 following. Some 10 m. before letting smaller male escape. Although hood male is much less bulky and smaller, his legs and neck are so long that when both were fully stretch out Hood male had his head up level with #208's and 208 was simply (Pg 89) more aggressive and scared #14005 away by more aggressive thrusts and probably larger size. Filmed this also - Roll #2, KII, first 20 feet. Jan took some stills of this also - Rolls - 298-300.
Next 20 feet of Roll #2 - Male 20003 attempting copulation with female 20002 (saddlebacked female). Unsuccessful - very normal simple attempt.

Remained in pens for next 2 hours and saw many attempted copulations (all unsuccessful because mounted animals very actively trying to escape and getting under shrubs and on embankments, and up against rocks, etc. Both Hood male and #208 male involved in many of these attempts with all shapes and small-med. Sizes of odds and sorts tortoises. All very normal mountings= most did not involve any preliminary olfaction. Tortoises all very excited and moving around. For example, saw Hood male attempt mountings of #'s 20002, 20003[?], 20019, 20007.
(Pg. 90)
Also - 1 brief normal aggression between Hood male and #20003 male, Hood male driving other away easily because got head up above and bit down at other causing retraction and retreat.

20 June 1971.
Returned male #208 to corral of G. e. chathamensis. Immediately upon entering it he saw female #15070 and headed directly for her with no hesitation, she saw his approach and began to "run" way but male easily overtook her, briefly sniffed (gular pumping) of cloacal area and mounted. However, she continued to move and managed to escape from beneath him and moved away rapidly into brush with male following but not having any success in catching or mounting her.
Filmed this - most of remainder of Roll #2.
(Pg 91). In process of chasing her, they passed with a few meters of #15071 and #20039, both which were feeding on cactus - they both immediately upon seeing male ran away into dense brush to avoid him. He continued chasing, mounting, tailing, etc. after 15070 and 15071 for another 1 ¼ hours before sun drove him into shad and forced inactivity.
End of Roll 2 is some 10 feet plus of Geospiza scandens feeding on fallen Opuntia pads in corral at CDRS.

5 July 1971.
At 1645 this evening noted G. e. hoodensis females #14001 and 14006 digging. Both had already released urine into holes where digging. #14001 digging in one of "artificial" or prepared nesting sites; #14006 digging in natural d. brown soil near pond, a very poor site.
At 1725 carefully approached each from rear, not being detected. #14006 already hitting a rock in bottom of cavity at 15 ½ cm. She quit in 1830-1900 time period, having progressed (Pg. 92). No further since 1725. Had released much urine but rock completely prevented any deeper excavation. [Marginal note- See Roll 310 17 to end and Roll 311 1-16 of this nest digging attempt.]

#14001 dug up till 1950 hours and then quit - she had used only a limited amount of urine and was having a definite problem with much caving in from all around sides of nest. Deepest she achieved was 16 cm and remained at this depth for last 1 ½ - 1 ¾ hours of digging due to caving in of loose soil. Why did she not use more urine.
#36 female G. e. porteri digging tonight also = in place where [or near] #14006 - gave up early - poor site.
6 July 1971.
Went up to corrals and checked around all 3 between 1600 - 1630 . No digging in G. e. chathamensis pen but female 15070 waling about and sniffing open spots in corral - looks like typical exploratory behavior before digging
(Pg 93). begins.

Female #36 G. e. porteri already digging in same poor area where was last evening - success here unlikely - abundant surface and subsurface lava rocks. No urine deposited yet.
Female 14006 digging in a site near corral wall - very poor place like last evening's, actually a bit worse - more surface and subsurface rocks. Area where she and 14001 dug some last year. Nor urine used yet.
Female 14001 digging in same area as last evening - just 2 feet from where she was then. First spotted her at 1435 and snuck up to her rear- already has dropped some urine but not too much. Hole is already 18 cm deep and urine obviously dropped recently as upper soil on foot deposition piles only is moist and muddy, lower soil being loose and dry. No rock anywhere in nest or near it so perhaps will be successful. Watched her for about 15 minutes - she is releasing small amounts (est. 10 -20 cc/release) of cloacal fluid frequently - i.e. after each few foot changes and is steadily and slowly deepening hole a tine fraction at a time.
(Pg 94)
Went to get cameras and returned at 1715 took up position to her rear and continued observations. Watching till 1845 - digging movement and process exactly same as in G. e. porteri nesting I have witnessed.

Between 1845 -1900 checking other tortoises. #14006 female and #36 female have stopped digging - both hit abundant rocks within 6- 10 cm of surface and stopped - no cloacal fluid released. #15070 also evidently began digging in a natural brown soil site very near where saw her searching earlier. Now lying beside it; inactive. She had struck rocks just below the surface and given up quickly due to this - no cloacal fluid used.

Returned to female 14001 just after 1900 and continued watching her excavation procedures. Using much cloacal fluid now - much (Pg. 95) cloacal fluid now - much wet soil in bottom of nest and on foot- deposition piles. Can not see any differences in her movement and G. e. porteri females have watched. She is alternating feet regularly; is resting on plastron while digging with one foot, i.e. resting on its (word not clear) but maintaining legs at ½ -2/3's out and raised up in front end., she is thus maintaining fore-feet in a fixed posture and fixed positions. She of course raises plastron off of ground when changes legs and carefully sweeps upward / forward with foot from resting position on deposition pile (thus pushing loose soil forward and away from nesting cavity), then

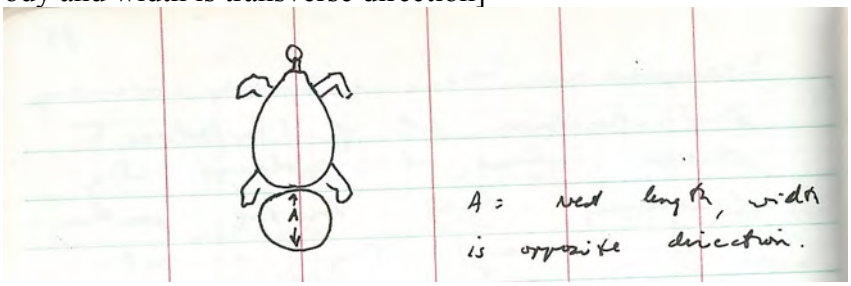
pulls leg/foot well up under herself, then wings over till foot is centered over cavity and then inserts foot/leg into hole thus carefully not knocking soil into nest. The reverse process of bringing foot up out of hole with a load of (Pg 96) still held on its base (one the cup formed of toe-nails and foot base) is also done very carefully by raising body off of ground in rear and carefully swinging foot and leg up and over and depositing soil on to deposition pile - thus minimizing chances of dropping soil or knocking soil into the nest cavity. Digging involves carefully gouging into soil with nails, sometimes using up to 4-5 "strokes" but always 2-3 before she brings soil out of nest and changes feet. Digs sometimes on same side of cavity floor as the foot she has in but often also digs diagonally and laterally to anteriorly into opposite side of cavity as the foot which is inside. She is also now 1930 starting to use the nails to dig forward to form the flask (Pg 97) undercut which occupies the forward ½ -2/3's of nest's circumference. This especially involves much diagonal "cross-digging" but not exclusively. She is frequently releasing small amounts of cloacal fluid, usually between feet, just when has both feet resting on deposition piles as is smoothly changing legs, but sometimes releases it more to side of cavity when has one foot in hole and is actually digging. This release is one smoothly with no interruption of the smooth flow of her digging and foot exchange movements.

2020 - in a few minutes am going to take some measurements of nest cavity because for post 40 minutes she has not been deepening, widening, or extending the undercut dept at all. She seems to have reached her limit of digging depth and width. The leg is fully stretched to its limit when digging either straight down into the center - bottom of the cavity or when digging forward into the (Pg. 98) undercut. In fact when 1 leg is in digging (word not clear), she is lowered to the ultimate extent with her rear plastron resting on the ground on the inserted leg's side and other side also and marginals above opposite leg are pressed down tightly and fully onto the resting leg which is as far out to the side on the deposition pile as possible and lying virtually flat on the soil. Thus she has reached two limits: legs are as far laterally as can be on deposition piles and when digging with one the whole rear of the body is so low as it can be placed, being limited from further lowering by the resting leg being flattened (word may be something else) by the marginals or its side of (Pg. 99) carapace. This is a very interesting and instructive set of limitations to observe because it explains why(assuming fixed forefoot positions are necessary) they do not simply dig a long trench behind them for the eggs - i.e. they can not do so and maintain the integrity of the nest cavity - if they tried it they would be plagued with caving in. It also sets a limit to nest depth.

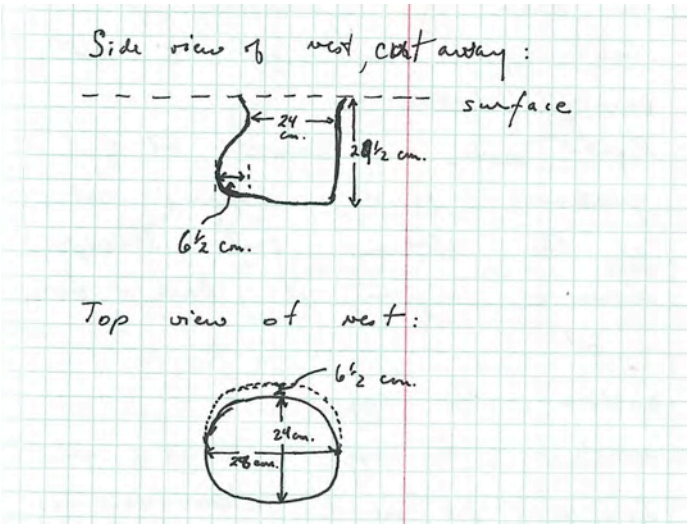
Earlier when the cavity was not as deep the female would occasionally raise slightly up with a digging stroke, thus putting all the rear body weight down through one foot bone (word may not be correct) and nails and thus adding force to the digging stroke - this is not possible now because her legs is fully stretched out in the cavity and she has reached her "reach - limit".

2026-2028 measurements taken quickly by working around and between her stretching and leg changing.

(Pg 100).
[Turtle in relation to nest showing that measurement A is in longitudinal axis of tortoise's body and width is transverse direction]



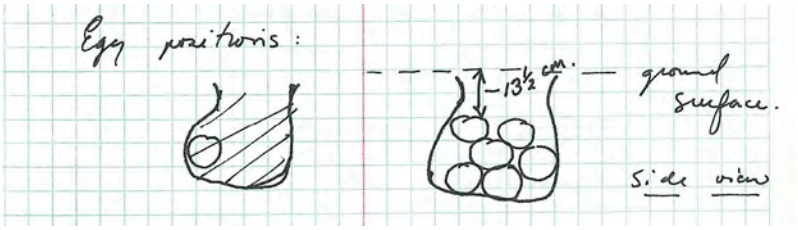
Nest hole is as big at top of ground as is possible.
Measurements:
1. Distance between inside borders of foot positions on soil deposition piles =- 33 ½ cm.
2. Nest cavity width at surface - ie. st. lines running up from sides of cavity proper - 28 cm.
3. Nest cavity length - 24 cm.
[Marginal note beside items 2 and 3 above; Nest cavity is nearly straight walled in rear ½ with a slight curving to wider opening at actual ground surface.]
4. Undercut depth - deepest in forward venter and at cavity base - decreasing slowly in depth as does up and laterally /posteriorly. = deepest pt = 6 ½ cm.
5. Max. depth of nest = in center of cavity - rising only slightly into undercut area = rest of cavity floor basically all same depth - 29 ½ cm.
[Side view of nest cut away and top view of nest.]



In this extremely stretched out digging position she is stretching so hard that resting foot occasionally is forced to move ever so slightly resulting in a small amount of soil falling into nest cavity

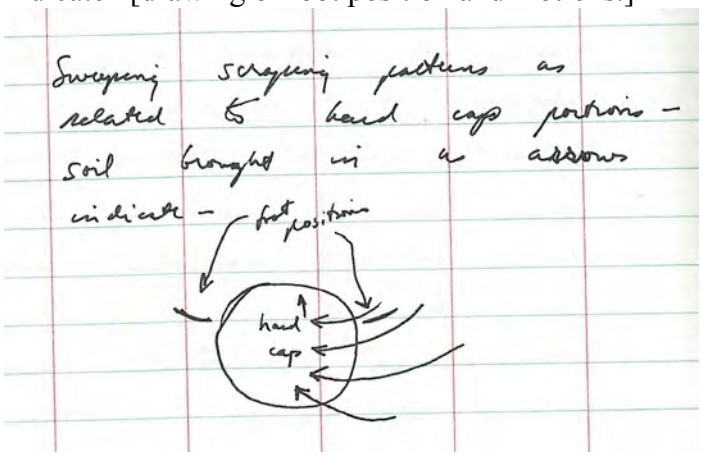
2031 = She has just stopped digging and dropped down onto legs which are lying flat on soil - dep. Site= marginals and fully pushing against (Pg 102) the flattened legs and doing so fully and hard (creasing into flesh). Legs are fully spread to widest position in rear thus allowing greatest dropping down in rear of plastron and closest tail can get to nest cavity bottom.
Right away a small bit of gelatinous fluid dripping out of the cloaca, tail straight down and wriggling it back and forth a bit.
2041 first egg
2043 ½ second egg
2045 ¼ third egg
2048 4th egg
2048 5th egg
2049 6th egg A bit of gelatin between each egg and minor tail twitching; gelatinous mass enclosing each egg and easing fall into nest.
Then sitting in same position, tail twitching a bit and more gelatin till 2055. Noticed a light down dropping of plastron with each egg (1-3 cm) just as egg cleared cloacal opening - i.e. shortened distance of egg's fall a bit - marginals really pressing into flattened rear legs with each of these "extra efforts" at lowering rear of body.

Egg positions: [2 drawings of nest chamber]



Just after 2055 she slowly raised up and inserted leg and foot carefully into cavity (remaining raised up slightly on rear "resting" leg, leg taut and straight down, foot flexed and nails almost straight down - lowered leg till tips of nail just touched one of top 2 eggs. Then changed legs and repeated in nest just to side of previous insertion. Then did same once more with each leg. No attempts to move eggs yet - seems to just be checking their depth by "touch". Then began filling nest in rear first =- scraping soil on inside rear edges of foot rest (wet soil) into rear of nest with front (Pg 104) surface of feet. This activity continuing for nest 35 minutes till eggs covered up and cavity full of loose wet soil up to within 5-7 cm of surface - till now no tamping at all and by taking soil on top of deposition piles and in their nearest and rearmost positions has used moistened soil exclusively. Now beginning first tamping and still getting moist soil only because sticking to deposition piles.
2150 - continuing filling, scraping in small amounts from deposition piles, then tamping them down with nails (front surface and by sticking them into mud downward), base of foot, side of foot even. (Pg 105)
From here on took no notes but continued watching covering process and photographing it - process same as in G. e. porteri - over time strokes getting further and further out till she is turning and pivoting way out and using a variety of tamping methods. She is

selectively scarping soil in from many areas in a large arc out beyond food deposition piles and also selectively depositing it in certain areas of hard up (not sure about these two words) tamping it and moving on to concentrate on another part of the hard cap. All of this documented in photos. By doing this, i.e. orderly moving to different areas for scraping and sweeping soil into different areas of forming hard cap she is assuring as +, - even and well -mounded and (not sure of word) h. cap and also a smooth, even scraping of surrounding areas. Most of this should be on film. She finally finished cap and covering and moved off of nest site to (Pg. 106). To rest a few meters away at 0307 in early morning.
Films of process (with Honeywell electronic strobe, all KII 36 exposure rolls) -
Roll #311 digging process (#s 17- end)
Roll #312 - pre-laying and egg laying
Roll #313 - early nest filling and testing of egg depth before this.
Roll #314 - covering nest.
Roll #315 - ditto
Roll #316 - (1-17) ditto
Sweeping scraping patterns as related to hard cap portions - soil brought in as arrows indicate –[drawing of foot position and motions.]



Pg. 107
Great variety of tamping methods used - see photos = all done with foot, lower leg, and nails, never plastron - often involves putting all of rear body weight down onto cap via leg and foot.

7 July 1971.
Excavated female 14001's nest this p.m., weighed, measured eggs, labeled them as to nest and # , and placed in natural sun incubator near sea at CDRS.

Nest #1 Hood 1971/72

Egg #	mm	X	mm	wgt. (grams)
I	60.4		55.0	108.4
II	58.1		56.7	105.8
III	57.3		55.0	102.7
IV	57.8		56.7	106.8
V	59.5		55.1	105.7
VI	58.4		57.0	110.1

(Pg. 108)
21 July 1971
Pepe Villa and A Rambeck opened nest and removed eggs and placed in incubator after marking them - 1000 hrs.
Laid 19-20 July 1971 (night of) female 15070 G. e. chathamensis pen)
6 eggs, all in good condition. Well made moist nest (and in red soil "artificial" site. Marked as nest #1, eggs I - VI. Will have to weight and measure at end of incubation as have received this information just now (2 Aug. 1971).
(Pg. 109)
23 July 1971
Villa and Rambeck - same for another nest 1100 hours to incubator. Nest #2, G. e. hoodensis. Female #14002. Probably laid night of 20-21 July but unsure. 5 eggs in good condition. Well made nest in red soil area. Marked eggs as nest #2, eggs I - V.

20 August 1971 - 3 nest laid recently in pens - 1 in Santa Cruz and 2 in Hood.

Nest in S. Cruz pen - found by A Rambeck, laid about 2 weeks ago by lg. Female #36 G. e. porteri; laid in same poor site where saw here digging this year and where dug past 2 years. Very poor spot, in fine, dark brown soil - 12 eggs; nest has a large rock in front bottom and rocks in front-sides and many surface rocks. Female obviously could not dig deep and because desperate, and laid; not much cloacal fluid, but no feces. Deepest part of nest in rear = 20.5 cm. Nest only about 20 X 20 cm. And almost no undercut due to rock in forward part of nest - Eggs in a great piled mass and top most one only a couple of cm down and completely smashed - next (Pg. 110) 3 only a couple cm. Deeper and all with caved in spots on shell but membranes intact. Will wit to measure and weight eggs- to incubator for now - numbered I - XI, nest #1 Partially damaged ones are #'s I, III, VII, other all appear OK.
Hood nests -
Nest #3 - laid also about 3 weeks ago by G. e. hoodensis female #14011. (Found by A. Rambeck, prob by 14011. Will be interesting to see if these hatch because exposed to male for only a short time. Will not with and measure now, but just examine nest and transfer eggs to incubator.
Nest dug down to 31 cm depth in center - forward and undercut has same bottom depth. For normal with shallow undercut of a few cm in anterior 2/5s of nest's circumference; no rocks, all red soil nest laid only 40 cm from that of 14001 female (nest #1 1971/72). Nest slants up in back and has loose, dry soil coming

[Marginal note: Hard cap moist and solid +- about 1 cm. loose dry soil over it. Moist soil scattered between eggs - hard cap down on top of upper 2 eggs.]

(Pg 111)
down into it in rear so that when she began laying only undercut still 31 cm. deep, center and rear of nest not as deep - center where she began laying eggs at 27.5 cm. deepest - then sloping rather steeply up to rear; 8 eggs, all small, neat (word unclear) and rounded. Depths to top of eggs from top of nest (ground surface) - eggs in 2 main layers 6 on bottom, 2 on top but depths to their tops vary because of slant of soil discussed above.
1st layer.--Bottomost egg in center - 21.5 cm. 3 eggs nearest this one in center and center/rear of nest - 19.5 cm. 2 egg above these, - 17.5 cm. more to rear of nest.
Upper layer.--Next to topmost egg - 16.5 cm.; top most egg - 16 cm. --These two resting in indentations, on top of bottom layer of 6 eggs, all of which were resting on soil.
She "left" [word unclear] no feces, but a moderate amount of cloacal fluid = nest still moist.
Numbered eggs I-VIII, nest 3 Nest rather full of eggs except none under undercut - if 2 top one had been in it would have been full at lower single layer.
(Pg. 112)
Nest #4
Laid about 2 weeks ago by G. e. hoodensis female #14007. Found by A. Rambeck. In dark brown fine soil, natural site, in a rather poor area of the corral.
Nest made in a tight place with surface boulders just behind where female stood; many rocks lining nest walls so that it is a long thin hole sloping down from rear of nest at about a 65-70 degree angle - rear of nest a long plate sock lying at this angle forward; front of nest soil, rocks in sides - Nest dimensions at surface - 20 cm side to side and 12 cm front to back, narrowing a bit in interior - no real undercut - whole cavity is slanted forward like an undercut. Hard cap not very durable - very wet with a small amount of feces in it. No rocks in bottom of nest so . . .
(Pg 113) . . .presumably as deep as she could or desired to dig. Used much urine - still moist.
Rear of nest caving in continuously and slightly so that actual bottom was at 32 cm. due to loose soil above, where she dug down to 34 cm from soil surface.
7 eggs in a jumble, nearly filling small cavity - all small, round, white and OK. Marked and to incubator without measuring or weighing yet.
Eggs - 1 on bottom - 25.5 cm to its top from ground surface.
1 beside it = 23 cm to its top
2 above these on slant - 19 cm to their top
3 above these on slant - 15 cm to their top.

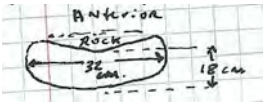
All eggs above bottom 2 resting partly on soil and or partly on eggs beside and below them. Loose moist soil scattered around and on top of eggs - then hard cap to within 1-2 cm of top of uppermost egg.
All three of these nest laid just after I went to James on 5 August 1971 so A Rambeck's statement of "two weeks ago" is about correct Since these three were laid he has not noted any more females digging till last night. He says 1 hoodensis and 1 female in chathamensis pen are now digging (last night) so will try to observe

(Pg. 114) . . . .these if possible.
Began taking photos (standard ones) of tortoises today from hoodensis group - Roll 352 #9-24 of G. e. hoodensis female #14011.

21 August 1971.
Female hoodensis digging last night and night before was #14008 - no success yet.

Female 15071 from chathamensis pen laid last night in last east upper corner of pen in artificial soil site, only ½ m from where nest #1 from this group was laid this year. Will open nest tomorrow.

22 August 1971. Opened nest - extremely well made using much urine, with a dense, thick, moist cap of well packed hard soil sting right down on top of eggs. Nest cavity quite large - she dug around a large rock which occupies entire front wall of nest from surface of soil to bottom of nest.
(Pg 115)
. . . cavity with any forward undercut, in an elongated kidney shape.
Top view of nest:



Nest of basically uniform depth on bottom, being 26 cm deep, but with 1 ½ cm of loose muddy solid in bottom, so that eggs resting on mud at 24.5 cm from ground surface.
12 eggs, 8 at same depth in bottom, 4 resting on these in their interstices; nest quite full but could have had put a few more eggs in upper layer. Female must have moved eggs with foot because very well spread out to occupy entire bottom of nest cavity 8 eggs there literally in pairs on two rows fitting into nest cavity (i.e. drawing showing 4 pairs of two eggs each in row) top view of nest.



Top 4 eggs at 16 cm from ground surface. Bottom of nest with some small rocks in it so perhaps female was forced to stop digging when she did so - however difficult to say exactly because nest bottom wet and clearly well scraped by digging feet but also with some open soil areas in it free of rocks.
Removed eggs to incubator without weighing and measuring because no time for that today. Will weigh and measure toward end of incubation period.

(Pg. 116).
22 August 1971.
#15,070 female digging tonight – no success
14,008 female digging tonight = no success

25 August 1971 – Same two females still digging each afternoon and night but with no success yet – neither has yet used a deep artificial soil site – using natural sties and hitting rocks within 5-15 cm. Every time. – no fluid dropped yet at all.
26 Aug. 1971 – same 2 females digging, some results
27 Aug 1971 – continued taking standard photos of Hood tortoises today –
Roll 352 31 - end #14005 male KII
Roll 353 all - #14005 male KII (marginal note "some of lichens")
Roll 354 – 1-12 - #14005 male KX (marginal note "some of lichens")
13-26 - #14001 female
27-36 - #14006 female
No laying this evening – both digging again but no results
28 Aug 1971
Continuing with Hood tortoises – took Roll 355, Kx, photos 1-22
(Pg. 117) . . . of Hood male 14005, mostly of lichens. He has some large patches of pale grey-green crustose form on top of carapace distribution is as follows:
1 large patch on rear (left side of center) of 2nd vertebral, a smaller patch beside this – lg. Patch is 3 x 1.6 cm. (?includes points?) and +/- oval.
1 large patch is same position on 3rd vertebral and small patch on same scute more to left and right. Lg. Patch measures 2.05 x 1.2 cm.
1 large patch on upper side of 3rd left costal where its "point" meets 3re and 4th vertebrals. This measures 2.25 x 1.3 cm .
1 large patch just to left rear center of 4th vertebral, measuring 2.0 x 1.8 c. Collected ½ of this one.
Tiny spots of same on 1) upper edge of last left costal 2) upper edge of 2nd left costal; 3) upper edge and aft.? (not clear) costal, 4) upper edge 3rd right costal, 5) fore border of 4th vertebral, and 6) a medium patch of 1.5 x 1.1 cm on fore edge 3rd vertebral.
All patches in low areas protected from abrasion. Pale bright yellow-green algae distributed over much of same low and non-abraded areas. Collected ½ of large patch on 4th vertebral and a smaller patch from 3rd vertebral (rear of it on right side)
Have not yet been able to determine whether these lichen patches were present on this tortoise . . . (Pg. 118) when he was brought to the CDRS in 1965 or not. Alan Root's photos of him were taken from the front right side and can not be used to determine these questions. Mr. Rambeck saw animal just after it was brought and he does not remember any of these patches as being present. He thinks they have been present in large patches on this tortoise for only past 3 years +/-. They were present on him when we came in 1969 (August) definitely, but have noticeably increased in size since then. I did not observe this male closely in July-Aug. 1968 and do not remember if the lichens were present on him then. This lichen is certainly one which normally occurs on Hood tortoises because #14,008 female has several patches of it on her shell which were present when she came in March 1971. from Hood.
Checked corrals between 16:30 –17:00 --#14,008 G. e. hoodensis began digging
(Pg 119) . . . in artificial red-soil nest site at about 1640 – she is digging about 25 cm away from center of nest laid by #14011 recently (nest 33 for 1971-72)
Perhaps will make a go of it this evening. #15070 in burrow already and not digging this evening. Certainly no nest yet so perhaps she is resting.

Checked back on #14008 female at 1910 – still digging – hole very deep – 33 cm and obviously she will get no deeper as is stretching feet out as far as possible and rear of carapace (marginals of leg pockets area are squashing down on legs; she will probably begin laying soon. Cavity about as wise as she could possibly make it - 31.5 cm. Wide and 27 cm ant- post.
1917 – stopped digging; shifting position about a bit.
1920 – first egg – cracked when hit bottom.
1922.5 second egg
1923.5 third egg
1926 testing movements – putting foot in; this continuing till 1929 – 2 times with each foot.
1930 – beginning to cover eggs. I am leaving.
2130 rechecked female – still covering nest – up to surface now and just starting to
(Pg 120).. . . . stretch out in wider arc to bring in soil. Watched 15 minutes and left.
2245 – checked again – still covering, sweeping way out to sides now; process just as in other nesting by Hood female 14001.
2400 – still covering – resting a lot –sweeping way out to sides will watch till she quits.
2457 – Just now quit finally – rested some 5 minutes after last strokes and now moving away a few meters. Stopped and resting there.
August 29, 1971. Opened Hood nest #5 from female #14008. 3 eggs as noted last night. – all on same level, bottom of nest at 33 cm. From ground surface- vest space left in nest. Cracked egg no good, seems to be a bit thin-shelled. Can not tell if fertile. Other 2 eggs a bit oblong, but entire and appear to be all right. Weighted and measured.
(pg 121) . . ..them.

		mm	mm	wgt-grams
Nest 5 eggs	#1	60.8	x 52.9	99.6
	#2	60.0	55,2	104,0

Cracked egg just about same size and shape as #1, but a bit more oblong.
All 3 eggs with small lumps, grains and other spots of calcium concretions on shells – all appear slightly thin shelled.
August 30, 1971
Continuing standard photos and some locomotion shots of G. e. hoodensis at CDRS.
Roll 355 - #'s 23-29 - #14,011 female feeding
#30 –34 - #14,009 female
#'s 35-36 - #14011 – head
Roll 356 – KII
#'s 1-18 - #14007 female
#'s 19-28 - #14010 female
` #'s 29-end - #14011 female

Roll 357 – KII
#'s 1-18 - #14009 female
19-34 - #14008 female
measured largest patch of pale grey –green crustose lichen (on left one of 2 scutes in position of 4th vertebral (abnormal) – measures 1.2 x 1.7 cm – oval. See last few photos.
#35-36 - #14,002 female.

(Pg 122) .
Roll 358 – KII - #'s 1-14 - #14,002 female
No digging this evening in Hood corral. Likewise, #15070 taking the night off again and not digging. No others in porteri or chathamensis pen digging either.
August 31, 1971.
1715 – Checked tortoises-
#15070 looking for nest site but not digging – certainly will not tonight.
#14007 female digging already – not too long would guess – about 10 cm down in read soil in artificial site – exactly where #14008 laid a few nights ago (nest 35) no cloacal fluid dropped yet.
1950 – Returned – still digging – very deep now and has dropped much cloacal fluid – has two larger (neat?) piles made. Will watch till through laying eggs.
2100 – has been at same depth for over 35-40 minutes; took measurements- 1) inside between feet in foot rests –29 cm.
2) front to rear of nest at surface – 30 cm.
3) front undercut – 10 cm deep
4) depth in center of nest – leg fully stretched out – 31 cm.
5) depth in undercut – 32 cm – 32.5 cm
She can not go any deeper or wider or further forward – legs are out to sides as far as is (supportable?); when digging with one foot marginal scutes of other side are fully pressed down on opposite leg which is lying on side in rest-mound pile; also she has dug so far forward that slight caving in of loose surface soil is now occurring.
6) front undercut is about 12-13 cm. Wide She is digging mainly in center and near bottom of nest but also occasionally into front undercut. She is loosing 9/10's of mud back into hole because she is so stretched out – even though still dropping cloacal fluid and soil in center and rear bottom of nest are very muddy.
All digging till now exact replica of that seen in other females of porteri and hoodensis.
About ½ hour ago she dropped 2 turds square into center of cavity and they became mixed with soil and are now ground in foot=rest piles.
Photos – Roll 358 #15 – end – digging process (15-21 probably no good – wrong shutter speed) Roll 359 - #1-21 – digging also.
Roll 360 – all – digging.
(Pg.124)
2215 – still at same depth – getting no –where; has not released any cloacal fluid for past hour. I scooped out several handfuls of moist but not muddy earth to see if it would affect her digging.
2221 -= After several digging each with each foot she released about ¼ -1/2 cupful of c. fluid into center of hole – Then began digging again – also clearly mixing soil by rotating digging foot in soil 45-90 degrees in bottom of cavity to make mud out of loose moist soil. This will clearly aid her in getting it out by making it into a sticky mud.
She then continued removing this sticky mud till 2033 at which time she had worst of it out and some drier but moist soil reached again (with some bits caving into cavity). I removed 2 more handfuls at this time. She now has cavity to 32 cm depth in center and 33 in undercut bottom.
(Pg 125)

Cavity dimensions still same size at surface – inside at floor level of course the cavity is smaller because of sloping in of sides top to bottom – width at cavity floor level – 18 cm. Front –back at cavity floor level (excluding undercut) – 12 cm. And with a gradual slope of loose soil all way t top at 30 cm. Depth.

2245 – Once again I removed almost all loose dirt from center and rear of nest: immediately upon inserting foot after I did this she felt it was gone and instead of digging in this area put foot forward and began to enlarge undercut or at least try to do so – she is about at limit there also because upper for –wall of cavity is preventing her from putting foot and toes any further forward in undercut.
2250 She is continuing alternating feet now and directing all activity to undercut. Since I last moved dirt – till now 3 insertions of each leg and all digging each time in undercut! This is resulting in her getting almost no dirt out of cavity because undercut soil is all dry and loose. However she is in the process lengthening and deepening the undercut very slightly and moving loose dirt from it back in rear and center parts of nest cavity.
(Pg 126)
2300
Still continuing the same but she has managed to widen the undercut considerably still it is only 10 cm deep but now approximately 20-22 cm. Wide – she is digging on each side with foot of that same side (into center also) and this widening the undercut. (see roll 361 , #'s 1-7)
2320 – continuing on undercut till now – now trying to get up loose dry soil from center and rear of nest which came from undercut. Undercut still same forward depth but 26-28 cm wide.
2322 – stopped after checking depth in center; looked as if perhaps she was getting ready to lay first egg. But then after 30 seconds with both feet on rests inserted opposite leg (right) and began on undercut again.
2325 – stopped again, feet in rest; now dropped down a far as possible so that marginals on each side of leg pockets are pressing down hard on lower legs, just at "ankles".
She is being supported only by sides /rears (heels) of feet on very inner sides of foot rests (see photos) – almost looks as if she is going to slip and one foot will fall into hole. Only reasons she is being supported is that foot rests are (Pg 127) . . made of stacked up, wet, solid mud.
Right away a small amount of thick gelatin came out of cloaca and slowly dropped down to center of nest cavity's floor. She then began moving tail slightly from side to side and contracting muscles in it so that it was lengthening out and thinning noticeably. These contractions frequent and lasting only a few second each time.
2343 – she finally squeezed out first egg just now – abnormally shaped (oblong), fairly large and covered with a few streaks of fresh red blood. Gelatin coating egg. Gelatin then dropping out again in a thick strand – blood in it too. Egg had to fall only some 8-10 cm due to her position - see photos. Tail contractions again.
2352 – 2nd egg – also oblong and with a knob of calcium on one side – blood streaks on it; more gelatin with blood. More contractions continuing.
2359 – 3rd egg – also oblong – blood but less. The passed a blood clot (1 x 1 cm) in gelatin. More tail contractions.

0010 – tail contraction continuing; she is breathing heavily and clearly uncomfortable and having trouble.
0020.5 - - 4th egg finally after great effort – only slight fresh blood flecks. Also oblong.
0035 - -5th egg – oblong and blood as in last one – again much effort . She seems t clearly "know" she (Pg. 128) still has more eggs to lay due to long time periods between eggs and the fact that she waits such time lengths between them but without wavering or stopping efforts.
0036- 40 sec. - 6th egg – also oblong and as large as others but passed easily and with little efforts. No blood now. A bit more gelatin after egg. All eggs in +- one layer but 2 rolled into undercut on their own. Other 4 in rear of nest, eggs are all on soil in one plane but at different depths from the top of the nest. She laid them all right in center of cavity but as each new one hit those below it rolled away to its own position on soil bottom.

43 Since last egg no contractions; sitting there in laying position however; just now stopped sting and slowly inserted right loot carefully, turned with anterior part of foot facing side of nest and nails +- straight down. (Pg 129) . . . wards. Foot touched bottom of nest cavity in extreme right rear of nest, (egg just in front of foot) – did not touch eggs – no sweeping movement. Then changed legs and did same on other side. Then right foot in again but a few cm forward of its last placement, this time touched squarely down on top of egg with nails and made a slow sweep with foot forward at 45 degree angle to right of anterior – posterior midline of nest cavity – Thusly moved egg a few cm. Forward toward undercut with nails – changed legs and did exact same thing with rearmost egg on left rear side. Right foot in again and right while inserting it tail began to contract. She stopped with right foot touching still in right rear of nest and at 0045.5 7th egg dropped directly in very rear (center) of nest just beside heal of right foot. Then removed leg; changed to left and swept over eggs forward on left but did not move any. Then inserted right foot and did same; she did not touch 7th egg and does not seem to be aware of its presence. (Pg 130) . . . and abnormal location (laid when cloaca in abnormal position). Then changed legs and began to crape soil from innermost side of left foot rest into rear center of nest. Changed feet and did same on right., but foot in bringing in soil came right down with nails on 7th egg and crushed it – she seems totally unaware of it. Filling continuing like this.

Now nearly 0100 and am going to bed for awhile – she is starting long boring covering process.
Rechecked 0315 – for 15 minutes Nest well covered and just starting to stretch out wide to bring soil from out beyond foot rest positions. Nothing eventful – movements as in all other nestings.
Rechecked 0610 – still covering – stretching way out to some 45 degree angle beyond foot rests original positions. Filling in . . . (Pg 131) dry loose soil to cover nest cap.
0700 – Nancy Jo checked her – lying beside nest – finished. So quit sometime between 0615 and 0700
Photos of egg laying and beginning of filling in Rolls 361 - #'s 8-end; Roll 362 - #'s 1-5

1 Sept. 1971. – Excavation of nest #6 – laid last night by G. e. hoodensis #14,007. Nest dimensions as indicated last night, plus 1 ½ cm loose dry soil and 1 ½ cm mud of hard cap above original ground surface layer where she was digging. Found 7 whole eggs – total # was 8 and she apparently laid one more after we had left, i.e. like #7 laid while she was filling in nest – somehow did not break #8. All eggs very oddly shaped and structural- see below. 3 eggs in undercut area, 4 in central (rear nest cavity, at depths from surface of (to their tops) 18.5 cm (1 egg) to 26.5 cm (3 in undercut) – other 3 at 23.5 cm in central nest cavity – with 8th eggs these would have just about filled bottom of the nest with no second layer. Removed eggs to incubators – Photos Roll 362, #'s 6,7,8.
(Pg 132)
Egg measurements, wgts, and comments – Nest #6 1971/72

Egg #	mm	x mm	wgt(grams)	comments
1	86.9	50.3	141.4	First egg laid; nest oblong; extensive thick calcium concretions (hard and smooth) at one narrow end. Thick shelled; concretions of soft calcium at other end.
2	74.0	52.8	126.4	2nd egg laid – concretions of soft calcium extra thick on one end. Shell a bit thick. This hard calcium bubble on shell – bubble broken now.
3	69.8	55.5	123.4	Shell normal thickness; concretions of extra soft calcium on one end.
4.	74.1	52.5	117.3	No concretions. Egg shell normal thickness very slightly been shaped.
5.	70.0	51.3	111.0	Egg shell normal thickness; slight concretion of soft calcium at one end.
6.	74.5	53.4	123.9	Egg shell of normal thickness; no concretions
7.	71.7	60..4 x 53.7	135.6 g	Egg shell thick; Heavy concretions of hard smooth calcium at each end; oblong, but also much wider in 1 dimension than others; unlike all others which had 3 width +- equal.

1 broken egg same shape and structure as #'s 2, 3, 5, 6,
Eggs to incubator – reasonable doubt about fertility however.

Note – of 6 nests (I know locations of 5 with certainty; and, although 2 other artificial sties of equal quality and 2 natural sites of fir quality are available to female hoodensis, 4 of the 5 nest have all been laid in same site – i.e. all within an area of about 1 meter square. Nest interference would obviously have occurred had nest not been excavated and eggs removed. Thus, a previous females nest being present at a site clearly does not deter another female from utilizing same place almost exactly . In fact 2 other good artificial sites have not yet been used this year although each have been dug in a bit on occasion. Will ask Pepe Villa for locations of 1 uncommon nest, i.e. #2 1971-72 hoodensis nest.
1730 – Checked female #15070 in chathamensis pen – sleeping in spot for night – no digging today apparently No other females digging or searching for nest sites in porteri, hoodensis, or chathamensis corrals.

(Pg 134)
25 Sept. 1971
Nest #7, G. e. hoodensis laid last night by female 14002 probably – not sure; 3 tortoises show evidence of having dug recently – 14002, 14008, 14001; probably 314002 but can not be sure.
Excavated nest – laid in a mixture of natural dark brown soil and red soil near gate – not a very good site because soil not too deep here. Size +- normal nest but without any real undercut because whole front center wall of nest is a large flat rock. Depth to bottom in center, 25.5 cm. But with about 2.5-3 cm loose muddy soil on bottom. Nest cavity walls not too sloping inwards – at surface nest is 28 cm side to side and 24.5 cm. Front – back. Bottom of nest full of rocks and scattered over in sides of walls; perhaps forced quitting at this depth – surely did so. 4 eggs. 1 at 16 cm., to top from ground surface, 2 at 17 cm. To tops; 1 at 19 cm to top - +- one (Pg. 135) . . . . slanting layer. Clearly room for 1-2 more eggs in this layer and others above also. Hard cap moist and full of scattered strands and pieces of tortoise fecal matter – probably 1-2 droppings in total. Took eggs to lab and weighted and measured and marked – placed in incubator afterwards.

Number	mm	x mm	wgt
I	65.4	56.2	117.0 g
II	67.0	54.1	116.8
III	59.5	56.9	100.2
IV	63.4	56.4	116.3

About 4 (word unclear) ago a female , #20, in odds and sorts pen laid 2 normal looking eggs, practically on surface in pen – she , of course could not find a decent place to lay eggs and was forced to lay wherever it was possible, lifting rock right away – she has been digging for over 3 weeks and finally had to (deposit?) eggs last night. Each egg 6 cm lower surface and packed in (loose?) hard mud and laying on tope of rocks. 1 broken on top and membrane open so can't incubate it. She made a valiant attempt but there simply is no way she could dig deep enough. Egg – 62.7 mm x 60.1 mm, 120.8 g. to incubator to see if anything results.
(Pg. 136)
12 Oct. 1971.
While I was on a trip to Cerro Azul, 3 more nest laid in corrals (1 in each) and last night one more laid in hoodensis corral. Will remove these today.
Nest #8, G. e. hoodensis, found fresh morning of 28 Sept. 1971. by A. Rambeck; he indicates (by drawing) that female #14008 laid the clutch. Opened nest – 8 eggs – very deep; not very easy to get nest dimensions because not very clear – however, at bottom 2 layers nest nearly full of eggs but probably could have held more above. Greatest depth of nest 37.5 cm, with some small mud clods in bottom that female could not remove. Eggs as follows with depths given from surface to their tops.
1 egg – 23
2 eggs – 25
1 egg – 27
2 eggs – 30.5

1 egg 31
1 egg 32
(Pg 137)
Nest sloping downward and inward in rear so all eggs but 3 most upper ones resting on soil in bottom, but some shallower ones more to rear of nest. Hard cap very solid, wet and down on top of eggs; only upper 3 with much mud around their tops and sides. Others +- in air space with mud only on top; some droppings in hard cap – well mixed in. No obstruction in bottom or sides of nest at all. Nest laid in same small site where most other nest laid this year i.e. rear central spot in corral of artificial construction – red, clay soil type as from S. Cruz nesting areas.
Eggs. And measurements =

Egg #	mm	x mm	wgt (grams)	
I (+- normal)	58.	51.2	88.2 g	
II (+- normal)	55.6	51.6	86.8 g	
III (elongated: some crenulations)				
	62.3	54.7	114.2	
IV(elongate a bit)	59.8	53.9	102.2	
V (elongated, small (word unclear)				
	59.3	50.0	87.2	membrane intact
VI (concretions)	56.9	55.0	1.07.5	
VII (very elongate., Concretions)				
	66.7	53.4	112.4	tail of calcium even
VIII(elongated, heavy concretions at one end				
	64.5	55.0	116.7	

To incubator –

Nest #9, G. e. hoodensis – impossible to determine which female, but probably #14001 or #14010 – both have mud signs.
Laid last night in corral, just 60 cm away from nest #*; in same area; as almost all nests this year. Opened nest.
(Pg 138).
Very little cloacal fluid used because mud only around eggs and for 5-8 cm above them; rest of covering of many cm is dry soil; i.e. no nat solid hard cap of usual type. Only 4 eggs, lying +- in 1 layer in bottom of nest being all between 21.5 and 25.5 cm to their tops, variability due to floor of nest sloping down, in, in rear. No obstructions at all in bottom or sides of nest. Nest deep – 32 cm. In forward undercut from top of soil surface, and not nearly as full of eggs as could be at any level=could have been 1or 2 more eggs even at lowest level. Removed eggs, marked, measured, weighted and to incubator.

Egg #	mm	x mm	wgt	comments
I	59.0	55.6	106.3	elongated a bit
II	60.0	54.5	105.6	elongated a bit
III	57.0	54.1	96.6	elongated a bit
IV	54.5	53.1	91.3	SPERICAL

Nest #3 from female #15,071
In San Cristobal corral. Laid night of 2-3 Oct 1971 and found nest day by A. Rambeck, who also noted down female due to fresh mud on her feet. (Pg 139)
Nest is located in upper left rear of corral , or directly opposite and end of corral from site when 2 previous nest laid this year. Not an artificial soil site; soil here is deep brown type found at this altitude. Opened nest – still very moist and with deep hard cap of mud with feces mixed into it. Nest rather deep, and both sides with rocks along entire wall, rocks in fore wall and rocks in bottom. Only part free of rocks is rear of nest. Due to larger rocks *plates almost) female made nest cavity long and thin, front to rear. Width – 15 cm. Only Length – 27 cm === based on opening side of cavity about 12-15 cm below soil surface – i.e. for most of its depth these dimensions hold and all eggs below this level and filled into this cavity confined by plat rocks. From top of (peak?) to surface cavity of top largely but not important for eggs themselves. Max depth fairly uniform at 33 cm. Eggs in a big bunch, tumbled in, filling cavity full from 17.5 cm to its bottom. Female must have had somewhat of a difficult time excavating this hold successfully. Removed eggs, marked and measured them (11 eggs), and to incubator.
(Pg 140)

Eggs	mm.	Mm	wgt.	Comment
I	59.5	57.0	116.9	normal
II	60.4	58.3	118.7	normal
III	59.9	57.9	115.0	normal
IV	60.5	57.9	119.1	normal
V	60.2	59.0	120.6	normal slight concretion on one side membrane ok
VI	60.0	58.2	118.4	normal
VII	59.5	58.3	118.7	normal
VIII	60.0	58.0	117.2	normal
IX	58.8	57.5	113.9	normal
X	61.4	59.7	126.8	normal
XI	62.0	59.3	126.4	normal

Nest #2, G. e. porteri, found in corral on morning of 29 Sept 1971, fresh and moist nest, by A. Rambeck. He is relatively sure was female #20028. Nest deep, Max depth of 30 cm. , full of eggs (8) from 20-30 cm., made in an artificial red soil site with no rock or obstructions in nest. Eggs in a jumbled group but basically only 2 layers. Treated eggs as in previous nests.

Egg	mm	x mm	wgt	comments
I	64.9	60.0	138.3	large
II	65.0	61.0	138.4	large
III	68.0	60.2	140.5	elongated and large
IV	62.7	60.3	128.3	large
V	65.3	61.3	144.6	elongate. Bit and large
VI	65.8	60.7	141.0	elongate. And large
VII	70.5	59.9	147.9	elongated and large
VIII	65.5	60.1	140.4	large

November 11, 1971 – more nest in corrals – Nest #10 G. e. hoodensis, laid by female #14007 on night of 4-5 Nov. 1971. after digging attempts since about 21-22 Oct. This is female we stopped from digging on 22 Oct. 1971 in central artificial spot where most nest are laid (see below). This nest is artificial and soil area in center of commonly used one. 7 eggs, all +- normal, a few oblong, others differing in size. Very deep – top egg 25.5 cm below soil surface, bottom of nest 33.5 cm. From soil surface, eggs all in 1 layer +- nest full at this level only – dimensions at bottom of nest – 21 cm x 14 cm. Hard cap not (Pg 142). . . .well made; fluid quantity used appeared to have been lower than usual. Eggs removed, weighed, and measured. To incubator.

Egg	mm	x mm	wgt (gms)
I	49.7	53.8	76.7
II	49.3	53.8	73.9
III	52.5	56.1	87.5
IV	49.3	58.7	84.1
V	51.1	58.7	91.3
VI	53.4	60.5	96.1
VII	53.0	56.4	92.2

Nest #11. G. e. hoodensis; laid by an unknown female. Date also unknown but probably first week of November 1971 because fresh. Nest deep – 32.5 cm. To bottom, and 22.5 cm to top of first egg. 4 eggs, all abnormally elongated, all lying in bottom at +- one level; full here but not above. Eggs removed, weighed, and measured.
(Pg. 143) . . . . and to incubator.

Egg	mm	x mm	wgt (gm)
I	52.2	69.4	114.7
II	51.9	74.0	121.6
III	53.8	70.3	124.1
IV	54.3	63.0	117.5

Nest #4 – Cristobal pen – mixed races
Laid night of 7-8 Nov. 1971 by female 20039
12 eggs, 4 on top in 1 layer, at 14.5 cm to their tops and 8 on bottom in another layer – nest really full at these levels; bottom of nest at 28.5 cm. No obstructions in it. In upper rgt rear corner nest spot where most females here lay. Eggs mostly normal but some very thin shelled obviously.
Weighed, measured, and to incubator.

Egg	mm	x mm	wgt
I	56.7	59.8	112.4
II	57.8	60.0	115.0
III	54.2	59.6	101.9
IV	56.9	58.8	112.0
V	56.8	62.6.	117.8
VI	53.1	60.0	101.6
VII	57.0	59.2	110.3
VIII	55.0	58.0	101.8
IX	59.0	61.4	122.8
X	56.4	67.7	123.9

[End of notebook, Pg. 145]

Isla Santa Cruz Volume #1.
Field Notebook of Craig MacFarland
July - August 1968

(Pg. 1)
29 July – Went up and across middle part of tortoise reserve. Turned off just few m north of lava tunnel on trail which leads to north-central part of eastern border of reserve (see map). Then went slightly west – sw for the rest of the day. Passed to southern parts of zone 6, zone 1 and finally ended up in nesting area in southern part of zone 3. Zone 6 and Zone 1 themselves would be adequate to work in but the veg is typical transition zone,, most often very thick and it is extremely hard to see tortoises even when very close to them. There seemed to be much low Pisonia, Pisidea, and Psidium, some cacti (Opuntia – scattered), and some Croton and Manzanilla. There were no temporary ponds in the southern part of zone 6, but there are a few in zone 6 to the north of where we were. We passed by one dried up pond in zone 1 which was completely full of a willow-like plant which Miguel calls "Rodillo de Caballo". He says this plant characteristically fills most of the temporary ponds in lower area and in the higher areas it is around the sides. He suggest that the ponds in the higher areas lack this plant in the middle and are thus very open because water stays in them longer during any given year. Anyway, wet or dry, it makes a very effective cover for tortoises. In several places one (Pg. 3) could see where the tortoises crawled beneath these plants and could have only been followed by hand –knee crawling after them through the resultant tunnels. The altitude in the areas of zone 1 and 6 where we crossed was about 70-80 m most of the time. Gradually went down most of the afternoon till we ended up in the nesting area of zone 3 – south pert which was at 60 m. There were very few tortoises in zones 1 and 6 as indicated by our findings – only encountered three; Miguel thinks up in higher part of 1 and 6 probably around dry ponds; but doesn't thing 1 and 6 usually as highly populated as 2 and 3 anyway; however zone 1 can have high nos. sometimes; 6 is less populated he thinks. (Pg. 4) He thinks they nest in zone 6 and 1 but only down near the coast . For zone 1 this corresponds to the La Fe area where they nest to altitudes as low as 10 m.; the zone 6 nesting area is on the map and they nest here to altitudes as low as 5 m.
Zone 3 nesting area is one of the highest, being at 60 m or so in transition vegetation.

July 30
We searched zone 3 nesting area, southern part, quite extensively. When I say southern part I should clarify this by saying it is in the central part of a N-S line from the caseta to La Fe coastal area (see map). Photographs no. 14-25 on roll 3 were (Pg 5) . . . .
taken in this general area; 14-17 were taken about 500 m. north in an area of very lava strewn rocks, with only very small patches of soil about ½ x ½ m – the tortoises could nest here and Miguel says he usually finds a few nest here, but more in the "lower" area (same altitude but south). This "lower" area is shown in photographs 18-25. Much of this area is also made up mostly of rock with very small patches of soil. But one part of perhaps 1-2 hectares has nearly as much or slightly more soil (reddish kind) than rock. In this area there seem to be more nests, if only because of more soil. In all Miguel says found 19 nests one year in all are of perhaps (Pg. 6) . . . .

1 sq. km. He protected 6 of these by piling lava boulders about the nest, leaving only the area of the nest top itself exposed. He was later able to determine that some of the young hatched from these nests and that the pigs did not destroy them. [Marginal note: Roger Perry questions this.] It seems funny to me that these boulders stopped the pigs because it looks as if they could just climb in and go down from the top very easily (they do dig into nest from the top and not the sides by the way!) Miguel thinks the rock piling affects the odor of the nest, which he thinks the pigs normally use to locate the nest. How this affects the odor I do not know. (Pg 7) . . . .
Miguel suggest that if the pigs do not locate the nest within 3-4 weeks after laying that they probably will never do so, because he thinks the odor of the tortoise urine and /or feces would be gone mostly from the surface by then. Anyway, he says that almost all the nests he has found here have been destroyed by pigs unless protected. During the search of the lower area we found a no of animals, mostly females (6) but only 3 of these looked large enough to lay eggs – Miguel suggest they are in this area to lay eggs in fact. However, no signs of digging activity were noticed. In addition there was one big male in the area. The time was (Pg. 8) . . . .
10 –1200 hrs. and it was overcast and drizzling off and on the whole time – most of the animals were moving along slowly or eating the abundant small seedlings which occurred all over the place. Anyway most of them seemed active – in the area above this in zone 3 at earlier hour 0830 on they seemed to be somewhat active, but before 0830 most seemed at still be in the little cavities where they spent the night.
These cavities seemed hard for the animals to make in this area, partly because of lack of open soil and partly because the soil is wet only a few inches down at most. The smaller animals seemed to get deeper, probably because (Pg. 9) . . . .
Of maneuverability in relation to the size of the small soil patches. The often make these shallow excavations up against small logs in the red soil; but some of them were in open areas, and the only two large animals (1 female and 1 male) seen had made feeble little excavations in such open places. Some lava rocks were moved in these activities by all different sizes of animals, but not many and not too large – i.e. maybe 1-3 lbs at most. Anyway, Miguel now expects laying to take place in August – Most interesting discovery was 2 small animals which we estimate to be perhaps 2 and 2.5 to 3 years old respectively. They were both in the lower 3 area and were in the roughest, rockiest, (Pg 10) . . . . parts where there was virtually no soil. They were both discovered about 1130, one being on open boulders moving, the other in open but near a lava crack and probably moving. These rocky areas were raised up about ½ to 1 m above the more open soil patchy areas where nest are made. Most significant is the fact that Miguel did not think either o f these were from the 6 protected nests because he marked those with paint and these showed no signs of such. The sizes were roughly as follows –
est. 2 years old – l.c. 17 cm.; a.c. 19 cm.
2.5 years old – l.c. 19 cm. ; a.c. – 22 cm.
I checked the growth rings carefully on several of the (Pg 11) . . . .
Carapace scales of each and concluded as I did at the station, that using these for age will be damn near impossible and probably faulty. The rings are very complex and highly confused; it is hard to tell if a given ridge is one ring or a conglomeration of several to many. The two and ½ year old one, for example, had the obvious embryonic scale and then a small ridge (first years growth after hatching?) but after that it was very confusing.

Knowing the irregularity of the weather here, I think a tortoise might have anywhere from none to 3-4 rings/year. Also, in some of the females and males, we saw (oldest ones) the shells are completely smooth and (Pg. 12) . . . .
No rings are evident at all or only on part of a scale and then not completely shown. Why this is so I am not sure – perhaps shed scales or rubbing on branches over the years? On some of these very large females I noticed that the scales are not completely joined at all paints anymore, especially on the back portions of the carapace. There are gaps present and very little or no indication of growth (no while) now at least. These same scales are also often pock –marked or partly eaten away a bit – perhaps due to fungus according to Miguel – but anyway this does not appear to affect the animal since it is not (Pg. 13) . . . Deep but only the superficial layers of the scales. When I say the scales are not joined I do not mean that the bones is exposed, but only that the gap between them is larger than normal – I guess the spaces in between is skin --will check.
We came up the trail through the major portion of zone 3, all of zone 2 and finally to the Caseta. Miguel showed me what he considers to be the northern limit of the nesting area in zone 3 – beyond it there is definitely a lack of reddish soil, the veg is more dense, it seems more humid and I would guess that the soil is more wet deeper down = perhaps 6 " - ? Anyway, I would guess that (Pg. 14) . . . .
This area was at an altitude of perhaps 70 m. [Marginal note: 1.5 km apart in direct N-S line (check this)]At 85 m. we came to a dry pond area in zone 3 near the zone 3 border where there were about 19 tortoises – 6 were big males, the others were all smaller (i.e. "medium" sized) and Miguel only checked some of them. He said 5 of them were females and the didn't determine the others but says some were probably males. Suggested that only 2 of the females in total were large enough to lay and were perhaps moving down to do so – but slowly. This area was still transition, with much manzanilla, (large tree), Pisidea, Psidium, and Pizonia. (Pg. 15) . . .
There was some Croton, but I did not notice any Scalesia and only a very few cacti. In general threes were bigger than at 60 m. and seemed more humid and wetter.
We continued on to the Caseta at 210 m., seeing very few tortoises. There were perhaps 4 or 5 in the pond just below the caseta (dry now), particularly dry year – see notes below _ and 2 large ones at the caseta.
July 31 – Talked to Miguel some about weather variations and migrations of the animals; his observations are probably OK. But should be taken with grain of salt. As to weather this highly variable apparently and each year can be quite different. For example, (Pg. 16) . . . . Can get heavy rain any time from late December to late May. However, the rain during these months may be nonexistent in some years or it may rain like hell during some and not at all during others. For example, may get rain during this period only in Jan and Feb and then dry sunny weather completely till the garua depending on the extent of this brief period of rain, the ponds may or may not stay filled for the remainder of the year.
Apparently the garua is not so variable, always showing up in June and lasting till December. So it might rain well for Jan – May or it may show only heavy rains in Jan or Feb., the rest of the rainy season being dry. In the highlands it is actually cooler and more humid for all of the garua season and therefore the Jan – May period is often called the dry season. Apparently there are occasional periods of one day to nearly a week when one may get some sunshine at the caseta level during the gaura but these are very

rare. Almost all the time it is drizzle or at least overcast. It does not seem that the tortoises could bask much if at all and their temp. during gaura must be close to their surroundings.
During rainy season, expect when are actual thunderstorms, it is clear even in highlands. As to the condition of the (Pg. 18) . . . ponds – we discussed ponds 1) near the caseta alt 180 m
2) upper regions of zone 1, alt about 180 m.; 3) near zone 2 border, alt. 80-85 m. so as to get a comparison. Miguel says that pond 3 always dries up and never lasts all year (this also goes for pond in middle part of zone 1 which we passed on July 29). How long it last depends on strength of rains in rainy season and when they occur; harder they fall and more closely toward gaura season when they occur; harder they fall and more closely toward garua season when temp crop and humidity goes up the more likely it is that they will last. Mya last up to 4-5 months if filled well and near garua – i.e. April or May; even (Pg. 19) rain in Feb. or March may last 3-4 monthys if fill very full. Depending on similar properties of the weather, ponds 1,2 may last all year long till next rainy season, or may not. For example, records for Caseta for this year (1968) show virtually no rain for April and May, and only about 6.56 inches for all of Jan 1 to March 31 period – this is low when one considers that records for garua season of 1967 at the caset who about 2-2.5 inches / month from July (beginning of records) to December. And the pond below the caseta is dry and Miguel expects will be same in upper part of zone 1. Miguel says these paonds have been (Pg. 20) . . . .
Dry since ?? Caseta pond and others of similar altitude usually last longer that lower ones and also have added advantage of ferns literally covering the whole top of the water, thus decreasing evaporation? Lowever ponds have heavy coverage of bushy "rodillo de caballo" which stands 3 – 5 m. high I would guess – which 1) does not cover h20 surface as closely as do ferns 2) probably casue more tanspiration than ferns there may be individual differences in pond of similar latitude, exposure, veg., in that pond in zone 1 one year had h20 longer than in caseta pond; because was (Pg. 21) . . . .
Filled much fuller by getting more heavy local rains than the caseta area. Anyway the above is a rough sketch of the variations in available pond water and precipitation. It is very clear now to me that the garua season is dry only in the lower areas – I wouold judge, that from 45-60 m and upwards that there is enough mist every day, especially in early moring on plants as if dew, that the animals might not need h20 supply in ponds even if it was present. I would think that they could do very well just eating wet vegetation -= as I saw them eating drenched seedling at 60 and 85 m. yesterday in zone 3. Also, the temp being lower and the humidity being almost constantly high, I suspect that (Pg. 22) . . . . both their activity and water losses are cut way down in garua season, except perhaps for females moving to nesting areas in July – Nov. – of course they may move there long before they actually lay the eggs.
It seems logical then, that they would be most active in Jan – May period when most warm and when have most sunshine – might also be most subject to h20 loss then if no rain storms.
This all seems to set the stage for several general cycles of movement in any given population. For example, on Santa Cruz, perhaps they spread out and maybe mainly go down when there are heavy rains (e.g. Jan – Feb.) and (Pg. 23) . . . .Miguel thinks this happens sometimes; whether it is because of the heavy rain causing them to be too cool

or have resp ailments or whether might be because can also then get food at any elevation because of abundant moisture remains to be seen.
Then if a period of no rain comes i.e. March or April till May or June and it is still warm, the increase dryness might result in their moving back up to higher areas where moist or at least to ponds or both. If stays rainy all way to garua then perhaps they don't do this. Miguel thinks they do go back up to more humid aras when this happens and go to ponds for h20. Says observ. On Santa Cruz during dry March – May periods indicate (Pg. 24) . . .this. Then in garua when there is much moisture, on veg , low temps and high humidity may spread out again. Then in last of garua (Oct or Nov. to Dec. or early Jan.) may move up again as it tends to get a bit drier in lower areas. Of course, on top of this is piled the problems of mating and movements of females to nesting areas. Will ask more about this, but Miguel thinks females move less quickly and not as far as some males may however, not move for several months to nearly a year from the same area – especially in the highlands (Pg. 25) . . . . Have discovered about 4 Galapagos with a hectare around the caseta; have been fairly carefully watching one of them and casually keeping track of the other two.
Have been watching female #820 (large) since yesterday at 4:45 pm (1645 hrs) when arrived was burrowed into mud wallow up against a log and mass of low herbaceous looking greenery – it was a nice muddy wallow she had constructed and just big enough to fit herself into – the bank like nature of the log and greenery above her made it easy to burrow into. She was covered up to the level of the bottom of the carapace in the posterior (most exposed portion) and her entire front end, legs, head and front pasrt of carapace to behind the first central lamina were (Pg. 26) . . . .completely covered – below by mud and above by the log and the vegetation; I would say that all her soft parts were probably covered by mud or wet veg in case of skin up under front part of carapace. After she moved this a.m. could see depressions in front of cavity where head and forelegs had been resting on the mud – perhaps to allow muscles to relay – her hind legs appeared to be pushed in most of the time – all night.
She stayed burrowed until about 0900 hrs. The next morning (watching since 0700). Finally moved out and lay about 3 m away from hole in open place where grass has been flattened by previous movements. Laid there with (Pg. 27) . . . .
Head and all legs spread out into sun till 1030; then grazed in immediately vicinity till about 1230; then began this laying spread –out posture again. While spread out so here eyes seemed to be shut all the way, and her legs and head and neck were all flat on the ground. About 1300 hrs. I snuck to within 12 ft. of her twice; the second time she either heard or felt (I favor the latter) me and raised up and watched me -- when I moved again she withdrew with a great hiss. This hiss did not seem to affect the other two animals (#246, 712) which wer grazing about 25 and 35 m away - in fact I don't think they were even heard her or saw me. I will follow up on her (Pg. 28). . . . . again tonight to see if she uses same burrow site and to get more on activity period. She may have been basking when spread – out because the sun has been trying to come out all day since about 1000 – hasn't't made it bet one can fee noticeable heat on the skin surface – From 1300-1400 I was near herr off and on, so behavior is probably altered.
Also have been watching #s 712 male, 246 male since about 1030 – they have both been grazing all day – now 1430 – move a bit and eat – mostly grass, but some small herbs; I would say that 712 male has moved perhaps 100 m all day and #246 female about 50 m;

as noted (Pg 29) . . . . above #820 has moved maybe 8 m all day = she is bigger than either of the other two.
From 1345 to 1400 I took a few temps for fun (shaded) – used black bulb schultheis to get soil surface (actually low herbs and little soil) temp and shell surface temp on brown –black portions of top of carapace. Also too air temps at ½ m all in degrees C.
Soil surface – 27.4

Animal #	Shell	Air
820	29.5	25.0
712	30.9	25.0
246	31.3	25.5

These slight differences in shell temp cold be time of day – they are in order taken opt to bottom - or size of animal, decreasing top to bottom - although last 2 nearly same size. (pg 30) . . . Sun very obscure all this time, byut you could tell its general location by brightness behind clouds (has been like this most of day – hasn't actually come out yet).
1430 - #820 back in resting posture – I am fairly certain it would have stayed thusly had I not bothered here at 1300.
Have also noted a male vermilion fly catcher on #820 off and on for 3-4 hrs. This has been entirely during time when the animal was most immobile and resting; the flycatcher never stays more than few minutes as a time, but is obviously using as a perch and feeding off this (Pg 31) . . . .vantage point – also feeding from off of perches on low veg around tortoise; interesting thing is that tortoise is not moving and stirring things up. See photo – Roll #3, #30.
1445 - # 820 back grazing, but moves ever so slowly and only a few dm at a time – mostly eating form half – resting posture.
1600 – went down to pond below the caseta – could see 9 animals – all medium to large – grazing in open area of pond floor. Most were moving about very slowly. When we passed by at 1630 in drizale yesterday all was wet and only one in open – saw 3 others under bushes (rodillo de caballo) to sides (Pg. 32) . . . of the pond – perhaps protection from excessive drizzle – everything was soaking.
Today everything is dry but the soil (see below) but it is cool and pleasant (see below). Watched for awhile – one large one went off into brush but all rest continued grazing; took photos of area. Went on a trail (there are many leading to pond from all sides) to west of pond and saw two more animals. About 50-75 m west found (large) male #53 drinking in a small rocky pond in a manzanilla grove with some clear area around covered by a very small (Pg 33) . . . . herbaceous growth; very little grass. The animal appeared to have perhaps increased the h20 on the pond by crunching the mud down with his fore-legs. There is however standing water in several other small cracks which is not too muddy. He may have gone in where I saw him because not surrounded by big boulders and easier access.. Water is only 5 cm. Deep in deepest parts and areal extent probably about 3-4 sq m.; can't tell if spring fed or just drainage. Signs (footprints) indicated that Galapagos have been into it on several sides all around h20. Much manzanilla around pool is at about 180 m. Wandered a bit more west and found 2 more of these areas with (Pg 34) . . . H20. Although rocky and think Galapagos could get to the H20, and both had signs of tortoise activity (prints). Also saw a tortoise overnight parking spot near one and fresh droppings at same pool.

Much sign of donkey and pig in the area, but not immediately "fresh" droppings – hard to tell because of wetness.
Came back by pond at 1700 and only 4 animals still in open – while I was watching one large one and one medium sized one wet to the bushes for the night; presumably the other 5 had already done so , or at least hey had moved elsewhere. Of the 2 remaining, one (medium size) was grazing, and one (also medium) had scratched (Pg 35) out a bit of ground and was apparently going to stay the night out in the middle of the pond – when I cam up at 1700 its head and forelegs were in and hindlegs 3/4s in and it appearedto b e sleeping from a distance.
When returned to Caseta could not see 820, 246, or 712 – when last saw at 1500 all 3 were grazing, 820 moving slowly east, 712 slowly southeast and 712 staying put just s of caseta. Apparently all to spend night a bit further away from caseta than last evening.
The day was cool and beautiful today = from 0900 hardly any drizzle at all ; sun almost out several times and from about 1100 till 1600 it was coming through the overcast enough to feel the temp. (Pg. 36) increase on the skin. From 1600 till 1700 it cooled noticeably and about 1700 garua began again and has been pretty steady till now (2000). Recorded 2.3 mm rain from 1900 July 30 to 1900 July 31.
The vegetation was noticeably dry when I first checked it at 1100 this a.m. and could have been dry before then.. Indicates that except when actually drizzling or having recently done so, the veg would be expected to offer no water on surface. The soil stayed wet all day and I doubt it dried much if at all. The humidity is still noticeable even when no garua and (?vpd?) must be low. Highest air (Pg 37) . . . . temp I recorded was 25.5 C at 1400, and I doubt it went too much above that – perhaps to 27 –28 C at most.
Althoug only tortoises I watched simply grazed and or slept most of the day, I would say they seem reasonably active for this type of weather – perhaps the lack of actual garua is more favorable for their moving about and feeding – less cool and less respiratory problems??

August 1 - [Note in margin: 72.7]
Got up at 0700 and searched for 820, 246, and 712; found 246 only about 25 m SE of where I had last seen her grazing at 1500; she was very effectively burrowed up under some low herbaceous stuff – whole first 1/3 of carapace covered; had excavated a bit of soil, [Marginal note: took photo, see roll #4; #2] (Pg. 38) . . .
Perhaps 1.5" and after she moved I could see where head and forelegs had been. When I found her at 0730 she was sleeping with head, neck and all four legs out on ground; could not tell if head fully out because of vegetation. Seemed to be fairly effectively hidden, but only 2 m off of trail to SE of Caseta. Couldn't find other 3 but only search ½ hr.
Returned at 0900 and she had just become active turning 90 degrees out of resting place and beginning to graze, but otherwise in same location. Came up through mora vegetation to El Chato. Several other peaks in the Santa Rosa area were visibile although it was overcast and occasional light drizzle. There were signs of Galapagos all along the cut (pg. 39) (N borer of reserve), droppings being evident, also many right burrows, and saw perhaps 9 or 10 either right on cut or within 50 m of it – probably many more since I was watching tail much of the time. All were medium (90 –100 cm l.c.) to large in size, several being obviously large males. Saw numerous trails going off through the mora and some were obviously made by galapagos since could see swath shell cut and in 2

cases could see the tortoise off in the mora. Most were either slowly moving on grazing. A few were still sleeping in night excavations. This all occurred 0900 –1030. Very little drizzle, but cool. Luataro says Galapagos commonly go through the mora and are scattered all over it – this somewhat (Pg 40) . . . . of a feat since it is low (1/2 – 2 m mostly), thick, and very thorny. It is obviously a legume of some sort. There are other small herbaceous, viney, and shrubby things in it, but most of the area is the legume. One can see it growing up and over trees, bushes etc. in the area – it apparently kills and eventually knocks down the vegetation which it covers. Saw one Psidium (guayavillo) which must have been 8-10 m tall which was covered allover with the mora legume.
We continued on past the mora area toward El Chato. Went down for a bit though vegetation composed mainly of tall (10 m +) Psidium (guayavillo) and some (Pg. 41) . . . slightly smaller scalesias (lechoso). There is a pond right at east base of el Chato, but it is dry as is one below cAseta. Altitude of the pond is 225 m. roughly, that of El Chato itself being 255 –260 m. [Marginal note: see photos] Pond is very wet on floor and covered with small herbs; at one side (east) thre is a slightly lower area with many boulders where there is a few sq m of standing H20; I think tortoises can get to it, and a few tracks near it may be tortoise, but not sure – saw no droppings. One large male grazing on herbs on pond floor and two smaller ones just out of pond a few m. All 3 separate. Too measurements for 2 smaller ones and marked one of them: (Pg. 42)
Male #1060 l.c. 89.5 cm; a.c. 97.5 cm.
Male # 981 l.c. 72.7 cm
By 0700 –0800 veg was dry except right at soil surface near the caseta.
1000-1030 Here and along tail through mora it is still a bit damp with beads of H20 on leaves a meter or so off gound, but drying out now I think. Could have misted here more recently or perhaps a bit cooler.
Lautaro thinks Galapagos sleep much during day during garua season because it is so cool. Today appears as if it will be without mist for most of day, as was yesterday.
Climbed El Chato about 1040 (Pg 43) . . . . On way up heard a male galapagos moaning rhythmically, about every 3-5 sec Couldn't see because of veg but would guess was 100 –200 m away. Lautara sys it is probably actually mating because he has heard this sound only during actual act of breeding. [Marginal note: with another male perhaps?] Sound lasted for 40 min. after first heard – may have been going on before we heard it at 1045.
Veg on El Chato is also Scalesia, Psidium and some very large agave like plant (fruiting talk of dead one even evident) which Lautaro calls "Cabulla".
Veg is very lush and nice here and is cool and humid as was in forest below. Took a few photos – one to west shows coast to northwest of Cerro Gallina. (Pg 44)
Descended and could see central mtn chain clearly, as could from El Chato – Lechoso, Piramide, Cerro Salasaca, Los Dos Hermanos, Mirado, Infiernillo, Cerro Santa Rosa, Bander, Cabulla, etc. Also from El Chato could see Zona 5, Zona 4, Zona Cerrito, Cerro Gallina, and much of coast line from below zone 5 to Pan de azucar. Could see Pinzon Isla and Caleta de las Palmitas also.
Coming though mora at alt of 250 m. just east of Lechoso – Guayavillo forest, I found male # about 30 m off of the cut – he had made an obvious trail through the mora –about ¾ m. wide and flattened veg - he was grazing when found at 1400. The night cavity was (Pg 45) about 5 –10 m off the cut and it appeared as if he had gone only away from it by

a circuitous path of 20 –30 m during the whole day – i.e. not very active – only eating and resting probably.
He appers to be selectively eating a small herb which looks very similar to U.S Smilacina {spelling uncertain} - at least had made for and was eating a patch of it (marginal note: will collect sample) when I arrived = much ofther stuff around it which he is not now eating; however, could have eaten much other stuff along the trail he has made. But all along the path signs indicate he was eating this tuff mostly, if not perhaps exclusively. Also found pig and donkey droppings and probably their trails in maor, but not many obvious trails by such. (Pg 46)
Took phot of one of the mora vine which both grows on ground and on trees – has beautiful flower and leaf.
1445 Bit further up trail saw male #58 eating same stuff at end of path and few m. off of cut – again appeared to be eating ti in preference to other mora plants. [marginal note: see photo].
His apparent burrow was just W on the cut about 4-5 m. so I would guess he has not moved for all day – two fresh droppings where he is feeding now. Traks from cut to present location and closeness of burrow enforces idea of little movement.
1500 Came across another male, unmarked., but I would gess about 80 –85 cm. L.c. He was right beside cut in pure patch of Smilacina like stuff and eating away. (Pg. 47)
Evidence around the area shows that he might have been through about ___ m of this stuff today. There is a small muddy patch were he may have been last night but not sure – if so has not traveled far – within a small rectangle around the cut; but may have been off in mora – can't tell; may have been here tow days or more also; There is another small place on border of cut and mora which might be used as night parking spot, but not clearly so – not much mud churned up. He seems to have cleared maybe 10 – 15 sq m of this plant. This plant may be an invader species as it seems most plentiful (almost exclusive) in places laong cut; only other place abundant is where mora veg is very low; it is lower than some other mora plants and may get shaded out easily. (Pg 48)
More on unmarked male – about 15 m down the trail found a well excavated night stop excavated into bank of mora veg; also about 5 sq m more of same plant cleared; maybe this male spent night (s) ? here and went up the trail – can't tell – no droppings, but is wide enough for him to move along without smashing much veg. Interestingly, there is less of the plant he is eating near night park, one whole side of the cut trail being some other low herb and part of the side the night park is on is also this other plant. –
Further up trail = saw 3 more medium to large males. #76 was (Pg 49). . . .
About 50 m. off of cut and had been doing a good deal of wandering it appeared – or at least was using trails made by other animlas (see below) = was eating smilacina type thing. Down trail saw male no 427in cut eating a large grassy species (will collect). Also male nol. 655 eating same grass – he is about as big an animal as I have seen – l.c. = 151.3 He was also right in the cut. As neared turn off to Caseta (about 250 m N – West of it) saw male #809 in cut eating Smilacina type plant.
Saw to more medium – large Galapagos on trail from cut to Caseta – one was already bedded down for the night – now 1630 – the other was grazing. About 1730 went up to pand (Pg. 50) . . . .area just above the cut north of the Caseta – saw 2 galapagos near it and 3 on the way (two mentioned above plus one more) – all were in night parking spots.

And appeared unaware of Lautaro and me – all were front end in first and all had churned up the soil some.

]My general impression after today's observations are three:

1) nearly all the animals to north of the Caseta and in the mora zone along the reserves northern border and the 3 seen below El Chalto on the east were males – perhaps there are some females in the area but certainly skewed (2) There is much evidence of Galapago activity both in Guayavilla – (Pg. 51) . . .Scalesia forest (as north of Caseta, near ponds in same area, and around El Chato) and in the mora; many trails are evident where the vegetation is mashed down in both areas – in some cases it is simply matted, in some cases partly eaten 3) The activity period of the animals in these areas is probably from about 0900 – 0930 till 1630 – 1700 for this time of year; observations of #820, and 246, near the Caseta and the animals in the pond below it seem to bear this out; this may depend partly on the extent of the garua drizzle on any given day – as noted on July 31, when we passed pond below Caseta on July 30 at 1630 most animals already under cover along sides and inactive – it was drizzling quite steadily then and had been (at least it had been down trail) for most of the afternoon. However on July 31 and today, the animals just started bedding down around 1630 p- 1700 and most were grazing steadily in mora region around 1630 when I passed – no mist this p.m. to speak of. One additional note on the eating of their Smilacina thing – saw one trail leading off of the cut where an animal had appeared to have walked about 5 m. mashing down plants, specifically eaten a patch of this stuff and then gone back to the cut trail and moved west.

Another note worthy of mention is the presence of h20 in various areas – as noted above there were (Pg. 53) small amounts in rocky areas 1) just west of pand below the Caseta, and 2) in one corner of pond at east base of the El Chato. Also, there is a good supply of H20 in patches here and there in the pond area just above the cut to the north of the caseta. (altitude about 235-245 m).

I would just, that if the animals needed H20 to drink, it is available in various places near the ponds or in them, even though this is a dry year. However, a goodly number of sunny days in succssion might exhaust the supply between the animals drinking and natural evaporation. So far I have only seen one animal actually drinking (see above) and although there are animals in each of the 3 pond areas . . . . (pg 54)

I have visited, they do not seem to be concentrated at all. Have seen few as compared to the conglmerations which supposedly occur there at certain times according to Miguel and Lautaro. In total, it would seem that at least at this elevation (and probably en general) the gaura provides ample H20 in form of drops on veg so that animals are spread out now – also cool, humid and v.p.d probably quite low.

Lautaro told me of a few interesting things – should perhaps check them out with Miguel. He says that during the gaura, the tortoises all spread out in general. However, he say (Pg. 55) that if one gets 7-8 days of sunshine without garua mist, that animals will collect around the ponds (if they have water) – he indicated that this might happen in October, November, or December, depending on prvevailing conditions. He also said that there are many animals in the Caseta mora areas of both sexes in Dec. – March Period; the hinks the breed mainly during these 3 month period of Dec. – Feb. and says don't do much breeding at all in March – May period? He

says that after March the females and some males begin to move slowly, eating all the way to the lower areas. By June or July there are no females at the Caseta altitudes. (Pg 56) . . . . and above – only males. It remains this way evidently till the females begin to move up again in late Sept. through November - again this is slow – they eat all the way.

He things the females lay eggs in July – Aug period on Santa Cruz anyway. He thinks that the males may show many varying patterns of movembent behavior. Some may remain in higher areas year round – e.g. near El Chato or the Caseta – he especially thinks this true of oldest and largest males. However, others may move (with or in search of females) to lower areas at various times. He suggests that they may go up and down several times / year whereas the females show a single (Pg. 57) migration pattern. He thinks with the males it depends almost entirely on weather patterns and sexual behavior. If it is a wet winter (Dec. – Feb. or March) some may move down where there is plenty of food – i.e. they may scatter after breeding. If it is however a dry winter he thinks they may stay in highlands where it is cooler and there is likely ot be more H20 especially in pond areas. He didn't say anything about leaving highlands if very hot dry year in search of cactus?.

Anyway, it is all just about as clear as it was before – i.e. totally confusing.

Some observations which might be worth following up and planning for are the following: (Pg 58). . . .

1) It would be interesting to check the animal's sense of hearing and vibrations – twice I have been able to sneak right up on a grazing animal from behind and failed to get a response by either whistling or clapping reasonably loudly – (a human could hear me for 75 – 150 ft. I'm sure). In one case the animal did not even respond to my stamping my foot right behind his shell several times until I did it quite hard – couldn't tell if he heard one or felt the vibrations. But probably the later However, when the animals are resting with their necks and heads on the ground and legs flattened out, I can't get nearly so close (at least from the side). I will test this more on Alcedo, but it would be interesting to rig up some simple tests for hearing and vibration sensing and see how this relates to behavior.
2) Along similar lines it would be interesting to see how they respond if at all to hissing sound – i.e. is it simply air being forced out or do other Galapagos (or other species use this noise in some way.
3) Eyesight seems to be damn good – have noticed them apparently watching me or Miguel approach 50 m away or more.
4) This parking behavior at night is interesting; the head end in posture is more interesting – might be worth checking on position of legs and head and neck at night (I think probably extended if well into excavation (Pg. 59) in relation to (1) and also might be interesting to see if has anything to do with wind protection and or thermoregulation. Try and decide how might run expt. In field – e.g. how to restrain an animal in the open for checking cooling rate or weight loss also check on orientation of these things in relation to prevailing winds at night. Are there yearly variations in this behavior – i.e. might it be related to precipitation protection etc. Ecto parasites and cycles of such?

5) What time of year do they actually immerse themselves in H20? Lautaro says in Dec. – Feb. period has seen one go into H20 near the Caseta and say all day or perhaps several days. Function of such
6) Thermoregulation – some half-assed decent method of core and shell temperature taking needed - ??

(Pg. 62)
Aug 2 – All temps with black bulb Schultheis air, h20, etc. – all
Located 6 animals I will follow above the Caseta near the pond, cut, beginning of mora area – I would guess it is an area of 2-3 hectares in total.
The animals are as follows, with second number being one I marked each with (on all 3 sides, but front) in white latex paint
#450 - #1
#336 - #2
#529 female - #3 – tail not too long
#277 - #5
#420 female - #6 – tail not too long
Additionals:
115 - #7
#305 - #8
#852 - # 9
#368 - #10
#403 - #11
#338 (maybe #138) - #12
#627 - #13
#256 - #14
#782 - #15
#695 - #16
(Pg. 63) Began watching at about 0800. Got pretty hard garua in nihgt and up till nearly 0800 it then stopped and looks as if may be still, warm day – will check rainfall tonight and include in notes.
Will take air at ½ hr open soil (which is wet everywhere), and animal shell surface temp. each hour all day long if possible and in case of any sharp weather changes, then also.
At 0800 – Air 22.6; Soil surface – 23.4; Shell surface of #529 – 23.4
At 0900 – Air 22.5; Soil surface – 21.8; (clouds heavier and breeze than at 0800)
At 1000 – air – 26.5; Soil surface 21.8; Shell surface of #277 – 30.3
Sun had been out to about 3-4 min. about 5-10 min prior to tempt taking but obscured again right away – (Pg 64) . . . .
First adequate obs on each animal at 0830 – situation is as follows:
#529 and #720 were still at night parking spots – excavation types , but had turned a little and were lying in fairly open positions with head – necks on ground and all legs out on ground. #820 was in similar position, but not at night park, which I could not locate. #336 had moved a few m from apparent night park and was grazing on wet seedlings but not moving at all. #450 first seen at 0850 heading toward Caseta on trail from cut – saw again at 0930, (Pg. 65) few m from where first seen – grazing on low herbs. #277 like #820, but could see night park – had moved maybe 15 m W on cut.

Came back by all animals but #720 at 0930 – 1000 and found following - #277, 820 still in resting position – feet and heads-necks out and on ground. #450, 336,529 all grazing - #529 now 8-10 m away from night park – all very slowly eating – nothing of note.
At 1020 say #720 again – lying in open – had moved 10 m from resting place by circuitous route and was in flat resting position with head and appendages out etc. Might note that this lying in open behavior is mostly in flat low grassy areas. However as noted above sometime occurs right (Pg 66) . . . .in muddy night parking spots.
At 1020 found #115 male at E. edge of pond area above Caseta – resting there it appeared – typical position – could have been eating a little, but herbs around him indicate not much if any. About 1030 #115 male was moving slightly west, but only very slowly.
At 1030 –1100 #529 still grazing , but between 1000 –1030 moved about 30 m to just n of cut – toward ponds – grazing there; #820 still in resting position.
At 1030 discovered 3 more animals and marked
#305 was in open place, in complete resting position
#852 was grazing on low herbs in open, (Pg. 67)
#368 was in semi – open next to Scalesia forest – grazing on low herbs.
Garua came in strong from 1045 – 1100, but made no difference in behaviors of 3820, 529 or these last 3 as far as I could tell – either kept on grazing or resting as before.
It looks (from trails and positions now) as if #852 and #305 could have literally spent night in excavations ¼ m apart in same clump of vegetation – but not sure.
All three of last named animals were away from night spots when found.
1105 - #305 now moving a bit and is beginning to graze on low herbs, then continuing to move ; saw #403 also about 1045 – grazing about -------m. from 368 – both continued to graze throughout the rain. (Pg. 68)
Watched nos. 2, 3, 4, 8, 9, 10 ,11 almost continuously from 1030 –1230; [Marginal note: written at 1300]
#4 (#802 female) did almost nothing but sleep – she has moved maybe 3 m all morning
#2, 3, 8, 9, 10, 11 grazed almost the entire time; 10, 11, 2 moving very little; 9 moved perhaps 15 m , and 8 about 20 m during time period. No. 2 had moved up about 30 m. previously (before 1030) to N of cut. No. 3 farily active, moved at least 100 m during morning, plus 20 m or so earlier across cut to N from night resting place; 10 and 11 have moved hardly at all since discovered. At 1230 saw 7 grazing in bottom of easternmost pond above the Caseta – dry – 6 was also near (Pg 69) . . . here on S border of this pond, resting with head and neck on ground. Should mention that sometimes rest with only chin on ground – i.e. esp. #4 (820) does this – in other words neck not necessarily on ground always.
Couldn't find #5 along cut – only went about 100 m up it from Caseta trail (to W)
Saw No 1 in region where No. 3 started out the day about 1200 – i.e. he had moved N as did 2 and 3 to near cut – but still S of it on Caseta trail. Grazing also.
Garua drizzle was strong from 1045 – 1100 and off and on from 1100 to little before 1200 – now "clear" and has been no mist from 1200 – 1300. Sun not out however at all, although could feel it a few times. (Pg. 70). . . . .

Temps –	Air	Soil surf.	Shell surf.
"garua" – 1100	21.8	26.3	26.5
1200	23.4	26.8	27.4
1300	25.0	27.8	28.2

May clear this afternoon! – sun!
Sun cameout for 5-10 min. between 13 – 1400, but that's it for the day it seems

Temps	Air	Soil Surf	Shell surf.
1400	23.2	26.4	27.0
1500	24.5	25.2	26.0

1500 – Found what is either male no 338 or 138 (2 marks on hundreds chipped, but I think it was cut by Miguel). Grazing in open area, right beside cut at Caseta trail
At same time saw no. 1 in virtually same area as at 1200 –1300 – think he is grazing. About 15 m east of last location. (Pg. 71)
1515 - #3 grazing about 100 m directly N of last nights resting place – i.e. near Caseta trail – cut junction.
#4 has moved 10 m to E of morning location – grazing
#13 (#627 male) is new arrival – grazing on grass about 4 m N of #4 – [Marginal note: all 3 close – no obvious interactions]
#8 where left at 1300 – grazing
#6 coming down from pond a bit - grazing about 25-30 m South of it – getting near area where #10 was this A.M.
#11 – has moved 30-35 m NW toward where #8 is – not too far apart – grazing also
#10 – about where #11 was most of morning – i.e. just a bit 4-5 m South of where he was all morning – he being #10 grazing – (Pg 72)

Temps		Air	Soil Surf	Shell Surf
Strong o.c	1600	23.1	24.4	25.2
Raining	1700	20.0	21.0	--
Raining	1800	19.0	20.0	--

1545 – Found No. 2 at H20 pond (most eastern, N of Caseta) – must have traveled a stright line distance of 175-200 m toaday – most of it since I last saw him at 1300 right near the Caseta trail – cut junction.
Don't know if drinking – perhaps so. But was apparently intending to burrow in for night [Marginal note: see photos]. By 1615 had managed to move in even though I was standing there and apparently scaring it.
1630 Went to other ponds to immediate west. Was reasonably good h20 in two of them (one large, one medium) – however not very deep – perhaps 20 –35 cm. (will check) – but certainly some – (Pg 73)
Were 3 animals in H20 for night apparently – none marked – will follow up to make certain. Checked again at 1700, and 1830 and no change – can't see any change in position or orientation. Of the 3, two are smallish – medium and are in open H20, the other one being medium –large, with only the back one-half of his body in open H20 – the front half is in very wet mud. I will try to mark and follow these three in the morning to get beginnings of activity, etc. =

Nos.	Sex	Marked	Temporary Code
#256	m	#14	a
#782	M	#15	B
#695	M	#16	C * see p. 91

See following pages for further comments – will use temporary code for now.

Pg. 74
Noticed #6 dug in for night about 1620 (probably accurate within 15 min as saw feeding south of here about 15 m about 1600) [Marginal note: see photos]
1640 – Saw #11 about 30 m. south of ponds (i.e. has progressed north) – still grazing
Saw #13 same area as before – grazing still
Saw #3 dug in for night in veg. Clump – similar to #6 – both facing about north.
Watched #13 continue to graze until perhaps 1700 or a few minutes after – in same area where first saw – he then began to burrow into a clump of vegetation. I could not tell if he used his head and / or neck in this process. However, he definitely used (Pg. 75) . . . his forelegs to dig and scrape his way into the soil under the vegetation. The hind legs seemed to be used only to push him in further after the forelegs had dug the cavity. Several side to side movements of the carapace were noted and these seemed to aid in wedging him in under the shrubby-like vegetation – his front end seemed to end up lower than his back end. The whole process lasted about 5 minutes – at the end of which he stopped maving and his laborious sounding breathing could be heard. 'When leaving at 1830 I rechecked all the animlas I had previously seen retire (total of 9 - #'s 2,3,6,10,13,11, and 3 unknowns (a, b, c). all were same , except #13 who had moved about 3-4 m to another shelter – facing in exactly same direction (east), but it had been constructed and used (Pg. 76) . . . . on some previous night (i.e. was there this a.m. at 0800) by an unknown animal – whereas the one he was in previously I saw him make – why did he move?? – does not seem any more protected .
Watched #10 graze till about 1710 – he then began similar process as saw #13 doing – however, he went into and eventually out and through one clump of veg without rrally digging in – he could have easily walked around it as there were tortoise paths on each side – my guess is he intended to excavate and then found something about it undesirable. Anyway, went only 1 m. further and dug under or into side of another clump. (Pg. 77) Process was the same as with #13 - #10 made exactly 2 twists of carapace in each direction and also obviously was using sweeping digging movements with forelegs and pushing forward with hind legs = could really see head well, - but it looked to perhaps out at several points during the process – took 6 min. and once started he seemed unaware of my walking only ¼ m away from his front end.
A few minutes searching in the environs of the areas where (1720) I last saw #'s 8 & 4 (at 1530 or so) failed to turn up either – did not look far however. I then watched #11 rretire – he grazed just S of ponds (15 m or so) till about 1730 and then began circuitously moving (Pg 78) . . . . toward the small middle pond which has the most H20 (___ cm in deepest part). He moved to the edge of this pond and drank off and on for 25 minutes (until 1800) [marginal note: see photos] About 1800 he entered the H20 and poked around in it for nearly 20 min and then for 10 min more up against the opposite bank- it seemed as if he may have been searching for a place in which he could elvate his front end enough to prevent him from having to hold head out of H20. He finally quit moving at 1830, with head end up against (perhaps raised up on a bit) North bank of pond. Carapace was at least ½ immersed, and back legs were totally (Pg. 79). . . . under H20 = front legs partially under H20, but head out and forelegs partly out of H20 in mud and veg against bank.
Took some temperatures for animals in H20 just to indicate conditions.

At 1650 – near #2 (eastern pond) - air temp at ½ m – 21.5; H20 temp where posterior end immersed – 22.7; shell temp on top 21.4; mud temp at 1 cm. Where legs and plastron resting – 22.6
H20 only 1.5 cm deep here – His entire front end is under veg [marginal note: see photo] and I suspect forelegs are mostly in mud and H20 – His hindlegs are about half in H20 and mud and half in air. Sort of in between condition (like A) as compared to #11 and #'s 10, 6, 13, 3 (Pg. 80)
At 1730 – Air temp at ½ m – 19.8 C. Pond (western one) where A, B, C are .
Water near A is only 4 cm deep at posterior end; he is in a similar position to No. 2 – front end and forelegs are in mud and back half and hindlegs in H20 – perhaps a bit more immersed. His front end is gammed snuggly up against a rock, his carapace, the rock, and the ground forming a little cavity – water at back end – 23.5 C; must by front legs – 22.4 C
B is completely in H20, but varies from 4 cm deep in front of head to 16.5 cm deep at back end – back half of animal is under H20 (except for top 1/3 of carapace only) – forelegs are completely immersed (Pg. 81) . . . and there is H20 up to plastron or slightly above the gulars in the front – water around him is uniformly 24 C – echecked severa depths and locations.
C – completely in H20 – didn't measure, but I would guess about 10-15 cm deep. = all legs under H20 – leg pockets and all – would guess H20 up to just under neck – H2o near him is 23.5 C at all depths.
At 1830 – H20 near #11 – uniformly 23.2 C; he in immersed up onto carapace in back – part of forelegs under H20 also. Water is about ____ cm deep near his posterior. A few general comments on behavioral observations of retiring animals. (Pg 82)

1) time varied for animals actually seen retiring (#'s 2, 6, 13, 11, 10) from 1543 – 1615 for #2 to 1800-1830 for #11. Most of those not using any open H20 seemed to retire in period of roughly 1615 – 1715 – ie. #'s 6, 10, 13, 3 – but not sure. For those using H20 time varied more widely – 1615 – 1830.
2) Smaller animals seemed to go in a bit earlier – c.f. #'s 3, 6, b, c, as compared to #'s 11, 10, 13, but this is probably coincidence and lack of observations.
3) Direction faced –either in H20 or in soil not consistent as far as can tell.

Front end directions for animals:
#2 – west; #3 – north; #6 – north; #10 – west; #13 – east (both times); #A – south; #B – east; #C – southeast; #11 – northwest.

4) in both types of areas (water, soil) and in between, the animals take about same stance – i.e. the legs and head are drawn in = either nearly completely or at least mostly so – don't appear to be in contracted state, but neither head – neck or appendages are extended as in resting posture. This results in two things – a) legs are more or less covered by water and or soil or mud; b) head end forms a more or less (Pg 84) . . . . closed pocket with veg and soil or rock (i.e. #A). Exception would be cases B & C where no pocket is formed.

In all situations can hear breathing in and out and have to poke fingeres right neart them to disturb them, even just after they have settled down.

5) It is important I think to note_

a) 3 animals well immersed in H20 in garua season
b) 2 more partly immersed ; However, others chose to burrow in soil when open H20 is close by – in fact certainly are more in soil burrows – No concentration of animal at H20 holes.
c) One animal seen drinking a lot – for 25 min off and on – (perhaps drank about 10 –15 min of this time). And one more (#2) probably drank also –

Comments on weather –Garua began again about 1700 and was strong off and on – actually raining – till about 1900. Since then occasional mist. Got 4.85 mm today - certainly nearly all since 1700 today (1900 yesterday to 1900 today)
So retiring did not seem to coincide with precip. In any obvious way – some before, some during, one after hardest part (#11). (Pg. 86)
Aug. 3 – The back came of(f) the thermometer, so am going to dispense with temps after activity begins unless sun comes out etc.
0700 – Near #2 who has moved back just slightly – 1-2 cm. – during night and is still sound asleep – has uextended both right limbs some (back or nearly fully in mud) but head and left limbs still in.
Air 19.2 C; Soil Surface – 20.8 ; Shell Surface – 20.6; Mud by back leg- 20.6; Water around plastron – 21.8
0710 - #11 moved sometime after 1830 last night – apparently came back across pond and to bus – total distance of 5-6 m. – burrowed in soil there in typical fashion. (Pg. 87)
Pond temp. now 20.6 C near where he was last night.
0720 – A, B in same positions; B awak and watching me when I came up – A sound asleep – only change is that his head is out a bit more - can see tip of nose in crack between marginals (pre-central rea); he is \breathing as usual.
Air 20.1 C; H20 near B 20.6; H20 behind A 20.6; Shell Surface of A 20.8
Little more H20 during night so can now see that all of back legs of A under H20 and part of forelegs and front of plastron also.
Can't locate C – moved during night (sometime after 1800 most likely). Can't see in open area around pond at all; since it was nearly completely dark at 1830, he and #11 must have moved in dark (Pg. 88)
0740 - #2 has backed out ¼ m and turned S a bit and is sitting there – don't know if was in resting position, because saw me and is watching now
0745 - #11, #6 still in positions – took some temps around 6 who may have heard me – heard hiss, but then normal breathing.
Air 20.3 C; Mud by back feet 21.5 C; Air Pocket under plastron just behind foreleg – sort of sealed by mud and veg – 23.4 C [Marginal note: Note!]
0745 - #s 13 and 3 have backed out of burrows and are turned away from them – are lying in open (in (word unclear) from above) in resting positions – legs out, but head and necks not on ground – partly out, eyes short. (Pg. 89)
Last saw them about 0700 – were still sound asleep then (as were #6, 12, 10)
0800 - #10 has seemed to turn ever so slightly, but is still sound asleep in cavity. 312 has moved out of burrow and turned around and moved few m south – is resting like #s 3, 13.
0810 - #2 pivoted a bit more and is drinking in pool beside his night park spot
#6 still hasn't moved – but is awake.

#11 has backed out of hole and pivoted a bit – in resting position with head up on mud near hole – 3 legs extended – other can't be because of mud.
0820 – A and B still same, but A awak and in resting position with head and neck on rock – i.e. elevated. (Pg. 90)
From now on call A and B, #14 and 15 respectively.
B resting with head and forelegs stretched out and up on mud and grass in front of him.
0815 – Temp – Air – 19.8; Soil Surf. 22.8; Shell surface 22.1
0840-45 – made a quick tour by all animals –
#10 and 6 have now turned around some from cavities and all in resting position.
#3,13, 12, 14, 15, 2, 11 all in virtually same places and all resting – only one I got a good look at was 3 and he was in full resting position, with head and part of neck on grouned.
0900 – Air 21.6; Soil 24.8; Shell 26.0
(Pg. 91) 0900 – 0910 #3, 13, 11, 2, 6. 10 still all resting beside night spots. #14 still resting at night spot; #15 moving across pond and drinking in shallow middle part of it active –
0915 - #13 moving a few m. - I think he will begin grazing now;
#12 grazing - probably has been since about 0900 judging from location and behavior
#9 just now seen beside Caseta trail, just off of cut. Is lying and resting in a flat open bare soil area (for heat in soil?)
#4 about 15-20 m from where last seen last night – resting and sitting there in greenish area. (Pg. 92)
1000- #1 – about where last saw yesterday – grazing
#12, #9 near where were at 0915 – both grazing
All three of above near Caseta trail – cut junction.
#3, 13 grazing near night burrows – neither has moved very far - #3 a few m at most, #3 about 1-2 m.
1030 - #6 down trail 10 m from night spot – in nearly full resting position with chin on the ground and forelegs out – hindlegs in a bit from full position.
#2 grazing right near night retreat –
1050 - #11 – same exactly as at 0900 – still resting.
#14 – has moved maybe 2 m from night spot. (Pg 93)
Is grazing on sedges and has cut a path in circuitous fasion around rock where was last night – I would guess active since 0930 at least.
Found animal who is apparently C of last night – marked him #16. He was grazing 15 m s of pond on sedges. Not sure where came from – but there is a path which splits in woods – will call #16, but may not be same as C - ?? About same size, but maybe a bit larger.
1100 –1140 – checked all animlas more or less
#s 12, 1, 4, 13, 14, 2, 15, all grazing – sedges, grasses, low herbs
#s 9, 3, 10, 6, 11, all resting = legs and heads out – usual positions – more or less in open –
Comments - #11 still hardly moved all day.
#4 in cut – found burrow and droppings, maybe move 10 m today so far – eating small herb. (Pg. 94)
#15 now 45-50 m south of pond where spent night – i.e. down in area where 3, 13, 4 etc. have been feeding for both days. All others in about same areas as noted so far today.

1200-1300 - #1 – resting – same area;
#9, 12, 3, 15, 10, 13, all grazing in lower area between Caseta trail – cut junction and ponds.
#12 has moved N 20 m and #15 is 20 m further S from area in which seen at 1130.
#11 = finally active – grazing about 15 m S of where spent night – i.e. on beginning of slope down into area where most animals are now.
1250 - #2 and 6 are both now at the pond where #11 spent night. In other words #6 moved S and then (Pg. 95) N. again today. This is the first time I have seen him near H20 – he is about 5 m from nearest H20 now eating sedges. #2 is apparently drinking from a small depression (perhaps he made it) about 3 m away from main pool where there is H20.
1250 - # 14 and 16 are both out in middle of sedges covered area of the western pond [marginal note: right next to each other – no interactions] – I think both are eating sedges.
1300 #2 moved and is now drinking in another depression close by – I don't think he made either of these – fairly certain.
At 1250 also found male ? #598 at pond just east of western one – up on a mound , eating grass – could be C from last night judging from size.
1330 – everything about same with all animals mentioned above since 1200. (Pg. 96)
1340 – went up a trail off the cut which parallels the eastern edge of the mor where it abuts on the field –forest area below the upper Caseta ponds. There were fresh droppings – about 50 m up the trail there was a very rocky pond with H20 – about ____ cm. There were fresh tracks (scale marks) of Galapago having used it and only 5m beyond I found no. 4 grazing – so she has been moving a good deal since 1130. She is now climbing up into a quite rocky area for this habitat- will try to follow till retires. Watched for 20 min. – covered about 55 m. in that time (actual distance) some of it climbing. Came out a little east of pond where (Pg. 97) . . 14 and 16 are – is now (1410) eating grass there.
Heard a thud behind me and saw no. 8 back down at H20 hole mentioned above where I think #4 drank. He began drinking; he must have come from easterly direction out of field area below ponds, because I did not see him on trail which is almost N – S and the mora is immediately to the west – he could have been in the mora however. He drank straight for about 10 min., then turned and started back south. Stopped about 3 m away and is grazing.

_____-
Made a tour of whole area
1445 – 1510
3s 1, 4 2, 3, 6, 8, 10, 11, 13, 14, 16 were all grazing.
Only #s 1, 2, 11 have moved much, of these, from last time ; 1 is (Pg. 98) back along Caseta trail, slightly S of cut; 2 is in next pond west of where last seen (short distance in other words); and 11 is 5- 10 m more south of previous location.

* #12 is apparently burrowed in for night, but burrow isn't very deep or "well constructed" and this may be temporary.

#9 is moving at a good clip to the W – NW toward mora border – perhaps is going to water hole where saw #s 4 & 8.

#15 – saw move to H20 hole where #6 now is between 1455-1510 – moving straight along path at good rate from campo area where has been grazing. – (Pg. 99) went right up to water and started drinking.

* As of 1500, at latest, #598 is immersed (about half of carapace out of sight) in pond where first seen!
Went around again from 1545 – 1600 Essentially all the same but the following:
#9 in for night under bush near mora border on west – don't think he went to H20 because of time factors involved.
* #7 and 11 – conflict – found 7 in campo just west of eastern forest border – where 11 has been most of the afternoon – 7 was grazing and 11 approached him – both had necks stretched way out and head tilted from neck at 45 degree angle – snout up. 11 opened mouth and appeared to bite down at head of 7 ; 7 (Pg. 100) . . . offered no resistance and withdrew head and started to move away (11 never bit him or touched his head). Then 11 just kept coming and rammed him once with his shell – 7 moved off 2-3 m and began grazing; 11 moved in where 7 had been and began grazing – both eating grass I think – no apparent pursuit by 11
- couldn't find #8
- Just as returned at 1600 - # 14 and 16 were burrowed in – both one sides of same pond area- but 16 completely in non – H20 area up into mora. #14 about as last night but with anterior in mora and post. Perhaps a bit deeper in H20. (Pg. 101)

1120 - #15 settled in right behind and to side of #598 – shells actually touching – water covering up onto ¼ of carapace – "snoring " well by 1630
1620 - saw a repeat of the scene between 7 and 11 between 2 and 4 – two started it and moved into pool beside 4 where 4 was grazing – this time both opened mouths, but 4 retreated immediately, turned back, moved 1 m and began grazing again. 2 followed in for about 2 footsteps, then turned 90 degrees and began grazing also. No blows struck – both eating same stuff before and after and there is an abundance of it – as in previous case (11 and 7).
1645 – 1715 – Toured again. #598, 15, 9, 12, 14, 16 all in place for night as before
3 – saw go in just S of cut at 1650 – took 2 min or so – used old excavation and added only a little. (Pg. 102).
2, 4, 7, 11, 10 grazing as before.
Couldn't find 6, 13, 1, 8 Not sure at all of 8? Tempted to conclude 13, 1, in ?
[marginal note: True of 13 – found later]. Pretty sure 6 must be in because was previously at pond where is plenty of food – probably moved off deliberately only to retire?
1720 –#4 waded in to deepest part of western pond and settled down – perhaps ¼ -1/3 of carapace covered – H20 above gular and legs covered.

1725 #2 in part of H20 mostly mud – dug into mud – legs only partly covered – maybe lower ½ of them – he may move- ?
1733 - #2 started grazing again!
1740 - #10 in bush for night. #7 – grazing – same place; #ll – in woods to east, about 20 m. (Pg. 103)
1745 - #11 into burrow new - in woods – 5 minutes
1750 - # 7 walked about 4 m into woods to east of campo and began burrowing inot a veg. Clump. –
1755 - #2 moved into pond and dug in more up against a rock – more H20 around him now – nearly up to leg pocket tops (of carapace).

All accounted for but 1, 8, 5
Not much rain today – only a little in the morning – none all afternoon and till now (2000) – not even mist. (Pg 104)
Plants – from Caseta and mora areas where tortoises watched.

1. The plant which I have frequently referred to above as the "Smilacina – like" thing is probably the following monocot, although there is not now a specimen at the station; D. Weber has also seen it and has a drawing which agrees wlosely with my observations – it is apparently common and Weber thinks it grows down fairly low in transition zone as well as higher in Scalesia – Psidian forest.

(Commelinaceae) local name is churuyuyo Stewart (1911) records it on Abingdon, Albermarle, Charles, Chatham, Duncan, Indef. – says common above 100 ft. (Pg. 105) . . . on Santa Cruz and occasional in open woods on same island at 450 ft.
Stewart says is generally distributed in the tropics. Svenson (1930) shows it from about 45 m to almost 317 m above Academy Bay. He says: a common abundant plant in mosit woodlands from about 100-1500 ft. – widely distri. In tropics.

2. Grasses and sedges – will have to collect or will be very difficult to say anythinbg p but see (7) below
3. Passifloriaceae

Passiflora punctata- specimen in station, but no flower; I have photograph from Aug 1, 1968. Very common in mora and flowering – growing both on the ground and as a vine onto trees – bushes; seems to (Pg 106) be one of the plants involved in smothering larger plants in the mora. Tortoises not seen eating it, although abundant and right beside or fully intermixed with Commelina and other low growing stuff. (see previous notes, Aug. 1) viny.

4. Cucurbitaceae – Plant with leaf with 5 lobes, orange furit, simple yellow flower. Station has specimen with flower only. Abundant in mora between Caseta and El Chato – in openish area below ponds above Caseta also, but not abundant; (perhaps mora moving into this latter areas). In mora it seems to be one of the smothering plants also; grows on ground too and very (Pg. 107) viney; mixed in with passion flower, Commelina, but tortoises not seen eating it in mora area. However did see a tortoise who was sort of indiscriminatly grazing in area below Caseta ponds (upper ones) eating leaves of it , along with grasses, and small herbaceous seedlings.

Name in doubt – says Echinopippan (/) on station specimen.

5. Legum? Or whatever which dominates mora area – Dr. Perry says Eliasson doesn't know even what family it is in as of now; apparently no flower ever seen. Tortoises definitely not eating it.
6. All other things I saw tortoises eating were low (Pg. 108) . . . herbaceous – looking seedlings and grasses – In area below upper Caset ponds and in pond area appeared to eat this variety of things plus – grasses, sedges, Commelina, Echinopippon, -- No selectivity apparent here, but ate much grasses. In mora area just to west were eating only Commelina (mostly) and some were eating grass along cut.

7. Saw tortoises eating one grass definitely – along cut through mora from Caseta to east of El Chato. Specimen in Station Herbarium collected by D.W. Snow in fruit on 8 May, 1963 at El Chato, 500 ft. [Marginal note: #800]. He says.(Pg 109) . . . 'forms the close cropped turf grazed by the tortoises round the ponds' . This may have been one of grasses round Caseta upper ponds, but I do not know. Flowering now and must collect – (Pg. 110)

Observations made on birds during the trip:

1. Flycatchers – once it became reasonably moist – perhaps 50 m plus or even less – both vermilion flycatchers of both sexes and the other small flycatcher were evident. They both seemed quite dense all around the Caseta, ponds, grassy and forested areas all being frequented. However the vermilion flycatcher was noticeably absent from the mora area and the cut through it, whereas the other flycatcher and the yellow warbler were both in these places. The latin names are: Vermilion (Pyrocephalus nanus) ; other one (Myiarchus magnirostris) (Pg. 111)

Should watch more carefully to see if these animals feed in relation to the tortoises as there is some indication that they might do so. Vermilion flycatcher is called "pajaro brujo" in Spanish.

2. Saw 5 short eared owls near the Caseta , mora area, and El Chato. Latin name is 'Asio galapagensis and Spanish name for both this species and barn owl is lechuza.
3. Heard Hawaiian petrels calling at night as returned to nests (holes in ground) around Caseta Pterodroma phaeopygia. Common name in Spanish is "pata pegarda" or "pata pegal"?
4. found nest of Galapagos rail with the bird on it – (Aug 4); 7 eggs, on ground. Very pretty and (Pg 112). . . . very fast animal. Nest was near pond above the Caseta. Name is Laterallus spilonotus. Lautaro Andrade called it "pachay" (sp?) in Spanish. Description of the nest and eggs: Nest was beneath a small Scalesia which was covered with a thick growth of vines on lower portion. The nest was a shallow cup of perhaps 5-6" diameter, woven out of some of the viny branches and a few sprigs of dry grass. The eggs numbered 7 and were an off –white and cream color with splotches of a dark brick –like red color, with perhaps a bit more brown than reddish pigment. The were about ½ chicken egg in size I would guess, but I (Pg. 113) did not measure any. [rest of page blank]

(Pg. 114) Summary of work done in Santa Cruz reserve in mora area and Caseta area Aug 1 – 4 , 1968.
Nos. of animals I encountered, with sexes entered as on cards at Station.

Painted No.	No.	Sex on Station Card	Det. By
	53	m	Prob all by Castro, most don't say
	58	f	
	76	f	
7	115	f	
	246	f	
14	256	f	
5	277	F	

8	305	F	
2	336	M	
12	338	F	
10	368	m	
11	403	f	
	427	f	
1	450	?	
3	529	f	
	598	m	
13	627	?	
	655	m	
16	695	?	
	712	f	
6	720	f Probably	C. MacF
15	782	?	Prob. By Castro
	809	m	same
4	820	f	
9	852	?	
	981	?	
	1060	f	C. MacF

(13 f; 7 m; 7?) total of 27 checked
Additional information from Dave and Pat Parkin (U. of Edinborough) on 7 – 8 Aug. 1968 while near the Caseta.
7 – VIII – 68 Saw the following:
#1 – 25 m west of the Caseta
#4 – 200 m N of Caseta – i.e. in openish area just below ponds and N of cut.
Beside pools – 2 unmarked; In and around pools - #s 2, 6, 7, 13, 14, 15
#3 – Just S of the cut. (Pg 116)
8 – VIII- 68
By cut - #s 3, 4, 8
By Caseta - #1 and 2 unmarked
On cut – one unmarked
At pools – one unmarked; and #s 2, 6, 7, 14
Last recorded size on these animals in the station cards and dates:

No.	Size – L.C.	A.C.	Date
53	95.0	102.0	June 1962
58	94.2	102.0	Dec. 1967
76	102.5	108.9	Jan. 1968
115	81.5	86.0	Sept. 1964
246	83.0	85.0	Sept. 1962
256	81.0	83.0	Sept. 1963
277	84.3	92.0	Dec. 1967
305	95.8	108.5	Dec. 1967
336	72.0	71.0	Dec. 1962
338	87.0	98.0	Dec. 1962
368	87.8	92.3	Jan. 1966

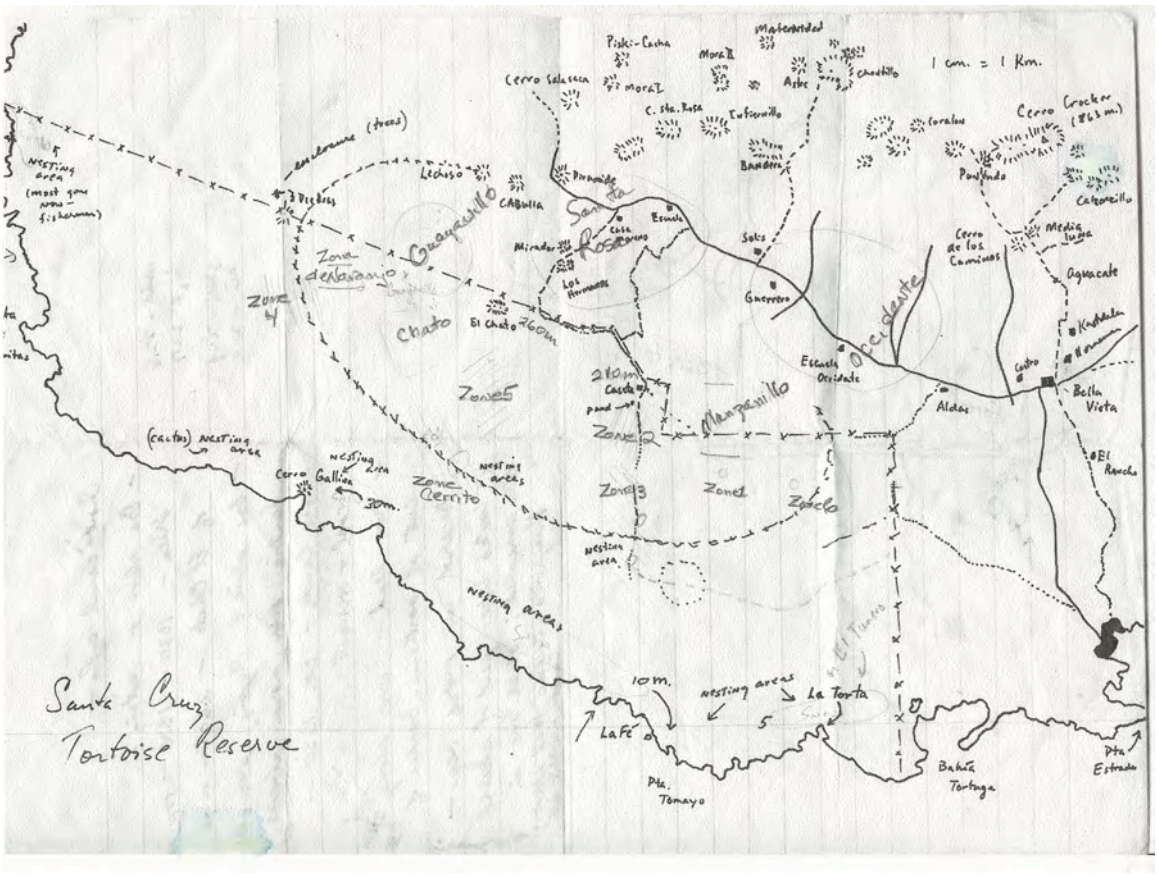
403	65.0	69.0	Mar. 1963
427	97.1	93.6	Dec. 1967
450	75.8	82.0	Dec. 1967
529	82.0	88.0	June 1967
598	67.5	74.9	June 1967
627	960.0	108.5	Dec. 1967
?655	119.2	121.5	Dec. 1967
695	77.6	79.0	Dec. 1967
712	91.2	99.7	Dec. 1967
720	67.0	72.0	Jan 1966
782	76.5	80.3	Dec. 1967
809	107.5	115.5	Oct. 1964
820	139.6	150.9	Jan 1966
852	64.5	72.3	Jan 1966
981	64.1	72.3	Jan 1966
1060	89.5	97.5	Aug 1, 1968

(Pg. 118) Pages 118 –119 contain financial info on Nat. Geo grant expenses and other personal information that was not entered in this file.
(Pgs 120 –138) are blank
(Pg 139 unumbered in book)
Photographs:
Santa Cruz Tortoise Reserve – Zone 3 – July 30, 31
Roll 3 (High Speed Ektachrome) #14 – large male (141.0 x 151.5 cm) – 8:30 a.m. Zone 3 (south) nesting area – Miguel saw at 0730 = still in same place – thinks there all night – much lava rocks – had cleared little soil, but unable to get into it very much.
Roll 3 - # 15 – churned up place near log where (female?) had spent night - had churned up – hole deepest right up against log - probably put head end there – saw 2 others doing same. (Zone 3 (south) nesting area)

Roll 3 #16 – smallish female (15-20 years old according to Miguel?) showing position spent nihgt in up against log - plastron probably 1-2 in down in cavity of soil; soil very red and very moist; soil moist now and probably only 2-4 " (zone 3 – south – nesting area)
Roll 3 # 17 zone 3 nesting area – very southern part of zone – farily typical open place , very rocky and rough; most areas heare not suitable probably because of brush and low tree (5-6 m) cover; also soil patches few and far between – then only ¾ x 3/4m at largest.
Roll 3 #18-21 zone 3 nesting area – lower part – large open areas – several nests (6) protected with rocks from pigs by Miguel; mostly low trees (5-6 m) of Pisonia, Pisidia and few Opuntias. Altitude about 60 m.
Roll 3 #22-25 Very upper part of zone 3, near zone 2 border; fry pond area –counted 18 tortoises in about 2-3 hectare area; many smaller ones feeding on small seedling growing in damp soil. Miguel checked some of them – see notes –
(Pg 140 – unnumbered)
Roll #3 - #s 26-29
Aspects of #820 female (large adult) in resting posture and just after discovering me 10 ft away and aspects of nighttime resting cavity.

Roll #3 - #30 - #820 again with vermilion flycatcher on back.
Roll #3 - #31 – pond below Caseta – tortoise grazing, dried out – July 31, 1968
Roll #3 – 32-35 – small bit of standing H20 to west of pond near caseta = with male large tortoise = see notes.
Roll 3 - #36 – another shot of pond below the Caseta.
Roll 4 - Kod. II. Aug 1, 1968
#2 – female 246 in night burrow – 0730 hrs. asleep – note legs are out.
(Pg. 141)
#2-7 Pictures of mora (semimisty 0930 hrs) area above the Caseta from the northern border of the reserve on way to El Chato. One taken toward north (Santa Rosa) showing Los Dos Hermanos and the extent of the mora; one to Southeast showing sea around La Fe; one of Lautaro and the mora, looking west along cut. One of tortoise near night burrow just after emerging; one of Psidium (8-10 m) covered by mora.
#8-10 Pond to east side just below El Chato. Very large male in one picture; dry except for rocky area with a little H20 – see photo.
#11-13 – up on El Chato
#14 – central highland chain of Santa Cruz – looking toward (Pg 142) . . Santa Rosa from border of mora and forest below east side of El Chato – ie. Looking to Santa Rosa from S – SW of it.
#15 – Tortoise in mora – male number ? – See notes
#18 – excavation in mora – night park.
#16 - tree being covered by several mora species
#17 – flower of mora vine
#19 – tortoise male #58) eating Smilacina like plant in mora

Roll #5 Aug 1-2 Ekta _ High Speed
Through #11 – photos of pond area and animal north of caseta on evening of Aug 1 – see notes for that date.
#12-17 photos of same pond area next a.m. – 0700 – 0900
#18 – Mora plant – yellow fl. Orange fruit.
#19-20's burrow of Aug 1 night after moving next a.m.
Roll #6 –
(Pg 143-145 blank)
(Pg 146- 150 comprised of addresses of companies and people [not entered into this file]
(Pg 153-159 comprised of lists a. Food and similar things; b. Things to bring to the Galapagos; c. ask Rolf about [not entered into this file]
Notebook also contains 8.5 x 11 hand drawn map of southern island (labeled Santa Cruz Tortoise Reserve).

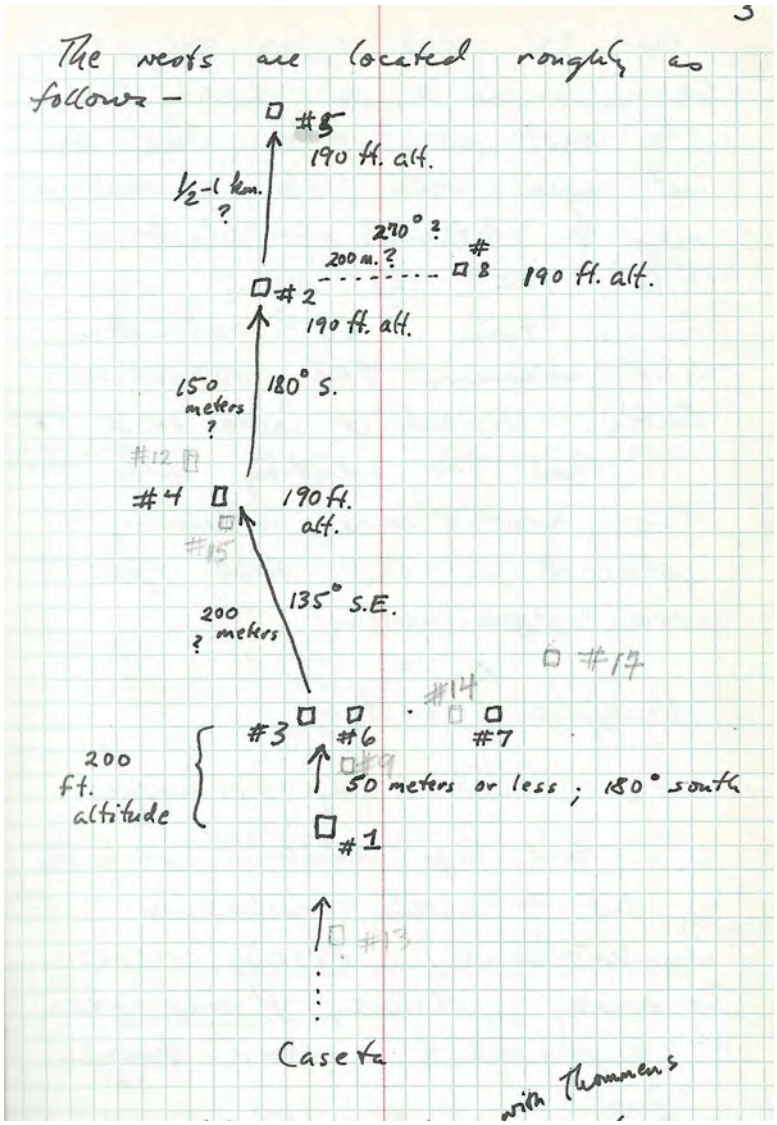

1 cm. = 1 Km.
Piski-Cocha
Mora II
Matazarate
Cerro Salatoca
Mora I
Arbo
Chacalilla
C. Sta. Rosa
Tortuguillo
Cerro Crocker (863 m.)
Coralon
Bandera
Pavinda
Cerro de los Caminos
Media Luna
Cabezudo
Agueacate
Lechoso
CABALLA
Casa Darwin
Escuela
Mirador
Los Hermanos
Sotos
Guerrero
Escuela Occidente
Occidente
Zona Guayaquillo
Zona Anaranjo
Zone 4
El Chato 760m
Chato
Zone5
210m
Caseta
pond
Zone2
Manzanillo
Aldea
Centro
Bella Vista
El Rancho
(cactus) nesting area
Cerro Gallina
nesting area
30m.
Zone Cerrito
nesting areas
Zone3
Zone1
Zone6
nesting area
NESTING AREAS
10m.
nesting areas
La Torta
5
LaFé
Pta. Tomayo
Bahía Tortuga
Pta Estrada
Santa Cruz Tortoise Reserve

Isla Santa Cruz Volume #3.
Field Notebook of Craig MacFarland
Aug – Oct 1969

[Editorial note: There is no Santa Cruz 2 volume of field notes – Volume 2 consisted of notes on lizard ecology in New Mexico.]
(Pg. 1)
Caseta area; El Chato; Zone 3 Nesting areas; first observance of complete nesting in wild; brief uncompleted digging sequence in Santa Cruz Pen at Station; installation of some meteorological equipment at Caseta and Zone 3 nesting area; description of regions between Caseta and Zone 3 nesting areas. First 24 hours records of Zone#3 NA nest temps and humidity; cutting of trail from Zone 1 to Zone 3; description of Zone 1 Naranjo, Zone 4, and latitudes and distances on P. Ayora - Caseta trail. General tortoise measurements and reconnaissance.

Pg. 1.
25 -AUG – 69
Came up to Caseta along normal trail. Thommens altimeter read 30 ft upon leaving CDRS and 650 ft at the Caseta (time CDRS – 0900, Caseta 1600). This differs with recorded 280 m for Caseta used by Srs. Black and Villa. Cool and cloudy in both locations when reading taken.
26 – AUG – 69 Went to Zone 3 nesting area with Oswaldo Chappy and Sr. Villa to look at * marked nests and general area. Most impressive thing comparing this Aug to past one is great extent of vegetation this year. This is noticeable around the Caseta and especially so throughout the nesting area in Zone 3 and at all points in between. For example, the nesting area is covered almost completely with a herbaceous growth reaching 1.5 – 3 ft; it is dry now but obviously was green during the period after the heavy rains of (Pg 2).
March and April of this year. Last year this area was very open with little vegetation and old nest with exposed red earth could be seen in all directions for up to 75-100 yds. Now it is hard to see a nest or reddish earth area unless right on top of them and most are in fact no longer exposed but covered with vegetation.
Another example is the former open area about 1-2 km above the nesting area which was covered with rocks and low growing veg (less than 1 ft.) last year – it is now hard to recognize the area because the veg is 2-3 ft tall and lush.
The cause of all these differences will be speculated upon below. The nesting area is roughly S of the Caseta and Chappy says 10-12 km in distance. Pg 3
The nests are located roughly as follows –

[Diagram showing relations of nests.]



These altitudes were taken with Thommens about 1300 hr. when was sunny and warm; this corresponds well with Chappy's statement that this nesting area is at 60 m. Chappy also says (Pg 4) that the nests occur only from 60 m or so and on down to the coast at La Fe. This does not agree with the generalized map and statements of Black and Villa that the nesting area runs from 60-100 m. Will examine this ourselves later. Altitude at Caseta 660 ft at 1530 under same conditions. Within the nesting area the nests were obviously placed in the most open area available.

Description of nests –

#1 found 9 July; 14 eggs. Hard cap indistinct (probably due to being opened and disturbance) [Marginal note: 5 of these eggs with dents in shells, but membranes intact] Pisonia 20 m away; shrubby Pisonia near and prevalent; open brownish soil.

#3 laid July 9; 15 eggs; Hard cap 52 x 45 cm; Thin dry veg was here before – red soil

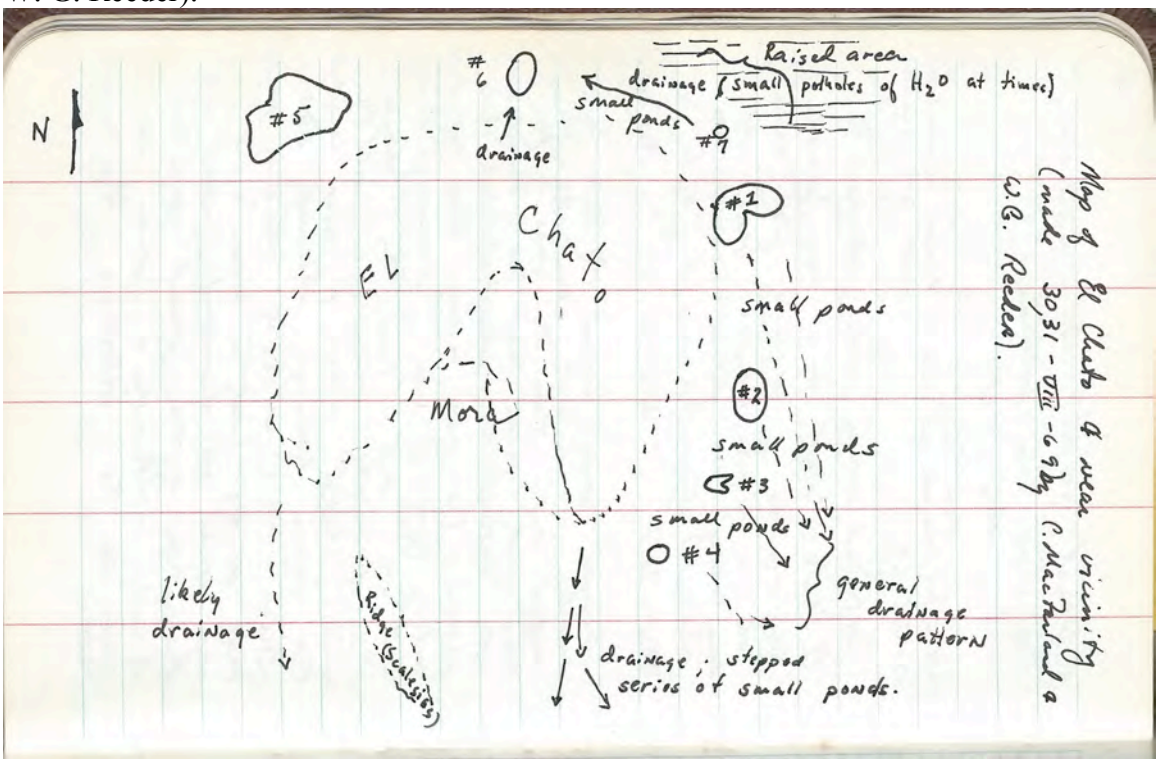
(Pg 5) and ♀ dug through it into soil; she had obviously made two previous attempts at digging a nest and hit rock; in one of these she hit it at about 15-16 cm; quit both times probably due to rock and not disturbance because 2 attempts only 1-2 m beside nest actually made. Nearest trees are Bursera, leafless and 6-8 m distance. Very open area.
#6 – only 2 – 2.5 m W of #3 Found August 19 – maybe laid 3 days before according to Chappy. 10 eggs. Hard cap 53 x 34 cm. Veg about same as no. 3; red soil.
#7 Found 19 August; 11 eggs; 2 no good and removed. [Marginal note: 5 of remaining eggs with cracks in shells but membranes intact] 56 x 33 cm hard cap. Some small trees at 3 m (one) and 7 m. (P. Santo) and 4 m (Croton). Red soil.
#4 found July 11; 8 eggs; 40 x 32 cm hard cap. Bursera at 4 m; Piscidia (Pg 6) at 5 m. Similarly open to other areas – brownish soil. [Marginal note: 1 egg broken shell (dent) but membrane intact.
#2 Found July 9 ; 10 eggs, 2 bad and removed. Pisonia of shrub and sapling size at about 3 m and Pisonia and Piscidia at 4 m but ½ of surrounding area is completely open for a long way. Brownish soil.
#8 Found August 19. 11 eggs; very rocky area, more veg. Than around all previous ones. Bursera at 4 m., large Pisonia at 10 m and small Pisonia at 5 and 6 m little open soil here and of brownish color.
#5 Found July 19, 9 eggs, 1 bad and removed; 47 X47 cm. Hard cap. Nest is in a small area of roughly 20 x 30 m surrounded on all sides by broken lava with no soil. Area has brownish soil and is very rocky and appears hard to dig in it. The nest is placed up against one of the lava walls and is thus partially blocked from the sun when at low levels. However this is on the S side and therefore may interfere hardly at all. 5 m and 4 m to Opuntias, 7 m to Pisonia, 4 m to Piscidia. In general this area is less open – i.e. like #8.
All of these have lava walls about 15-20 cm thick and ½ - 1 m high placed about them by Chappy – the diameters of the walls are about 3-4 ft and more or less encompass the hard cap . . . . .

– July 20 1969 – O. Chappy to Cerrito N.A. – no nests found. Pg. 8
. . . . plus and additional ring of 5- 10 cm beyond this. Am not sure that this is fare enough to provide room for the young to emerge within or without the ring definitely without coming up under the wall. In addition some of the walls seem rather tight and sound to allow the young out if they hatch and emerge within the wall.

Saw only 12 tortoises on the way to and including the nesting areas; of these about 7 or 8 were actually in or very near the nesting area. Most of the 12 were ♀♀ and all actually in or near the nesting area were ♀♀except one medium – large sized ♂. Since the veg is so thick it is possible that there were as many animals along this trail as I saw last year, but I seriously doubt it and it appears that they are more dispersed now than roughly one year ago. Also, there (Pg 9) . . . . are more in the clearing around the Caseta and saw only one in the large pond just below the Caseta. The area above the Caseta has apparently few or none because can not detect much mashing down of the veg there. Will check this more carefully later.
27 – AUG – 69

Went over to El Chato in afternoon – as before mentioned, the veg of the mora region agrees with that everywhere else – it is more extensively dense than last year and notably taller. The trail is much more overgrown than before.
The small pond just to the N about 15 m of the trail to Chato (just before the W running tail turns SW) is now dry but Sr. Villa says it had H20 in it up to mid – Jul from the spring rains. The large pond on the E side of Chato is almost dry, with a few spots of shallow water and mud in it. This also had H20 in it up till late Jul according to Sr. Villa. There are other ponds all around Chato on the (Pg 10) E and S sides and varying from very small (3 x 3 m) to larger ones. [Marginal note: Many of these ponds now have H20]. Chappy and Villa say that there is a large pond on the W side and smaller ones most of the way around. There are quite a few large, old ♂♂ around these ponds which appear to live there now rather regularly – i.e. many trails of mashed down and partly eaten vegetation.
It is impossible to say if these tortoises all more or less concentrated than last year in this area because I did not search it carefully then , but appears to perhaps be the same concentration or slightly less – We will examine these ponds and tortoises more carefully soon.
The weather since arriving has been interesting- no garua at this altitude since we have been here and probably none for awhile because the rain gAuge was dry (Monday, 25 Aug; 1900 hr) and the ground is more or less dry and cracked on the trails in the area. Monday was cloudy all day (25 Aug 69), but yesterday (26 Aug 69) it cleared about 1300 and remained so till 1900 and was partly cloudy still at 2300 when last checked. Was fully cloudy at 0600 today when arose. Today was partly cloudy off and on from 1000 hr but only light clouds and lots of sun till sundown. Is partly cloudy and clouds are moving in from SE as did last night and expect full cover by morning. There is heavy dew each morning but no garua or rain yet. Appeared clear today (& perhaps yesterday?), as high as we could see into the mtns. From the northern border of the Reserve.
Altitudes taken today with Thommens
1230 – Caseta 600 ft; 1820 – Caseta 620 ft.
1445 – Base of Chato – E side – 700 ft.
1540 – Rim of Chato – E side – 880 ft
Compass bearings from E rim of Chato = Cerro Gallina 223˚ (in direct line to Isla Tortuga) Pg. 12
Cerrito to its left somewhat more; small close dome shaped pointed rock at sea – 5˚ S of due W.
28-Aug-69 No garua all day. Spent day surveying ponds around the Caseta – this will be written up below when more complete – day was overcast at rising 0630 and remained so all day, but no garua mist – cool, seemingly dry breeze all day. [Marginal note: checked rain at 1900: But .5 mm garua sometime previous night]
29-Aug-69 Again, still no garua to speak of. Returned to El Chato to map ponds, topography, etc. of this area. Cleared about 0900 and remained so all day long; bright and sunny; clear in mtns above as far as could see; Set Taylor max-min up at Caseta at breast height last night early – at 1900 this evening. Max 81.5 F; Min 61.0 F.
While writing these notes at 1926 a tremor occurred for about 6-8 seconds.
30-AUG – 69

Continued survey when returned to El Chato; except for a few periods of few minutes of sunshine, was overcast, cool, and light, dryish breeze all day today; no garua however; was overcast when arose at 0630. Max 78 F; Min 61 F; 1900 hr.
Surveyed ponds around El Chato by walking a circuit about 15-100 m out from its base – this does not mean that we found every little actual or potential water hole around the mtn or even those extending out from it in the drainage lines, but we did find the major ones and most minor ones with the units stated above and also located the main drainage channels down which more series of hanging pond may or are likely to occur. The major ponds are numbered and located and descriptions of the present condition of all waterholes and ponds are given in the following map and notes:
Pg 14
Map of El Chato and near vicinity (made 30, 31 – Aug – 69 by C. Mac Farland and W. G. Reeder).

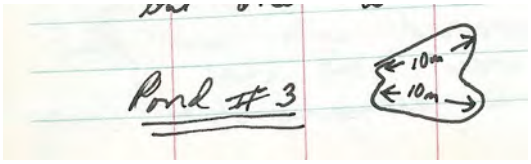


Pg. 15
General comments on the map – The general drainage pattern away from Chato to the coast seems to head to the S-SE with stepped series of small interconnected hanging ponds being likely (one definite series of 6 followed out for 1.5 km as indicated). The mountain may have other drainages on the S and or SW but these have not been followed carefully as of now. The ridge indicated seems to enforce the apparent drainage to the SE.
On the northern slopes of the mountain there is little apparent chance for ponds or H20 collection other than those indicated because the only low areas all around the base of the mountain the land generally rising again to the N, NE, and NW. The areas and ponds are described in more detail as follows as of late Aug 1969.

Pond #1 –



mostly semi-dry, or slightly muddy; some small areas of H20 and soupy mud. 4 tortoises in near vicinity; Water areas covered with red plant and dried up areas still show a mat of it in decaying state. (Note . . . Pg 16 . . .
That this pond was dry last year around 1 Aug and showed no red plant in any obvious stage, living or decaying.
5 small ponds between #1 and 2. 2 with H20 and red plant ; 2 dry; 1 with mud and red plant. Mostly about 2 x 2 m, 5 x 1.5 m etc.
Pond #2 – Oval pond, 35 x 15 m ; very open and surrounded by much grass; dry almost entirely but small area of mud and red plant; shows evidence of having been covered by red plant.
4 more small ponds (5 x 2.5 m, 5 m x 5 m, etc.) between #'s 2 and 3; all with H20 and red plant but one with only H20.
Pond #3 –



Water and plenty (Pg. 17) of red plant; not as open as 1 and 2 and considerably smaller.
More small potholes with H20 between #3 and 4.
Pond #4 – circular, 7 m diameter; well shaded (2/3s of it) by a large thickly leaved Hippomane. Full of H20, covered with red plant and abundantly used by tortoises (tracks, feces, wallows).
Stepped series of ponds out to S, SE of Chato along main drainage followed out for ½ km and saw 6 small ponds (4 dry , 2 with H20); all beneath large Hippomanes and well shaded; 2 with H20 had red plant, but only in green phase.
Pond #5 – Surrounded thoroughly with a plant of thick shrubby form and white flowers (collected some) Plant may be "Rodillo de caballo" as in ponds of Zones 1 and 6 – see last year's notes (book #1). There is an (Pg 18) . . . .occasional plant of this type in the middle of the main pond on slightly more elevated areas. It is flowering now, but has either passed or not reached its peak (probably the former since fruits are abundant. About 125 m x 75 m and mostly dry now. New and old tortoise wallows evident; 3 areas of 10 x 3 m or so have H20 and red plant. Tortoises are using it. Evidence of burro grazing also.
Pond #6 Large dry pond of 10 x 30 m with thick covering of grass, which is grazed right down to the ground, apparently by tortoises (many recent feces); no burro or other feral signs.
Drainage with small potholes, some dry, some with little H20 between Ponds 6 and 7.
Pg 19
Pond #7 – Small dry pond, 6 x 6 m, with thoroughly grazed grass all over bottom. It should be noted that the area from Pond #1 around to the ridge on the SW side is generally more open, has more H20 collected (actually now and potentially) more ponds and potholes, and a thick covering of grass. There is abundant evidence of

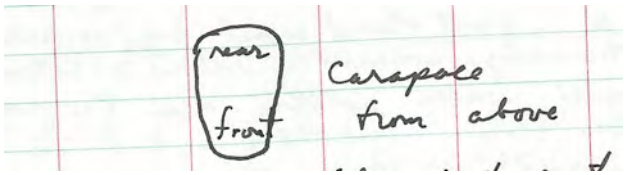
much recent tortoise use (trails all over, droppings, wallows,) and many tortoises were seen (see below). The area from the ridge back around the NW, N and NE to Pond 1 on the other hand is generally a bit drier much less open, and has much less grass for grazing ; most of the veg is shrubby, and trees, lianas, etc, are abundant. The tortoises, although there, are less abundant and their sign is much less abundant; most grass is confined to the floors of or areas around ponds.

The following tortoises were seen in traversing the area around El Chato during the past 2 days: **CL = curved length of carapace; CW = curved width of carapace; SL = straight length of carapace; SW = straight width of carapace. Pg 20 HF = height from ground to nuchal notch when resting flat on plastron; PL = depth of plastral concavity at deepest point.**

(1200 hr, ♂ #302 large; east side of Chato, just above pond #1; CL 139.0 cm; CW 155.0 cm; height in front 43.0 cm; SL 118.0 cm; SW 92.0 cm.
Plastron concavity 15.0 cm; has algae and 3 types of lichen growing in rear area of dome on vertebral and costal scutes. Also has drying red plant and pond snail on back. Was in a pool about 300 m from here when we were here 2 days ago at 1500 hr.
1230 hr - #172 (perhaps 372) ♀(?) [♂ penciled in later] same area as above tortoise; CL 135; CW 146; HF 34; SL 103; SW 86; PC 11.8
1245 hr - #92? – (both 7 and 4 marked in 1's position); grazing near pond #1. CL 95.4; CW 105.0; HF 22.0; SL 75.0; SW 63.0.
1330 hr - #296 m – In pond 1, in mud and H20 and grazing on grass along edge. (hole in 1,000 scute) CL 136; CW 150; HF 32; SL 111; SW 86
1330 hr - #139 m; on edge of pond #1; grazing on grass in shade; very high carapace in front; very oval shape and flat carapace; gular retracted very far underneath. CL; 140; CW 151; HF 40; SL 118; SW 92.
1430 hr – 3171 m – in shade under tree at edge of pond #2; resting, head and 4 legs extended and on ground. Very knobby plastron and very flared around leg pockets (marginal scutes) CL 141; CW 144; HF 34; SL 111; SW 89.
#10 m (number questionable; scutes very eaten up and broken along edges) between ponds 2 and 3. CL 138; CW 151.5; HF 33; SL 113.5; SW 93
#61 m; near pond #3; CL153; CW 141; HF 30.5; SL 118; SW 85
Pg 22. #209 (or 309) ♂ – CL 110.5; CW 115; HF 29; SL 80; SW 71. Almost vertical rear drop off to carapace which is otherwise dome –shaped. Marginal scutes flared widely at leg pockets; long back toenails (2 x normal) Gular scute extends beyond perpendicular to the nuchal notch.
#142 ♂; feeding on grass near pond #4; knobby shell and well – flared at leg margins. CL 139; CW 149.5; HF 30.5; SL 108; SW 77
#208 ♂ (700 has large notch = disconnection); CL 139; CW 146; HF 33; SL 113: SW 91.
#204 ♂ (CL 129; CW 137; HF 36; SL 104; SW 82.5
[Marginal note: both eating grass cerca de Pond #4]

#200 ♀ – (slightly questionable)= CL 93; CW 100; FH 19.5; SL 74.5; SW 61.0; along SSE drainage, near a pond.
Pg. 23 - #155 ♂; CL 133; CW 145; HF 34; SL 109; SW 89.
#130 ♂; CL 130.5; CW138; HF 34; SL 107; SW 87; very flat; both of these near pond #2; eating grass 1630 hr.

30 – AUG – 69 - #322 ♀; just to N of pond #6; shell flared around leg pockets noticeably; concavity rather shallow. 0930 hr; small water pothole near the animal. CL 93; CW 98; HF 22; SL 76; SW 60.5
3482 ♂; CL 125.5; CW 136.5; SW 95.0; SW 76.0; HF 27.0
1030 hr - #1045 ♂ – CL 111; CW 122; HF 28; SL 86; SW 70.5 – eating a carex or some similar sedge (both of above in Pond #5 basin)
1100 hr - #375 ♂; CL 145; CW 159.9 HF 44.0; SL 116.5; SW 87.0
Quite raised in front and marginal scutes strongly flared; beyond pond #5, 50 m to S .
Pg 24 #205 ♂ (? – forgot to record sex; probably a ♂)
1130 hr; CL 130; CW 140.5; HF 33; SL 111.5; SW 83.0. Very notable shape – very thick shell and flared and sharply recurved back marginals; front marginals also flared and vaguely recurved; very oblong overall carapace shape, and tapered from front to rear. [Carapace shape from dorsal view showing slightly wider at read than at front].



On SW side just E of ridge.

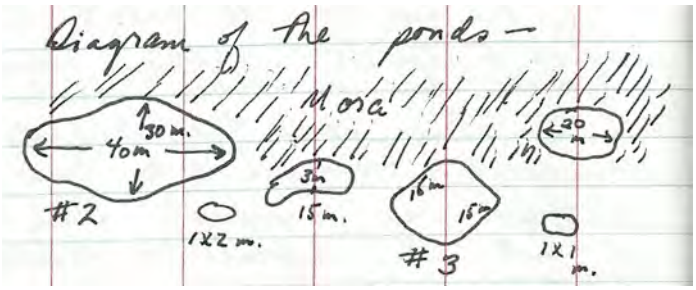
1200 hr - #281 ♂ "normal" Santa Cruz shape, very much of typical scale loss all over this animal – CL 132; CW 139; HF 31.0; SL 107; SW 83.5 – on SSW side of Chato; easting grass, Commelina and one other plant.
Also saw many of these animals again on 30 AUG – 69. Pg 25 . . . which had been seen the previous day as follows:
#208, 204 within 100 ft of where were yesterday – more up toward base of Chato feeding on grass; and psuedo Labiatae plant (collected already)
#142 at pond #4 as yesterday; #10 approached pond #4 while we were there making observations. #130 drinking at pond 100 m NE of where was yesterday.
#302 grazing on grass near pond #6.
#171 in same area as 202 – also feeding on grass.
#155 just emerging from small pool between ponds #1 and 2; eating grass along edge.
This makes a total of 21 tortoises seen in traversing area at base of El Chato –mostly quite large and mostly ♂♂ – at present count is 17 ♂♂ and 4 ♀♀ barring future corrections.
Also saw three tortoises on way to Chato in mora area through which the Reserve border passes Pg 26 -
One #167 ♂ (or perhaps 168 or 178) is largest seen, I think; probably 300 – 400 lbs. CL 151 cm; CW 153; SL 121; SW 85; HF 28; Pc 14.4; he was first seen on 27 –Aug – 67 beneath a tree about 3/8 mi up the border cut from above the Caseta on way to El Chato. Have since seen him on 29 – Aug – 67 and 30 – Aug – 67 – he has moved a total straight line distance of about 350-400 m in 3 days. [Transcription note; notes specifically say '67 for these two dates but may be 1969 the period in which these notes are taken]; is eating grass, Passiflora nudcania and Commelina. Between the 27th and 29th he had

cleared about an area of about 24-25 sq m of Commelina and eaten it to the ground. (Pg 27) #13 ♀ (?) – also has hole bored into 200 scute. In mora on reserve border just before turning into woods above El Chato. Has been moving all over in the mora in this area between when saw first at 0900; 30 Aug 1969 and 1500 same day; is largely passing between mora plants and eating Passiflora and grasses but has clearly crushed and knocked some mora itself down; appears to be able to penetrate far into the stuff.

#237 ♂; CL 150; CW 161.5; HF 37.5; SL 120; SW 94.
Carapace slopes off sharply in rear; found just where reserve border in mora turns from E-W to NW–SE between Caseta and El Chato. Seems to have been in this area past 3 days (and longer) because can see no trails into and out of this area – general area coved with Passiflora and Commelina which tortoises keep eaten back probably, thus limiting extent of mora.
Thus saw a total of 3 tortoises (Pg 28) . . . along tail through mora between El Chato and Caseta. Sr. Villa remarked that pond #1 at Chato had H20 (of some notable amount I guess) up till mid July. Also that pond #8 just ENE of El Chato area (along Reserve border) had H20 till early – mid July. The latter is now dry completely – no mud even.

A few more interesting observations:
1 On 30 – Aug – 69 – saw a medium ground finch hopping about on the back of a large ♂ tortoise (#167) in the dried up part of pond #1 below El Chato (where the tortoise was eating grass). There were a number of these finches (all same species) feeding in the grass and (Pg 29) lava rocks in the pond bed. This finch twice appeared to definitely pick something (seeds) from between the marginal scutes at the tortoise's anterior end; the tortoise did not appear to notice at all the finch's presence. Jan took one photo of the finch on the tortoise and one of 3 of this species of finch on the ground near each other (c.f. film roll R (= Reeder) 5.
2. Watched large ♂ tortoise #10 drink in shade at pond #4 beneath El Chato; drank for at least 15 minutes while we watched without anything more than short 30-second stops. Timed 2 drinking sessions at 5 min and 2 min 15 secs respectively. During these times the animal kept his head and neck down at about a 45- 50˚ angle with the horizontal and appeared to drink constantly by throat (hyoid) pumping (later saw same pumping in another animal). In other words, I do not think that raising the head is necessary in order for the animal to swallow and get the H20 into the (Pg 30) gut.
3. In 2 cases today we were able to disturb one tortoise and cause it to loudly exhale a gush of air without disturbing or being seen or detected by a nearby tortoise. In one case the tortoises were 50 ft apart and in another 35 ft apart (#142 and #10 and #202 and #171 respectively) These distances are based on straight pacing. In neither case did the undisturbed tortoise appear to detect or at least respond in any noticeable manner or with any of the typical alert behaviors to the noise made by the tortoise close by it.
Altitude taken yesterday = Thommens
0915 – Caseta 630 ft; 1200 – Base of Chato 780 ft.
Pg 31
31- Aug- 69 – No garua still. Sun was out off and on (mostly out) from 1100 till sunset today; clouded up as SE breeze picked up soon after sunset and was overcast by 2000.
1900 hr. – Max 81.5 F; Min 63 F.

Sr. Juan Villa and Oswaldo Chappy went down to La Fe nesting area by way of Zone 3 nesting area on 28 – Aug – 69 and returned in the late afternoon on 19 – Aug- 69. Discussed their trip with them and learned the following: they said there were many goats and pigs between Zone 3 and La Fe and in the La Fe area were many of these 3 ferals plus cats and dogs. They killed "many" cats and goats with 22 rifles (note: at least 4 goats because brought back shanks of this many) and killed one pig. [On 26- Aug- 69 they killed 7 goats about ½ - 1 km below Zone 3 nesting area.]
They say that the La Fe nesting area is "several km X several km" in size, is at about 20 m altitude and is only 2 km or so inland from a convenient landing spot just E (Pg 32) of La Fe proper (this is 2 km inland in a NE direction) In other words the "La Fe" nesting area is more or less directly SE of the Zone 3 nesting area.
No nests were found as of yet in the La Fe area, but they located two nests (how recent?) from this year in the area between Zone 3 and La Fe area – both had been destroyed by pigs and they commented that it will be very hard to find nests in this intervening area and at La Fe before pigs destroy them. Chappy says that one of these nests was only about 1 km or so below nest #5 (see page 3) (presumably in a SE direction). Both nests were in small areas in the lava with enough soil and space for only 2-4 tortoise nests. Villa apparently discussed possibilities of nests with (Pg 33) Chappy and they decided that there are probably many of these small potential sites in lava-covered areas between La Fe and Zone 3, and Zone 3 and Cerro Gallina.
They recorded 14-15 tortoises between Zone 3 and La Fe including the La Fe nesting area – mixture of ♂♂ and ♀♀ (numbers inexact, sexes likewise). Some of these in La Fe area were small ones of maybe 20-30 cm straight carapace length (i.e. by my account probably 5-8 yrs of age). They mentioned that the area between the lower portion of Zone 3 and the border of the Reserve directly to the east is very closed with vegetation and hard to penetrate due to much "chala" and pega-pega. Also the area from El Chato to Cerro Gallina and Cerrito is likewise hard to negotiate due to much chala. On the other hand the area along the coast from La Fe to Cero Gallina is supposedly fairly open and not too difficult to travel through.
Surveyed some of the ponds near the Caseta on 28 Aug 69. These notes are written up here belatedly. First there (Pg 34) is a group of ponds more or less NNE of the Caseta which run in a NW- SE line. They are exactly on a line 15˚ NE of the Caseta and about ¼ mile above it (The reserve border above the Caseta runs about 345˚ NNW). These ponds are bordered on their whole northern side by the mora and it has in fact encroached upon them some over last years position. The altitude (Thommens) of the ponds was 710 ft at 1200 noon and 640 ft at the Caseta at 1230 hr.
Diagram of the ponds



The largest one of these will be Caseta pond #2; it has much H20 now, is covered with red plant, is open and has a good (Pg 35) stand of grass around it. There is also a common shrub with yellow flowers surrounding it rather thickly wherever the mora is absent. This plant was not ever noticeable last year and the whole area is immensely more lush and vegetated than 1 year ago. 3 ducks on it.
Pond #3 H20 (8") and red plant all over top; veg shrub height and tightly closed about it; appears little used lately.
The 20 m pond is dry and covered with a low herb and grass and is being noticeably invaded by mora; there is at least one tortoise active in the area, especially if not completely, around pond #2 and the woods directly S of it leading to the reserve border. Many recent mashed down paths and droppings around. Very little or no activity around more easterly ponds and the large semi-open sloping area between these and the Reserve border (see comments below) (Pg 36)
There is a large pond to the SW (210˚) of the Caseta, approx. 5/8 of a mile. At 1420 hr the Thommens read 680 ft. at the Caseta and 580 ft at this pond at 1445 hr. It is full of H20 and covered with red plant and has about 45 ducks on it (have been there for all 3 days we have visited the pond). The pond will be **Caseta #1**; its area must be about 100 m by 45-50 m. It is surrounded by shrubs but has a number of small openings leading to it all around the edges. There is good evidence of tortoise traffic (trails, mashed down areas, grazed areas, droppings) from the Caseta to it and all around it. Coming down to it from the Caseta one is (Pg 37) . . .struck by the fact that most of the activity seems to be for the last 2/8 –3/8 miles along either side of the trail as one nears the pond; very little or no activity near the Caseta.
Two drainage systems were located just W of this pond, both leading to a confluence with its overflow (#1 not draining now out to the SW). One of these has a series of small dried up H20 holes under Hypomanne trees. The other consists of a similar series of Hypomanne shaded pools which are mostly full now and covered with the green stages of the red plant.
Another drainage system seems to come in toward this pond area from the NE and the area of Caseta pond #4. Pond #4 is located ¼ mi. SE of the Caseta at an altitude of 610 m [thf note; is this meters here or ft as above?] It is about 20 m x 10 m and is now dry; recently was wet because drying and decaying red plant is all over its surface. (Pg 38)
4 tortoises have been seen around pond #1. One is large and has not been identified; saw it soaking in water on eastern edge on 26 – Aug – 69. 3 others: #608 ♀; on NE side of pond about 30 m from H20 in grass; CL 100.0; CW 104; HF 22.5; SL 75.5; SW 61.5
#102 ♀; on SW side of pond; about 25 m away from it eating Commelina and psuedo-labiateae plant with purple flowers. Had been into H20 of pond and out and had been eating a Ranunculus like thing (collected some of it). #134 ♀; WSW of Caseta near set of hanging ponds above pond #1; eating grass and a vine like plant which may (Pg 39) be a morning glory ? CL 95.5; CW 101.0; SL 74.5; SW 64.0; HF 17.5
1 – Sep – 69
1900 – Max – 77˚ F; Min 65˚ F. Cool and overcast all day; light breeze varying from SE, S and SW at various times. Garua finally returned today; began with little about 0600 and has done so occasionally all day long. Stayed in Caseta and worked on the thermocouples, notes, and study ideas all day long, so nothing much to report in sum. 0.2 mm rain.

2 – Sep – 69
1900 hr. Max 76˚ F; Min 66˚ F. Garua last night, and off and on all day today – total of 2.6 mm; most since we've been here.
3 –Sep – 69
Left for Zone 3 nesting area at 0730. Low last night was 65˚ F.

Notes on a nesting observed at Zone 3, weather instrument installation, and other observations made from 3 –Sep to 6 –Sep - 69 will be recorded beginning on page 53; the nesting sequence notes will be recorded last to allow addition of comments after discussing observations with Bill Reeder. (Pg 40)
7 – Sep – 69
Santa Cruz tortoise -#36 "laying" in pen. W. A. Dunson told us saw digging about 1130-1140. [Marginal note: watching from wall above – 2 m away and 1.5 m above her] 1150 – 1200 I have notes – see later. 1200 – 1220-5. Bill Reeder has notes. She is digging in a raised area in middle of lava beds at only 12 m from S wall of cage – very little, dark brown soil in middle of much embedded flat lava blacks.
Was originally facing wall and digging but only got down about 1-2 inches at most, (estimate) and hit solid lava floor – Quit at 1207.
Turned about roughly 180-200˚and started digging almost where her front feet had been in the previous attempt – now trying to dig there but it does not look much more promising – again hitting lava on sides and at bottom of soil – again only got 1.5 –2 inches down. (Pg 41)
Time now – 1235–30 – Moved front right anchor at 1233-30"; left front one just slipped back about 5-10 cm – still trying for a hole in the same position but again it looks futile. 1238-1240-30". Moving counter clockwise very slowly – apparently trying to locate a new spot – moves forefeet over a bit, then probes with nails and bottoms of hind feet in area behind her – 1241-30" – 1243-30" – Turning slowly full around to original position, still counter clockwise – now moving slowly forward toward wall – put head down (neck outstretched) to ground 3 times and sniffed soil I think – gular pumping would be seen to accompany this – 1244 – took up new front anchor position and started trying to excavate about – 10 cm closer to wall than original first hole.
1249-30" – quit again moved clockwise (Pg 42) . . . to her right a bit (is facing wall) Again seems to be sniffing ground in front of her some – head down – can hear air passing in and out and see gular moving some.
Tried again till 1252-30" and then turned parallel to wall and is moving very slowly to W; has neck stretched far out and head down so nose is near ground.
1254 – head up (watching us?) and making probing digs with back feet – mostly using right one but also left occasionally; made about 8 of these.
1256 – now attempting normal digging pattern.
1257-30" – again quit - scraping bare rock again-
1258 – Moving in circle slowly counter clockwise again.
(Pg 43)
Making test digs with back right foot using nails in a backwards stroke as before.
1301 turned around completely and is moving slowly to E; again seemed to be definitely smelling soil in front of her; neck outstretched; 5 times put nose to ground by bending head down a bit and could see gular pumping some – pressed nose definitely flush against soil so that nostrils were right on it.

1304 – has completed turning counter clockwise so that rear is now where she was sniffing just few moments ago and has started a digging sequence attempt; this is the same general area where she was originally digging and has dug once more since first beginning – the hole she is attempting is right flush up against a rock (on the right side); in fact her right foot's resting spots is up on some lava rocks about 8-10 cm above the hole surface.
Is using (and has been generally in these sequences) the fore surface of the nails and lowest portion of the fore (Pg. 44) . . . surface of the foot to move soil – sometimes used to move soil from center bottom and sides of nest toward foot rest in an outward stroke. This may all be fortuitously caused by the extreme looseness of the soil here. Same thing occurs occasionally as she moves a resting foot forward from its resting position as she begins to lift it to put it into the excavated cavity. [Marginal note: Jan is photographing this Rolls 11 and 12(?SE)]
1328-30" – still going strong – down about 8-10 cm; but soil is very loose and she is getting little or none out with each digging event. The rock mentioned above is still occupying the entire right side of the nest and appear to go even deeper. It is severely hampering the digging ability of her right foot so that the nails are digging almost cross-wise toward her other leg (Pg 45) . . . instead of backward out of the cavity – she is attempting to compensate for this cramped space but is getting almost nothing done with this.
1337-30" – quit again – no rocks at bottom but one on right side is slanting inward badly and right foot almost couldn't dig at all. Total depth still only 8-10 cm.
Rotated completely around 360º and has come back to same exact place by 1345 – started digging sequence again. Had pushed much of the loose soil back into the pit again by time rotated – now digging in same area and nearly to same depth after moving loose soil out (1348). * Note: W. G. Reeder says that he thought that at each previous semi-"rotational" sequence that she was ending up with cloaca and digging area right over where she had "smelled" (i.e. touched nose to ground) just previously on her swing' I agree to this in one specific case but feel others were very indefinite – in some cases. (Pg 46) . . . she definitely did not do this even after smelling; in others she simply rotated a little and began testing or digging with hind feet with no smelling at all involved (these however did not involve much of an arc (less than 15-20º) in turning.

- Note: she is certainly aware that we are here and yet continues with no apparent disturbance of activity
- Note: When doing the last full rotation and then starting to dig again in the same location, she did not show smelling behavior but may have stopped half way and felt area with back feet - couldn't tell.

1424 – changed rhythm – stopped momentarily; made 6 "half –hearted" grubbing motions with left foot and stopped completely at 1426 – during this (Pg 47) 2 minutes she put nose to ground about 6 times with gular pumping – moved off from the area over the lava; W. G. Reeder says had been making movements of 3-4 more whole hearted sweeps with nails in each case of one foot being in hole.
Again got hole to about 10 cm when quit – however had been about this deep (same anyway) for nearly 30 minutes and just kept trying to dig – what cued quitting is unsure – but just before 6 stroke sequence Jan jumped in behind her and she then left

– however I doubt this movement was the cause even though the tortoise definitely saw her.
1445-1500 - Moved off 25 m and investigated two areas with similar soil to one just digging in – sniffing ground in each one; settled in second and dug in forelegs and laid rear ones out flat – for only a few minutes – then turned 90 º and started digging with cloaca above general area where nose had passed previously, but not exactly – dug only a few strokes (Pg. 48) . . . and then moved off after I moved up behind her- perhaps I drove her off.
1500 – Returned to original digging area and started test digging and testing around in same positions just forward of where gave up before – sequence this time was definitely sniffing an area – then moving over it and taking some test swipes when cloaca was in general position above the area where she sniffed. [Marginal note: in doing so went past one area of about same size which looks deeper at least if not better in other ways.]
1510 – Another similar sequence; now digging just slightly anterior and in similar body position to where she just spent over 1.5 hr. to no avail.
1521 – quit – moved about in half circle, sniffed area – moved over it and is now attempting to dig there – It would be interesting to know why she is so oriented to this particular area. (Pg. 49).
1600 – Still doing same thing; moving about in same area; testing; sniffing, digging, moving a bit, etc.
While she was digging at about 1605, two other tortoises came by at the same time - #997 ♂(?) and a small one – the small one went behind her, bumping into her right rear leg; however she simply never broke stride and continued to dig. Just as this ended the larger one approached her front end, head on, from her right side – the classic aggression sequence then followed, with each trying by stretching the neck up to full height to get the down-turned (45˚ from horizontal) head above that of the opponent. The smaller one (#997) was on a lava plate beside #36 and was thus actually up higher than the larger ♀. They finally opened their mouths and hissed some; for a few moments the smaller one had its head higher, but the ♀ never shrank back and finally got her neck higher by virtue of maintaining her neck outstretched combined with the smaller (Pg 50) one retreating a bit back into its shell; the ♀ may also have been stretching hers out further at this time – it was simply impossible to determine exactly. The ♂ (i.e. smaller one) finally pulled in his head rapidly, turned 90˚, and lumbered away from #36 very quickly. The whole sequence took only a few dozen seconds and was hard to adequately follow. The showing of the open mouth in a down–turned direction accompanied by hissing (air being forced out?) and getting the neck out very far so that the head is above the opponent's seemed important. They both also stretched their forelegs out to increase height Through all this #36 never lost her digging position or exact same footing at all and she only paused in the actual digging for the (Pg. 51) same duration time as the aggressive encounter; immediately after #997 began retreating she continued the digging sequence.
At 1630 she stopped digging having again reached lava rocks within 5 cm of the surface and moved away. She finally stopped ½ way across the pen in a red earth pit (artificial) next to the big ♂of the pen where she is now (1715) lying doing nothing.

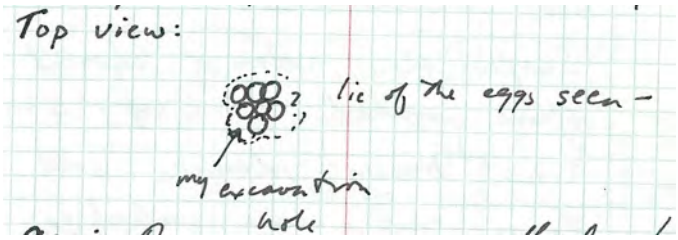
Anders Rombeck says that she laid a nest with eggs yesterday morning. At 0700-0800 he saw her digging in dry soil. This area is very similar to the one we saw here in today, but does appear to have greater depth. He left and returned in late morning and found the area covered over out with no hard cap. Note that it did not appear wet today except in so far as the light rain of this morning and midday had dampened the surface. He dug down, found one smashed egg and saw another which was OK and re-covered the area. The area, and the nest, seems strange and perhaps an abortive attempt after what we saw today and the normal nesting sequence we saw (Pg. 52). recently in the Reserve. Rombeck says this same ♀ dug a lot in early Aug, but he never saw or found any nests; she then began digging again a few days ago. He found the one nest yesterday and she obviously is continuing to dig today. Rombeck says the eggs are at most 3 inches below the surface (to the first eggs). Also we scraped the soil aside and found it only wet to a few cm and then like dry dust!
It was cool and overcast virtually all day today with rain off and on from sunrise to about 1300; rain last night also; it is interesting to speculate on whether she could have survived the 5 hour digging ordeal in full sunlight. *Note: Observed #36 ♀ (Santa Cruz) digging again from abut 1630 - 1800 on 9 Sep 1969 but nothing came of it - was even digging in a good red soil filled (artificial) area. (Pg 53)
3 - Sep -69
All altimeter reading are with Thommens -
0745 - left Caseta - 665 ft
0800 - #98 ♀eating grass in semi-open area just below Caseta pond #1; alt is 535 ft. CL - 105; CW 116; SL 77; SW 66.6; HF 26.
0820 - Veg has shifted a bit to about 50% cover by trees and shrubs (mostly former) but is much the same as before.
#403 ♀ feeding in trail at about 500 ft. alt.; CL 95.5; CW 106; HF 22; SL 79.0; SW 63
0850 #827 ♀ at 370 ft.; veg drier now; much guayavillo and matasarno cover; she is coming up the trail; CL 83.5; CW 89; FH 20; SL 62.5; SW 53.
0900 #248 ♂ at 340 ft; notable dominants are guayavillo, matasarno and Pisonia. CL 119.5; CW 133; HF 31.5; SW 92.0; SW 79.5
Noted first cacti; (Opuntia) along trail at about 320 ft; trees are not as tall; much matasarno and Pisonia, some guayavillo.
0920 #410 ♀(?) at 290 ft. CL 74; CW 84; FH 20; SL 62; SW 51. (Pg 54)
1000-1100
At 270 ft. came into a very open area which is even more open than that around pond #1 just below the Caseta. There is much matasarno and Pisonia, some guayavillo, a few manzanillas. The trees are notably shorter here than around the Caseta and the soil is drier and cracked in the most open areas to at least several inches below the surface. Some of this area looks as if it could serve as potential nesting sites, but there is no direct evidence of such. The soil is a dark brown-gray and not like that in Zone 3 nesting area at all. One large open area with cracked soil (40 x 20 m) and heavily strewn with embedded lava boulders lies just to the W of the main drainage we have been following down from the (Pg. 55) Caseta. When there is a great deal of

rain above or in this area one might expect this area to fill up with a thin layer of H20 at least a few centimeters deep.
Just E of this area there is a large pond witch is covered all over by large ("Rodillo de Caballo") bushes. It has H20 in it and a covering of Azolla (red plant) in its green stage. This is about 200 m long by 100 m wide and sits roughly N-S, oblong fashion. The drainage mentioned probably leads into it at least in part. There is virtually no grass in the understory anywhere in this open area or around this pond. There is much evidence of tortoise activity in the area of the pond (trails, fresh droppings) and some trails lead under the Rodillo de Caballo into the pond. Saw a number of tortoises in the area and some skeletal remains of at least 2 animals.
Unmarked animal; put Roman numeral I on 5th vertebral scute. CL 72; CW 75.5; HF 19; SL 65; SW 43.5.
#890 ♂ CL 136; CW 150.5; HF 28.5; SL 105; SW 86.0.
(Pg 56).
#699 ♂ (?) CL 92; CW 95.5; HF 23.5; SL 68; SW 56.5.
#53 ♂ CL 119.5; CW 129.5; HF 30; SL 94.0; SW 78.5
#906 ♀ (?) very small hard to sex, CL 69; CW 71.5; HF 15; SL 52; SW 44.
#423 ♀ CL 81; CW 82; HF 20; SL 64; SW 51.
Unmarked ♂ (?) put Roman II on 5th vertebral scute. CL 80; CW 83; FH 20; SL 61; SW 50.
#421 ♀ CL 82; CW 91; FH 23; SL 60; SW 54.
1140 below open flat area a ways; understory dense now with much mallow and a rocky substrate; most trees are matsarno.
Unmarked ♀ (Roman III placed on 5th vertebral scute) CL 65; CW 65; HF 15.5; SL 49; SW 39.5. (Pg 57)
1155- #1151 ♀ at 240 ft ?; CL 60; CW 61; FH 16; SL 48.5; SW 36.5.
1205 - 240 ft ?
Unmarked animal sex indeterminate; marked with IV on 5th vertebral scute. Rocky area much matasarno - CL 61; CW 63; HF 15; SL 43.5; SW 38.5.

Reached nesting area at 1330 - still Thommens registers 240 ft. but I doubt this very seriously , and I also question all the above reading below 270 ft. because as we were obviously descending during these times there was a lack of change and sometimes a slight increase in alt on the instrument. This probably being some pressure changes.
On arriving noted a new nest, #9, next to #2 and #6 which Chappy had found that morning at 0930 - 1000; still wet at surface and therefore probably from the previous afternoon and evening. Chappy says that there was a ♀ #127 near this nest when he arrived and he thinks she made the nest; when asked of her whereabouts he said she had already started "arriba". However there was another ♀ only 20 m away from the nest when we arrived #503. Chappy did not open the nest yet, so we will use it for a thermocouple series. [Marginal note: but #503 without mud on feet].
Chappy returned from a flying round trip to Cerrito at 1500. He found 2 nests (Pg. 58) at about 40 m altitude and 12 km inland from the coast S of Cerrito. He did not open either nest, but in probing one of the nests (he was not sure it was a nest and was testing for the hard cap with his machete) he broke through a cracked area and the machete sunk down and broke an egg. He removed the embryo from this and brought

it back; we have preserved this and it is a completely well formed little tortoise, lacking apparently only in size. Chappy says the nests were fresh, but I doubt that the one from which the embryo came could be, in light of its size and development. * At about 1530 saw ♀ #131 feeding under a Cordia in the Zone 3 nesting area about 35-50 m W of Nest #4. At 1600 saw her only 25 m W of this nest in a primarily open area, nest to an overturned rock and what (Pg. 59) may have been a bit of digging; at first I interpreted this as digging but close inspection made it all look like nothing more than the disturbance of soil caused by flipping the rock. [Marginal note: this was dark brown-grey soil]. The rock was plate-like and about 2 X 3 dm and I doubt the tortoise was able to dig it out - perhaps pig or human did so - however noted that the disturbance was fresh.
Anyway, about 1630 I again located #131, this time digging a nest just 15 m S of nest #4. She was at this pint about 15-25 cm down and had not yet dumped any visible cloacal fluid. [Nest #12] Began watching her continuously about 5 minutes later till 0015 hr the next morning. Sometime between the 1630 sighting and 1635, she dropped her first batch of cloacal H20; the description of this sequence follows beginning on page xxx.

4-Sep-69 Zone 3 Nesting Area.
0715 - Found a small tortoise active in the nesting area just to the E of the main area traversed by the Nat'l Park wardens and Miguel Castro most often. This area also has signs of old nests from previous years. The animal was 3-4 m away from the nearest site of lava (Pg 60) . . . boulders, but actually in a fairly open area on the edge of a potential nesting area. It is now wet and cool due to garua off and on last night and it is presently overcast. The animal is unmarked (we gave it a V on the fifth Vertebral scute) about 3-4 years old (compare to Station animals) and would guess it weighs 4-5 lbs. CL 29.0; CW 31.0; HF 7.5; SW 23.25; SW 19.5.
It does not seem possible to sex it.
0730 - Found #131 on some open lava boulders; head and feet out and active; about 50 m to the NW of the nest. Took her measurements CL 91.0; CW 1200.5; HF 21.0; SW 65.0; SW 60.0.
*Note: she stayed within this same general area the rest of the day; always within 50 to 100 m to the W of the nest site; feeding, resting, (Pg 61). . . slowly moving. Spent night under a log and was in same area when we left on 5- Sep - 69 about 0930. Spent the rest of the day implanting thermocouple columns and soil moisture blocks.
1. Excavation and implantation of nest #9; There was no real egg space in nest #9 (same true of #12); the eggs were just covered with soil and the only space occurs in areas where the soil has not fallen though between the eggs to create fill.
The ♀ appears to have placed the hard cap to the left - center in this case so that some of the eggs laid on the right hand side of the nest beyond the area covered by the surface cap. This is in contrast to the nest of ♀ #131 (#12) in which the cap was set forward a bit so that some of the rear part of the cavity and the eggs within were not overlain by the hard cap proper. As with nest #12, the eggs here are in what appears to be a single layer; my excavation took place at one corner of the cavity and I could see 7 eggs from this position; there are undoubtedly more.



Again the cavity seems flask-shaped but with overhang only extending (Pg 62) semi-circularly for about 220-240˚ around, the back 120-140˚ not having any overhang. Chappy says that in some cases nests are found with eggs stacked up and not only in single layers(?). This nest is well within the open, in red soil, and has essentially the same conditions as nest #3, 6, 7. There is virtually no significant shade around it and I doubt if when the sun is out on a clear day that it is shaded for any significant time from sunrise to sunset. There is no evidence of beginning attempts at digging in the area around this completed nest.

Nest measurements. Surface through bottom of cloacal-fluid-soaked hard cap - 6 cm. Looser, red-brown volcanic soil layer; not urine soaked to (Pg. 63) same extent if at all - 5.5 cm. Area of cloacal-fluid-soaked fill surrounding eggs - 9.5 cm. Total depth to bottom of nest is thus 21 cm. The thermocouple probe for the nest was implanted on one side of the nest with the 3 thermocouples extending into the egg mass coming over into the eggs (2 eggs "depth" within the group of eggs). The other 4 thermocouples came out of the red only a few millimeters. After placement, the nest was refilled with the soil layers as nearly intact and in position as possible; the whole operation took only 1 hr. and only 2 eggs were temporarily removed from the nest (carefully and with no rotation). Thus the amount of drying was probably minimal. The cap was restructed (reconstructed) using cap soil and a little added water.

The positions of the thermocouples for this rod are a follows - switch #1.

#1 - surface (i.e. 0-.5 cm down) in cap
#2 - 3 cm - in cap
#3 - 8 cm - in looser soil beneath cap
#4 - 15 cm - at top of eggs
#5 - 18 cm - at center of eggs
#6 -21 cm - at bottom of eggs; bottom of cavity
#7 - 22 cm - below cavity in soil (switch position #9) (Pg. 64)

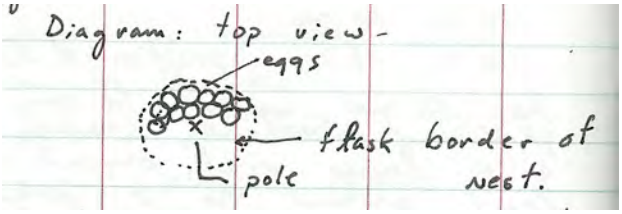
Pole position: side view {diagram showing pole vertical along side of nest cavity just barely contacting lateral margin of hard cap}

The pole was cut off so that its top most part is buried about 1 cm below the soil surface thus avoiding direct exposure to the sun. A second "control" pole was put in place beside the first a short distance away and also in bare exposed red soil. This as done by first drilling a hole with a soil Auger to the proper depth and then putting the pole with t.c.'s in place and filling some loose dirt in around it to simulate previous natural conditions - this was not difficult because the soil core was entirely dry, dusty, loose red soil. Again the pole was sawed off so that its top is 1 cm below the surface. (Pg. 65).

The switch for this pole is #2 and the position and depths below the soil surface are as follows:

#1 -- surface (as defined before)

#2 -- 3 cm
#3 -- 5 cm
#4 -- 10 cm
#5 -- 15 cm
#6 -- 20 cm
#7 -- 25 cm (position #8)
There do not appear to be any major problems of artificially shading this site so a large oval shaped wall was built around the 3 poles out of lava blocks in order to help prevent destruction of the nest by pigs.
Diagram of wall: {Sketch of nest and measurements not copied here}
Total length of wall (inside diam) is 246 cm. Total width (inside diameter) is 142 cm
The wall is thus positioned along the line which the sun takes in its arc and will offer little or no shading.
2. Emplacement of thermocouples and soil blocks in nest #12; this nest is of known size, egg numbers etc. since we (Pg 66) . . . watched ♀ # 131 make the nest. The thermocouple pole was put in directly down through the cap in the rear-center part of the nest so that the thermocouples at the appropriate levels are flush up against the eggs.
Diagram: top view –



The thermocouple protrudes about 0.8 - 1 cm. out of the pole. As before, the plastic pole was cut off at the proper height so that its top will be 1 cm below the surface of the soil (in the hard cap) At 18 cm hit the flat piece of rock which had stopped the ♀ from digging the night before so could not put any thermocouples below this point .
The thermocouple positions are:
#1 - surface (0 -0.5 cm down)
#2 - 3 cm. - in hard cap
#3 - 5 cm. - in hard cap
#4 - 8 cm - in loose soil = hard cap transition
#5 - 11 cm - top of eggs
#6 14 cm - middle of eggs
#7 - 18 cm - bottom of eggs.
Also put in 2 soil moisture blocks (Bonycons meter variety gypsum in substance). One was placed right next to middle of egg mass level - at 14 cm and the other in the middle of the hard cap at 5 cm. These are abutting right up next to the pole (in the case of the 5 cm. one) and the eggs (in the case of the 14 cm one). Again carefully rebuilt nest and used proper soil for each area of the excavation in repacking. In this case the cavity was exposed for only about 30 minutes, no eggs were removed, and the drying which resulted must have been very minimal because it was overcast and cool during the entire implantation process.

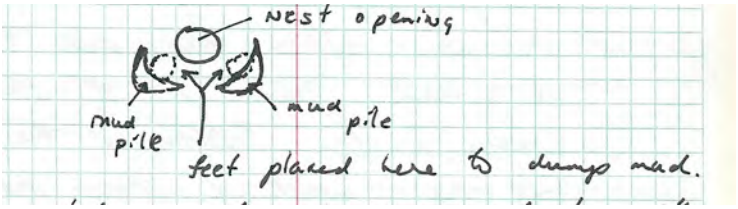
Again built a wall around the nest for protection - this one is more nearly round, but the nest is placed to allow minimal (if any) shading by the sun. The trees are tall enough here (as against the area of nest #3, 5, 7, and 9) to cause some shading in early morning (perhaps first 1.5 -2 hr after sunrise) and afternoon (perhaps last 45 minutes to 1 hr before sunset). Even then the shade will not be dense unless the trees leaf out more fully - they are mostly matasarno. (Pg 68).
The height of the wall is 72 cm. Center of the nest 61 cm from S wall.
Center of nest 89 cm from N. wall
Center of nest 76 cm from E wall
Center of nest 71 cm from W wall.
Nest #12 sits at about same relative position to the wall as #9. Axis along which wall runs is again about 230˚ W-E.
All the thermocouples used in these implantation were made of 24 gauge copper - constantan (?) (coated with weather proof polyvinyl- obtained from West Inst. Co., Schiller Park Illinois). The measuring instrument will be a West Model 9 B Pyrotest potentiometer with automatic cold junction compensation and an accuracy better than 0.5˚C. (Pg. 69).
5-Sep-69 Saw small No. V in same general area as yesterday at 0820. Had searched for it from 0630 to 0715 but did not find. It was still near the rock pile about 25 m from where it was seen yesterday. It was still active (cool and overcast so far today) at 0830 eating the common plant with red "stolons" and a prostrate growth, which covers much of the open areas in the nesting zone.
Set up a Tru-chek rain gauge and Casell evaporimeter directly east of nest #2, 6, 7, 9 in an open area devoid of any trees or shrubs and cleared of vegetation from 5 ft all around. Top of rain gauge and bottom of evaporimeter are at about 1 m in height. Started the instruments working at 0800 hours. The evaporimeter is reading 1.3 ml at this point.
Returned to the Caseta along trail from Zone 3; tried to set up some reasonable zones based partly on vegetation aspects and partly on likely or potential use by tortoises. Justification of these zones is not entirely possible and will have to modify these with time almost certainly. For now have 7 main zones or regions with some subdivisions within these which will be mentioned below. Also, since recorded tortoises and altitudes (Thommens) these will be given along with the descriptions for simplicity - the latitude readings are about 60-90 ft higher in every case then those obtained on 3-Sep- 69 on the way down this trail (Pg 70) . . . from the Caseta to Zone 3 nesting area. Traverse was made from 0930 - 1430 hr.
1. Region 7 - Zone 3 nesting area; open with low canopy cover by trees - only 5-10 % in maximum areas. Main trees are matasarno (Piscidia) and Palo Santo (Bursera) with some scattered Pisonia, a few Cordia and a rare guayavillo (Psidium). The understory is made up of mostly herbs reaching only up to 0.5 m in height, but some areas have more dense brush up to 1.5 m. The main herbs are unknown at this time but I collected two of them, collections # [not specified] and these will be identified later. The surface of the soil is strewn with boulders and from our excavations and watching ♀ #13, I doubt the soil is very deep anywhere, at least not so without hitting many buried pieces of lava. The (Pg. 71) . . . soil varies from the red type so often used for making nests by the tortoises to more brown and brown-greyish soils. Altitude when left this area was 215 ft. As left found a smallish tortoise #918 ♀ (?) CL 56.5; CW 61; HF 11.0; SL 44.5; SW 36.5

Just a short way above the Zone 3 nesting area proper, ran across a newly protected nest which Chappy found this morning on his way up - this was up a rise from Zone # 3 but was on a flattened out area - Alt. 240 ft. will be nest #13. Not obviously fresh - no wetness to top of hard cap.
♀ #133 near this nest; scutes have deep grooves and lack all growth rings as did #131. Appears very "old" and worn carapace. CL 96 ; CW 109; HF 25; SL 77; SW 63.
2. Region 6 area running from about 220 ft at edge of Zone 3 nesting area up to about 290-295 ft. There is some distinct veg change within this area but it is all characterized by a denser understory, greater canopy cover and general lower degree of openness than found in Region 7 and 5. A generalized description of the zone and some changes within it follows: from the Zone 3 nesting area to about 150-260 ft the (Pg. 72) . . .
veg is about the same but with a bit thicker overstory and understory; the tree composition and height however is about the same as the Zone 3 nest area. At about 260 ft the trees are noticeably a bit taller - reaching up to 20-25 ft max. now; Pisonia dominant in some area and understory getting up to 1.5 m and even denser; substrate covered with boulders here and I doubt nesting is possible at all due to shade from above and rocks below. Just slightly above this area at about 260-266 ft there is an open area with some lava rocks (some plate-like, others more rounded) embedded in the soil. Trees same, a few manzanillos however; there is some open soil here, but it is now cracked and dry and looks like the area probably collects standing water when rainfall is abundant. It is open enough for nesting, but a (Pg. 73) doubtful area - probably too high and wet and cool.
In Region 6 saw the following animals:
At 240 ft. - #275 ♂; CL 92.5; CW 98.0; HF ? couldn't get to easily; SL 75.0; SW 62.0; grazing in veg. About 12 ft off of the trail.
At 260-265 ft in open rocky area- #694 ♀; CL 89.5; CW 98.5; hf 22.0; SL 69.0; SW 58.
3. Region 5 - Runs from about 290-295 ft to large open area at 320 -3309 ft. Most notable because of veg change. Trees now commonly 25-30 ft height and reaching up to 35 ft. Guayavillos now becoming common and making up more of canopy. Also goodly admixture of matasarno and Pisonia still and both these trees are larger than at lower elevations (larger in girth and height). Understory of shrub-bush height - commonly 3-6 ft high. Hanging lichens common now through this area whereas absent below. Generally denser and more shade than below - general aspect is of a more moist region. At upper end of this area there is a circular rock pile where things open up a bit (about 300-360 ft) and for lack of better place will include in this region.
One tortoise seen - #718 (maybe 711) ♀ at 300 ft; CL 86.5; CW 90.0; HF 21.0; SL 67.0; SW 54.0 (Pg 74)
4. Region 4 - From about 320 ft to 340 ft; begins with an open area covered by embedded rocks and opens up into the large open area with the pond covered with Rodillo de Caballo mentioned on pages 54-55. Overstory is about like previous Region (4) [note probably means Region 5 since he has changed several zone numbers through this section of the notes]. . . . but not as dense - in fact only about 15-20% canopy at most. Also noticed some manzanillos, Maytenus, and Xanthoxylum in with the other 3 tree species. This will probably be a major area for finding tortoises in concentrations due to the pond and open areas for feeding.
Saw a few tortoises:

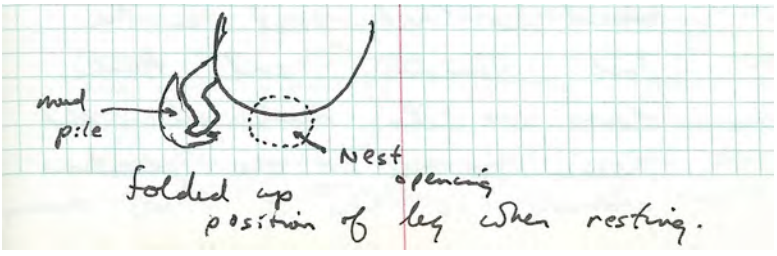
#904 ♀ CL 79.5; CW 82.0; FH 20; SL 61.5; SW 50.0
#423 ♀ (see 3 – Sep - 69 same general area)
#106 ♂ CL 94.0; CW 98.0; HF 25.0; SL 73.0; SW 56.0
#223 ♀ CL 81.0: CW 63.0; HF 18; SL 86.5; SW 50.0
[Marginal note: All within few meters of each other in lower open area just before major one 320 ft] At 330 ft in major open area (Pg. 75)
5. Region 3 - This is a very complicated area running from about 340 ft just above the Region 3 open area to about 560 ft just below Caseta Pond #1. It is the steepest slope of the entire trek from the Caseta to Zone 3 - the veg changes considerably over this expanse but is united in the understory is dense, the trees large and tall and there is virtually nothing in the way of open areas for tortoise grazing. It is notably more moist than the regions below, it becomes moister, denser, and the trees larger in girth and height as the region is traversed upwardly. Canopy cover 85-90%.
Description: At 340 ft the canopy changes to being dominated by guayavillo - 50-75% of all trees; some matasarno and Pisonia are still the other main tree species. The trees all reaching heights of 30-40 ft. At 390-400 ft the trees are even larger and reach heights of 40-50 ft at times (largest ones are guayavillo and matasarno in terms of height). Guayavillo is the clear dominant with Pisonia and matasarno still being the other most important species. Epiphytes such as ferns, mosses, and lichens become more and more abundant between 350-440 ft. Continues about same to 560 ft - almost no openings - lianas, epiphytes, trees dense; much shade and luxuriant growth. (Pg. 76)
Tortoises:
#278 ♂ at 340 ft; CL 109.0; CW 117.0; HF 27.0; SL 82.0; SW 64.5; very flared rear marginals.
#410 ♀; in small cleared area at about 350 ft; same general area as on 3 -Sep- 69.
#891 ♀ at 460 ft; CL 75.0; CW 81.0; HF 21.5: SL 63.5; SW 48.5
#827 ♀ at 560 ft; feeding just off of trail; on 3-Sep- 69 was on trail "coming up" at an alt of 370 ft (i.e. = 400-450 ft of today probably).
6. Region 2 - Veg largely the same - dominated by guayavillo reaching 45-55 ft in height, with large trunked Pisonias and a few matasarnos mixed in (later becoming scarce); the first Scalesia all beginning to show up as a secondary story of 25-30 ft in height. (Pg 77) However the overstory is not as dense; the canopy cover is only about 50 % beginning at about 560 ft and continuing in this fashion to 585 - 595 ft. At about 580 ft began to notice first grass along trail. Region 2 is there from 560 -590 ft or so.
Tortoises:
#403 at about 600 ft (same general area as on 3-Sep-69 when recorded at 500 ft.) at uppermost edge of Region 2 - feeding on Commelina nudicaula beside the trail.
7. Region 1 - Runs from just slightly below Caseta pond #1 to Caseta. About 590 ft to 735 ft. Generally very open overstory - canopy no more than 25-30%, even less in places. Dominant varies from guayavillo to Scalesia. Generally like Region 2, but simply more open. A lot of grass in some open places especially around pond and where the tortoises keep the vegetation eaten down. A lot of tortoise trails and activity in this area, especially around pond #1 and in area just above and E of pond on way to Caseta and NE running trail from Reserve border to (Pg 78) . . . the Caseta.
Tortoises:

#98 ♀ at 620 ft; just below pond #1 on its E side; same exact area as when saw on 3-Sep-69 at a recorded altitude of 535 ft.
Caseta on arrival at 1430 gives altitude of 735 ft. Max of last 3 days 80˚ F; minimum of last 3 days 64˚ F.
1900 - The garua the last few days has been rather strong
3-Sep-69 and 4-Sep-69 -- 3.3 mm
5-Sep-69 - 2.9 mm
Went down to the Pond #1 below the Caseta to relax from 1630 - 1800. Saw a large ♂ #31 along the trail (1/2 way down).
4 more tortoises were in the pond when I arrived at circa 1700; 3 were at rest already buried in H20 ½ way up and including #102 ♀ (Pg. 79) on the W side of the pond near where I saw her before (Pages 38). 1 of them was active eating Azolla and grass while stomping about in the water till about 1800 when it too quieted down for the night. Couldn't get numbers on 3 of them.
Thus saw a total of 34 tortoises between the Caseta and Zone 3 (including those 3 areas not including #655 which was seen at pond just SE of Caseta along trail), for 2 traverses with some short side searching at Caseta Pond #1 in Region 4, and in Zone 3 nesting area. The sexual breakdown is 9 ♂♂, 19 ♀♀, and 6 indeterminate (either couldn't tell or didn't get chance to see sexual characters because immersed in H20). Five of these were seen in the Zone 3 NA proper and all were ♀♀ but one small indeterminate one (# V for now). However it is certainly not true that all ♀♀ are low (of breeding size) and all ♂♂ up high or anything approaching this. The ♂♂ seemed well scattered down through all the altitudes and areas visited down to at least 240 ft (maybe 180 ft or so) just above the nesting area (in Region 6). See p. 73, #275 ♂ also, egg-laying-sized ♀♀ were found right around Caseta pond #1. This will have to be further quantified. (Pg. 80).
Nesting sequence - behavior of ♀ #131 in Zone 3 Nesting Area of Santa Cruz tortoise reserve. Nest is #12 for Santa Cruz this year.
See pages 58-59 for introductions to this sequence.
1635 We are watching this from about 3 ft behind the ♀; have a clear view and she knows we are here because has looked at us as we came up into position. However, since we remained quiet she quickly returned to digging after looking at each of us as we approached separately. Bill Reeder, Jan, and I are making the observations.
Is digging with the hind feet only; the forelegs are extended and bent at approximately right angles out to her sides; she is raised up on her forelegs which are supporting part of her weight at all times. The forefeet are (Pg. 81) . . .placed in definite positions and she seems to be carefully avoiding moving these feet out of place - sort of anchor positions; the forelegs are essentially in a normal walking position. The hole has a good bit of cloacal fluid in it - we agree on an estimate of about 1 liter; the fluid is clearly making it easier to dig as it soaks into the fairly hard dry soil. Also it causes the soil to adhere and take on the consistency of mud - this undoubtedly aids in removing it easily from the hole on her hind feet so that it can be dumped to the side.
1655 - still digging; is digging at forward limit of the hole and can see her using the claws to scrape the wall and then bends foot slowly down as she pushes down backward; this tends to make a pile of mud on the base of her foot and under the nails. She then brings soil up with leg extended fully and foot bent slightly to form a "cup" to hold soil with nails and pad of foot. This all looks like the natural follow through to the digging

movements described above. Just as the foot and leg clear the hole, she swings the leg about 30˚ to the side and dumps the muddy soil. In dumping the soil, she is making a fancy little twist with the foot using the wrist as the pivotal joint. This is very difficult to describe but it appears that she simply (Pg. 82). . . . drops the wrist down (i.e. into a more extended position) and follows through by bending it into the normal walking position; but in the same motion the foot is bent outward till it comes to a final position of almost 90˚ turned outward to the normal walking position. This leaves the nails pointed outwardly, perpendicular to the length of the carapace. Just as this final position is reached the foot comes down onto the pile of mud being built. Some of the mud falls off onto the pile when the foot is first "lowered", i.e. unbent, but most of it is delivered to the pile still stuck onto the foot. This mud then get stomped or pressed more exactly into the pile when the animal raises up and puts the opposite foot in to dig - i.e. the weight of the animal is then being (Pg. 83) . . . partly supported by the foot just newly placed onto the mud pile. The mud piles are being made in a very specific places, each about 2-3 inches away from the aperture of the nest; they are sort of half moon shaped.
[Sketch of round nest hole with crescent moon shaped dirt piles at 4 and 8 o'clock positions with small circles between moons and nest hole to show where feet are placed to dump mud]



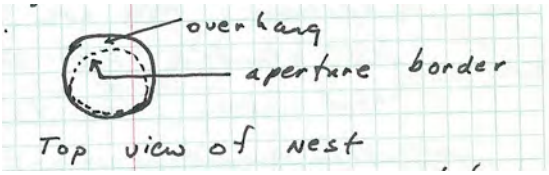
The hole aperture is now about 8-9" in diameter. She is definitely making a flask shaped hole and is digging an overhang of about 3-4" in depth in the front 180˚ of the nest below the aperture - can see using claws to cut into this. She is also definitely resting now, every so often - she puts on load of dirt onto a pile inserts the other foot into the hole and then rest with the new digging foot dangling into the hole, the plastron (back part anyway) onto the soil in front of the aperture and the opposite foot pushed onto its mud pile, sometimes extended and supporting weight. And sometimes folded up some -
[Sketch of carapace, leg, dirt pile and hole relative to each other]



(Pg 84)
1716 - A spurt of cloacal fluid dropped into hole just in between times when a digging leg was in - did not stop rhythm of changing legs. Maybe ½ cup or so. When she did this

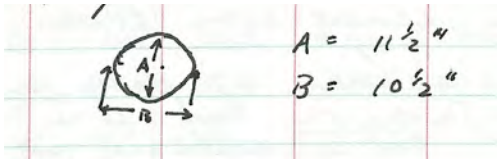
she had run out of standing water in the bottom of the hole, but the walls of the hole still looked muddy.
1717 - Another spurt of cloacal fluid dropped in same fashion; approximately the same amount. The total depth of the hole is now 8-9", and there has been almost no breakdown of the original surface around the aperture. She has been quite regularly alternating the feet (see Reeders notes for few exceptions) in digging. The movements are timed so that just as the foot removing soil touches down on its mud pile she raises up off of the ground (i.e. has 3 points touching (Pg 85) . . . the ground - 2 front feet and hind foot on mud pile), swings over in a slight rocking motion and inserts the new digging foot. This is timed so that she is always supported on a triangle of support points.
1720 - At least ½ of the nest (front half) now has a good distinguishable flask shape; there is a small rock of 3 x 4 cm or so on the right side of the nest partly exposed at the surface and embedded a few cm into the soil - i.e. makes up part of aperture border - finally fell into nest as she dug out under it; in doing so it destroyed a small portion of the flash shape by caving in a portion of the overhang. She now appears well aware of the rock's presence and is digging under area where it fell in repairing the damage to the flask. In the process the rock has been moved to the center-left of the nest on the bottom.
1730 - When resting and when actually digging into the side of the nest, she seems to be resting on her plastron or at least the back portion of it is on the ground; however, during this time the forelegs are extended supporting the front part of the body - the digging leg is giving no real support and the other legs is usually in the folded up position pressed into its respective (Pg 86) . . .mud pile.
1738 - However, when removing mud and dumping it she is raised fully up - the closest part of the plastron to the soil is at least 1.5" above the substrate. She is also raised up when changing legs and inserting the new one into the hole, until as the new one just touches the bottom of the nest to begin digging - the plastron again comes to rest on the soil. In sum, she raises up when she begins to bring the digging leg out of the hole in a backward upward motion and remains raised till the new digging leg is inserted into the hole; the rest o f the time she is resting partly on the plastron
She never appears to relax the forelegs - is still holding them in original positions - foot holds. When she starts to change legs, the new digging leg is lifted vertically very carefully at least (Pg 87) . . .5- 8 cm before she swings it toward the hole; then when the foot is just over the center of the hole, she extends the leg, and then the foot as its goes into the hole. In the swing from over the mud pile to over the nest she keeps the leg folded up at the knee. She also curls the toes under as the leg is raised vertically and keeps them so curled until the foot is re-extended after entering the nest. This all very effectively avoids hitting the aperture border and otherwise knocking any soil into the nest cavity. She also uncurls the nails when digging into the side of the nest and the bottom of it. But when pushing backwards in the bottom while digging, she tends to curl them again to get more leverage.
She curls the nails also during the backward upward stroke which gathers the soil onto the foot and lifts it out of the hole - they remain so curled until dropping the foot (extending it) just above the appropriate mud pile. Another thing the wet soil seems to aid in (i.e. function of cloacal fluid) is to keep a semi-solid compact pile of soil in the area where she places it - if this soil were loose and dry much of it would probably fall back into the hole. Since it is wet and she presses it down virtually none of it slides back

into the hole. (Pg. 88) 1740 - Rock which was embedded in the left hand wall of the nest finally fell into the nest bottom she is working around it as she did with the previous one.
1747 She is getting to the stage in which the right leg is nearly fully extended when digging in the bottom of the nest. But she is not fully extending the foot and the nails; also she could raise the forelegs up and thus lower the back end of the plastron; all this should combine to allow her to dig another 3-4 inches down in at least the center-bottom part of the nest.
1750-1755 There is a third small rock - this one is partially buried in the bottom on the left-central side of the cavity. She tried loosening it with the nails of the right foot by pushing backwards but it will not move. Then changed feet and dug several strokes of soil out from behind it with the left foot. Then reinserted right foot and (Pg. 89) tried same pushing techniques from in front; this time it came loose and she pushed it to the rear of the nest where the previous three small rocks are - all three rocks are about the same size ? (can not tell exactly). No, two are fist-sized; one smaller.
1755 – Flask-shaped about all the way around except for 140˚ at back. - symmetrical.



Noted that even when she does not have a foot full of mud to dump, she still performs the same sequence of motions in foot lifting and dumping.
1813 - She has apparently reached the limit of her reach for the flask undercut in the front and the right forward quadrant of the nest. This is because the foot is physically limited by the wall of the aperture - when the leg is adpressed against the wall and she is stretching under the overhang with the foot and nails as far as she can and can not seem to dig any more into the flask wall; looks like overhang horizontal distance from the aperture is limited to about 3-4". For the same reason she can not dig deeper below the overhand proper - now about 7- 8" maximum depth - this is only an estimate - she can still go deeper in the center of the nest out from under the overhang.
1815 - Some light garua now beginning. (Pg. 90).
1820 - Starting to dig along the sides now more - especially forward portions of rear two quadrants.
1824 Added one cup of cloacal fluid in similar position to previous additions. Hole was empty of free, standing H20 at the time and had been for 40 minutes plus. Then moved rock from left rear to left center and is excavating flask on left middle and front part of left rear quadrant.
1830 Garua stopped; essentially has become too dark to see what she is doing now. Have begun using flashlight (with old batteries!) intermittently - does not seem to bother her at all. Jan took one roll (20 photos) h. speed Ektachrome of digging movements between 1700 and 11800. Will be N. Geographic roll #6.
1834 The rock is back on the left side and she is again working on the front 2 quadrants, flask portions. However due to the limits of the aperture. (Pg. 91). . . .wall she is getting virtually no soil out of the flask walls.

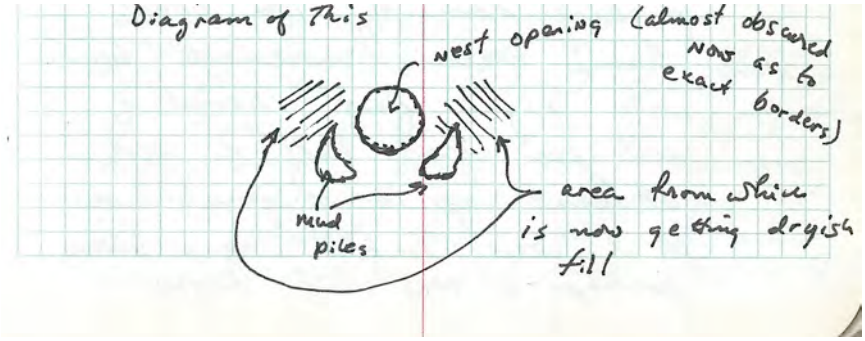
1838 - Rocks - has two loose fist-sized ones and one much smaller one - all in left rear out of way - there is also a flat plate of about 3-4" diameter which is partially (actually mostly) embedded in the bottom of the nest to the center-right; seems to be trying to dig around this plate, but without much success.
1850 - Has been noticeably resting between almost every stroke since about 1835. There are now two plates on the bottom which she has come up against. One is described just above. The other is somewhat larger and slopes slightly forward and downward from the back edge of the cavity. It is also mostly embedded - in fact the two plates make a nearly flat surface to the bottom of the nest below the open aperture. Depth from top of the nest to the rock plates is 8" - measured (i.e. about 18 cm almost exactly)
1925 - Has continued digging on bottom of nest below aperture, but to almost no avail - can hear nails scraping over the two plates - but she is getting no soil and can not get around the plates for they fill most of the area below the aperture proper. Between her strokes, Bill Reeder slipped (Pg 92) the pocket measure in and took a few measurements.
1. nest is 8" deep in the center of the cavity - from top of aperture to rock plates.
2. Diameter of aperture is 11.5" one way and 10.5" the other - sort of a curious diamond shape (but with rounded edges).



3. Undercut (flask) looks to be about 2.5", hard to measure but approximately this. Measured in front part.
1930 Light garua begins
1935 Moved right foot around in bottom of nest as if smoothing out the area over the floor of the cavity. May have smoothed a bit of soil, but not much; also this could have been an investigation of the cavity size or some other type of measuring device; impossible to tell; it all lasted only 30 (Pg 93) . . . seconds at most. This was all done without any sharp break between digging and the rotary movements; was digging with left foot simply changed feet and instead of digging with right just started the brief rotation movements.
1936 Immediately removed right foot and was up on all 4 outstretched legs; dropped down to left side a bit so that left rear side of plastron was on soil; also left rear leg in folded up position described on page 83. Other 3 legs extended supporting body.
1937 Tail started moving very slightly to sides and up and down just a tiny bit; looks as if some muscles are contracting.
1941.5 - 1-2 cc of a clear gelatinous looking substance (mucous-like in consistency) or like raw chicken egg albumin) came out and dropped into bottom of hole; note that she is positioned with cloaca directly above center of aperture - i.e. over central part of cavity floor. Tail moving slightly still.
1944 - 1-2 cc more of same; tail continuing to move slightly as before.
1950 - First egg - hit smack onto flat rock in bottom - landed in left -center portion in nearly the middle of the cavity; egg is brittle shelled about billiard ball sized and similar to a very white Q-ball in appearance. (Pg. 94) Clunk of the egg on the rock was

shocking, but in perfectly OK condition. The egg was surrounded by the albumen like clear stuff and was followed by ½ -1 cc of the same immediately. The tail really expanded to let it out (from rear view) and a perceptible "crack" was heard just as tail began to visibly swell at base but before the egg could be seen - what this is (is) not known - expansion of something in cloacal region?
1951 ½ - #2 egg; broken when came out; could see crack running most of way around and some yolk was visible through crack; fell onto first one and rolled off to left side. Certainly will be no good.
1952 1/2 #3 egg; OK
1953 - #4 egg; OK
1953 ½ - #5 egg; OK
Noticed perceptible deep, labored breathing right after first 5 eggs. (Pg 95)
1955 - #6 egg; OK (deep breathing ceased (audibly anyway) during this and next egg)
1955.5 - #7 egg; OK
1956 - #8 e.g.; OK; small dent in one side when came out;
1957 - breathing heavy again.
Virtually no variation in position of cloaca was noticed during the laying of these 8 eggs; if any it was only slight. A few of the eggs hit the bottom plate rocks directly; others landed on top of eggs layered before and simply rolled off to one side or another. Some variation in the cloacal position may have taken place simply due to twisting and expansion of tail as eggs come out.
1958 - Heavy breathing ceased; lower back edge of plastron very slightly backwards in doing so, maybe ¼" This is the first instance I've seen of any noticeable lowering of the cloaca above the area where the eggs will drop; on all previous eggs the cloaca was about at same level as during digging, i.e. only a few cm. below ground level at most. This is the case despite the fact that she could lower the cloaca at least 5-8 cm or more if she wished to by raising upon front legs and contracting the rear ones somewhat.
1959 - #9 egg - OK; pulled up and forward a bit as laid - as if came out - canceled out effect of previous movements and thus dropped (Pg. 96) near where all previous ones dropped; after egg came out settled back into position she was in just before egg emerged from cloaca.
1959.5 - #10 egg; OK; same movements as with #9 exactly
2000 - heavy, audible breathing again.
2002.5 heavy breathing stopped again; trying to "squeeze" one out.
2003 - #11 egg – OK; rolled off to right after hitting other eggs.
2003.5 - All eggs except one are in a single (closely abutting each other) layer; that one is on top of two others and resting up against rock on the left side of the nest.
2004 - put right foot in very carefully, nails curled under; lowered leg very gently and carefully; then extended nails so they are parallel with the leg; then is using very gentle (Pg. 97) . . . (fantastically careful and gentle!) sweeping movements to the front and right from the center of the cavity; is doing so that tips and slight part of front surface of nails is brushing over eggs; the movements are going out to just a bit under the overhang - i.e. slightly into the flask part. Actually she is hardly moving the eggs, but if there were some on top these movements would certainly move them over under the overhang and into a single layer. Movements also seem to assure a single layer of eggs barring obstacles and assuming a large enough cavity

2055 - Shifted to left foot; same movements in center and left side of cavity; movements have been largely restricted to forward 2/3's to ¾'s of the cavity. One egg on top of others won't budge because of rock it is up against.
2006 - back to right foot - series of sweeps again; have not counted sweeps accurately but seems to be 3-5 each time or so.
2007 - back to left foot; another series of gentle sweeps.
2007.5 right foot - 3 sweeps; no eggs at that level - pushing air only this time; did not perceptibly touch eggs with nails.
2008 - left foot - another series of sweeps
2008.25 - right foot - another series of sweeps. (Pg. 98)
2008.5 - right foot out; started filling in movements now with no break in activity.
2009.5 - Alternating feet in filling in; using right foot to spread what the left throws in to cover eggs under overhang of flask on right, and vice versa
Using feet and lower part of legs as sideways scoops, mostly feet alone. Swings legs in from side in a 75-90˚ arc and in doing so keeps foot and nails in a cupped position so that soil and mud gets pushed in on top of eggs. Alternating feet. Often follows a "mudpushing in" swipe with a sweep of the foot and forward face of nails over the soil which has the effect of pushing dirt into the flask under the overhang and thus over the eggs in this region. Appears very delicately balanced; is up on all legs outstretched part way and not resting on (Pg. 99) plastron at all; often only thing supporting rear is one foot balanced on one edge of the opening and the nails of the other foot pressing lightly on the soil which they are moving. Has been mostly filling in the rear half of the nest till now.
2016 - made a definite push with right foot (using the nails and part of anterior face of the foot) to the right and forward, thus pushing soil in under overhang in this area.
2018 - Still bringing in soil from piles of mud and occasionally pushes some forward with anterior face of leg and nails to cover front portions of the cavity. Eggs are now no longer visible - all covered with a least some soil.
2019 - At first she was getting some of the wet mud back in, but now is not doing so very often; most of the mud originally taken out is still in the two foot rest piles as shown on page 83. Is now bringing in mostly dry soil from area to left and right rear of nest opening but out to sides and slightly in front of mud piles. Diagram of this.

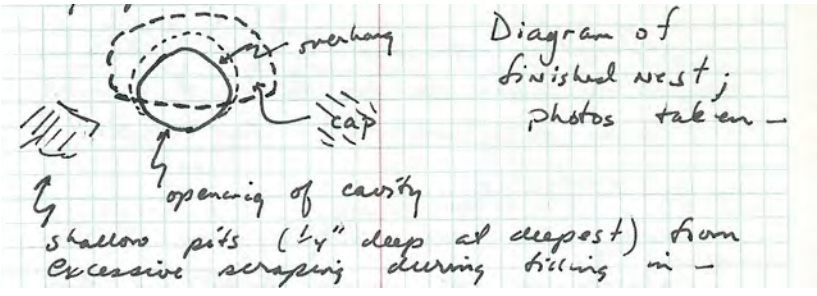


Pg. 100
2023 - had been bringing in soil from the side - back region around the nest indicated in just previously shown diagram. Alternating feet; moves a bit to one side, the side from

which soil is being pushed and swept in, but is keeping front feet in their fixed grooves as throughout the entire nesting period up till now.
At this time, reached forward with left foot when was in centered position over the nest; did so by elevating foot and leg and bringing up under raised plastron. Seemed to simply test soil height at very front of area above nest by probing twice lightly with the nails of the foot. Could have also resulted in some packing down of the soil?
2026 - Same checking movements forward with right foot. Mound of soil over front half of nest is at least up to original level as it was before began nesting - perhaps a tiny bit higher. (Pg. 101)
2028 - When returns foot from forward checking position, nails drag a bit sometimes and move a little soil to the rear above approximately center part of nest. Still bringing in soil from the sides.
2030 - By this time has made a shallow excavation above the very rear part of the nest on the right - probably because there was not as much soil deposited here in original excavation as on the left side. Still bringing in soil from sides.
2035 - Just swept both legs in together from sides to form a small pile of soil over the middle of the nest- not much soil gotten this way. Reached forward with one leg or the other occasionally and pushes a little soil to the back area with bottom of foot.
2038 - Again using both legs together as scoops and bringing them to center - has a small oblong pile of soil built up.
2044 - For 3rd time in last few minutes - rests flat on plastron, raises both back legs and feet and pulls them in a bit and forward along her sides; almost as if measuring the height of the mound or perhaps its lateral extent ???? [Marginal note: only lasts short time, 10-15 seconds]
2045 reaches forward with left leg under plastron pushes small bit of soil backward a few cm with nails and bottom of foot. Then pushed into soil with nails - thus is compacting soil under plastron a (Pg. 102) . . . little by this movement.
2049 - Moved whole body to left and reached way to left, then swept foot in across in front of mud pile and thus brought some soil in over nest. Fore-feet kept in footholds still, however.
2053 - Checking posture with both feet.
2054 - Again reaching way to left; brings in some wet soil from mound (pile) and some looser soil beyond it to the side; swept this soil to central mound near rear edge of plastron, rose up off of plastron even more and pressed the area down where brought soil using nails and bottom of foot (latter only in part; the portion near the nails). Same with right foot; same with left foot.
2058 - Same sequence; checking posture with both feet, scooping, then pressing with nails.
2100 - Same sequence.
2101 - Right foot out, brings in soil, packing with nails. (Pg 103)
2102 - Same with left foot
2103 - Reached back with both legs fully extended and then brought them together to scoop soil over the back part of the nest cavity - heaping up dirt in other words. Reached out to same areas to side and in front of where former mud piles were; also sweeping legs over where piles were - the piles are largely used up and indistinguishable now.

2110 - Pressing soil over rear part of nest a bit with anterior face of feet and lowest part of legs; also using nails.
2114 - Again checking posture; again sweeps both legs from sides behind in over center of nest, then pressed with nails and soles of feet (mostly nails) on mound under rear of plastron.
2115 - Rising up again even higher.
2116 - Same sequence as at 2114
2117 - Same sequence as at 2114
2120 - Wide sweep of just left leg and then pressing with nails above rear portion of nest
2123 - Light garua just now again.
2124 - Check, sweeping motion with one leg, pressing with nails.
2125 - Same sequence as at 2124
2128 - Swung whole back part of body a full 60˚ to the left and then brought in soil with sweeping movement; then pressing with nails.
2138 and 2140 - has been continuing these wide movements of 60-70˚ followed by (Pg 104) sweeping-in movement and pressing with nails. This may all be directed at smoothing the mound over and pressing it down more and more. Twice came back to perfect orientation directly above the area which was formerly the center of the nest opening and started pressing soil there with nails and anterior face of the legs and feet (latter two mostly). However, made these same pressing movements well onto left side of the nest also. Orientation probably maintained in part by the rest for the forefeet which have been so carefully maintained.
2155 - Same general sequences continuing - mostly seems superfluous now !!! Hard compact cap does not cover all of nest and eggs; in fact it appears to cover only about the anterior 2/3s of the nest.
2215 - Just took a look at the head from the side - it is extended beyond the gulars only 5-6 "; the eyes are open; not moving head at all as far as I can tell.
2300 - For last 35-45 minutes has been continuing to reach way out to the sides and sweeping feet in (one at a time, moving way out 60˚ and more) - only bringing in a scattered stem of vegetation and a little soil now and again - except for roughing up area not accomplishing much by all this activity and even so the main cap area is still visible, compact, and wet, and uncovered by loose soil.
2330 - Swinging out in an arc up to 2 ft away from nest cavity proper and bringing in a little soil and moving bits of vegetation, wood, and rock about. In moving since 2300 has been swinging out 60 - 90˚ and generally jumbling up surface even further- this area runs largely from just over the nest to her left; the right hand side is not being treated at all now.
She is up on all four legs well off of the soil in doing this - is being very careful not to step on the area being "camouflaged". Swings way out with a wide, raised, exaggerated step of the left foot and then sweeps it back over the area with only the toenails touching - like a rake. Rests a few minutes between about each series of ten sweeps or so. (Pg 106).
0010 - Just finally quit - no obvious measuring movements or anything similar detectable; she swung around counter-clockwise about 100˚ and appears to be staring at the candle which was behind her (we have been burning a series of small candles about 2 ft behind the nest hole area since about 1900). She is looking straight at it; head is only

about 5" from the flame; she is clearly done with it all; we blew out candle and left her sitting on top of the completed nest.
Some general comments:
1. Timing - a. Digging - 3 hr, 5 min plus
b. Egg laying and maneuvering - total - 33 min.; 1st to last egg - 13 min.
c. Filling in and disturbing surface - 4 hr, 2 min
Total - at least 7 hr, 40 min but certainly a bit more because missed some of earliest digging - up to 30 min at most. (Pg 107)
2. All seemed very mechanical; transition from one stage to nest was virtually unsignalled by any rest stops, etc. Just stopped one series of mechanical and predictable movements and began the next right away. How variable these movements can be potentially is intriguing!!
3. Limits on nest cavity size - see notes during sequence above; suffice this summary to say that she appeared to have reached the limits of the flask undercut - overhang area due to physical blockage of foot by aperture wall - was trying to dig further with foot and nails as extended as possible but could get no more soil loose. Maximum overhang for this animal is about 2.5". Also may have reached limit of extent of flask overhang in sense of how much of nest cavity can have this shape given her fixed digging position - about all of nest had this shape but rear 100 -120˚ arc to excavate an overhang any further I think she would have had to give up her fixed position and turned around at least somewhat (for one side) on 180˚ to get full flask all way around. As discussed above the flat rocks in the bottom limited her depth to abut 8" maximum whereas she could theoretically have dug 2-4" further down given full extension of foot and nails and tilting backward and downward of plastron. (Pg 108)
4. No gap was left between the eggs and cap - just filled stuff in on eggs and built cap on top of this
5. No excrement dropped at anytime, either into nest or into excavated soil
6. Cloacal water may be just exactly that in large part - i.e. urine concentration is probably very low.
7. No eggs cracked by hitting against each other when dropping or when hitting nest bottom; also when moving them just after laying she did not damage any.
8. Ended up with cap being placed only over front 2/3 of eggs and not over all the eggs. Most eggs were either under overhang of flask or in front central position of nest cavity, but not all; of 11 eggs probably 3 were out from under cap. (Pg 109) . . . proper.



Cap is thickest over forward part of nest - in fact thickest perhaps slightly in front of nest cavity aperture, i.e. over overhang area. Slopes to rear and becomes thinner.



9. ♀ could probably be frightened into or disturbed enough so that she would leave the nesting site; but once started digging well she seems to tolerate some minor disturbance as long as one is quiet and obscure most of the time - certainly not affected by candles and flashlights, talking, note writing, rustling of coats, etc. all within three ft of her rear end. WGR will send his notes later and I will type up separately. (Pg 110)

1 Oct 1969

Finally returned to the Caseta! Very good to be back and infinitely more enjoyable than the station drudgeries. On way up, first saw tortoise sign in an area about two km to the E (SE actually) of the small pond (Pond #4) just SE of the Caseta; there were abundant droppings along the border trail and fresh paths through the green vegetation; burrows were also abundant; this was in an area in which I am certain we did not encounter tortoise sign on last trip. (late Aug - early Sep 1969) [Marginal note: Checked this with pedometer and is about two mi from Caseta; (staying on trail all the way)]

Finally found ♀#268 in the border trail pointed toward the Caseta (and moving that way perhaps ??) She was sleeping when found in shade (sun out). Once we passed her all tortoise sign stopped which makes one think that she was the cause of the (50 m or so) area along the trail where the fresh sign was (Pg. 111) . . . obvious.

Altitude here was 570 ft according to the Thommens which was set at 0 at the coast before departing (5 hr before - conditions similar).

After a break of about 1.5 km with no tortoise sign again encountered some fresh droppings about 0.5 km SE of the above mentioned pond; also some recently depressed green vegetation; but no animals seen.

There was also evidence of very recent use around the pond and from it to Caseta saw burrows, trails, and droppings.

♂#220 was in trail halfway between Caseta and the pond (#4).

At Caseta ♂ #31 and ♂ #444 were feeding on grass in open - (former one was just below Caseta when last was here - Sep 5 , 1969. Altitudes on arrival at 1530 hr (left Puerto Ayora at 1000) l- Thommens - 670 ft; Taylor 690 ft.; Taylor with correction (for temp) would = 718 ft.

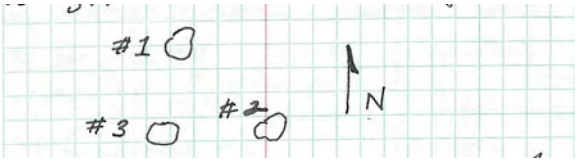
1900 hr - checked rain and evaporation - Evaporimeter (Piche, caella) set up on Sep 6 at 0900 - total to this time is 18.6 m. (set up time read 1.0 ml and 19.6 ml today)

Rain since 1900 yesterday - 1.1 mm; the greatest max temp since last checked (Sep 5, 1969) is 85.5˚ F; lowest min 60˚ F. (Pg 112).

2 Oct. 1969 - Went with O. Chappy and Julio San Miguel (new warden) to Zone 1 and below Zone 1 toward Zone 3 in order to check on use by galápagos and possibility of putting in a trail tomorrow - will describe all this in more detail later, but few notes now are worthy of attention.

We checked all galapagos seen for number and sex (however, some of the sexing was done by Chappy and should be rechecked if possible since he tends to identify gender somewhat by size and location I think.

Left Caseta at 0740 and returned at 1230 hr Thommens reading 540 ft and 525 ft respectively at these hours. – but, this is certainly incorrect. Stations official record is 205 m or 672.6 ft. My reading of 670 ft yesterday is correct I think -- because was virtually no weather variation between time left Puerto Ayora and arrived at the Caseta. (Pg 113) Also the correct altitude of Pond #1 below the Caseta is about 540 ft. In sum, the altitudes as read with the Thommens will be given here but I think all of them are about 110 to 150 ft too low for the entire day - these tortoises seen before (late Aug-early Sep) will be marked with an asterisk for future checking.
There are three good sized ponds - a few acres in size each, not far (guess about 1.5 - 2 km) below the border of the reserve in Zone 1; they are situated in sort of a triangle -



and will be numbered as shown in reference to Zone #1. The ponds are not far apart especially 2 & 3 and much of the entire area around and between all three is very open and covered abundantly with the plant which is unidentified but so common at these altitudes - field #1 plant. All the ponds had abundant H20, and #1 was completely covered with Azolla, #3 partly so, but #2 lacked it. All are surrounded by Rodillo de Caballo, but #2 is the only one which is difficult to approach. (Pg 114)
#1 was at 410 ft, #2 at 380 ft. and #3 at 365 ft. The open areas around and between the ponds have many small (a few x few meters) little low areas, some with mud and some with water and Azolla. There was much evidence of activity of tortoises - trails in fresh green, vegetation and droppings. Saw the following animals in these open areas mostly between pond #1 and #2.
333 ♂
74 or 76 ♂ (?) [perhaps 274 or 276; probably simply 74]
822 ♂
636 ♂
Around pond #3 saw the following - 233 ♂; 34 ♂; 87 ♂, and 445 ♀ plus one unmarked ♀.
We then proceeded directly S of pond #3 along a well utilized donkey trail, seeing much sign of pig rooting (very fresh) and abundant (Pg 115).. . . indications of tortoise use; we probably went about 1.5 - 2 km through varying areas of 40-50% canopy cover to areas of more dense forest. At about 3 km. Below Pond #3 and at an altitude of 350 ft found another very large pond area surrounded by thick Rodillo de Caballo - have to investigate this on further (difficult to access). Between ponds #3 and 4 saw a few tortoises - #266 ♂, #111 ♂ (?); at pond #4 saw #14 ♂. I think there is probably considerable movement between pond #4 and the three above it by tortoises based on the utilization seen today and the #'s of tortoises encountered on one flying trip.
Continued S and SSW for another 2-3 km or so (estimate) and then cut due W looking for Caseta - Zone 3 trail - we finally hit the latter at an altitude of 260 ft. From just below Zone 1 pond #4 to this trail, it was very rough traveling - thickly vegetated loose lava, very blocky and hard to traverse. All along this trek there was no sign which I could

detect as being tortoise. I doubt they would cross or utilize this area unless no others' were available - also the donkey trail gave out (Pg 116). . . just a little below Zone 1 pond #4. The whole area we crossed was in general poor habitat for tortoises. Came up Zone 3 - Caseta trail from where hit it in Region 3 (veg. Zone) - saw following animals.
Region 3 - at 270 ft - #423 ♀; at 275 ft - #268; at 370 ft - #627 ♂[Marginal note: note #423♀ has come up considerably]
Region 2 - #827 ♀ - 415 ft.; #136 ♂- 420 ft. [Marginal note same areas last seen a little higher now]
Region 1 - 430 ft - just to side of Caseta pond #1 - #274 ♀ (?); #98 ♀ (?) [same area as last seen]
Must correct above readings of altitude.
1900 hr - Maxi temp 79˚F; Min temp 60˚ F; Rain 0.0 mm. (Pg 117)
3 Oct 1969 - Rather clear, warm, partly sunny days - 1900 hours - Max 80.5˚ F; Min 59˚ F; Rainfall 0.1 mm; Evaporation since 1 Oct at this hour - 6.3 ml (now reads 25.9 ml)
The following notes were taken during trip to Zone 1 ponds and cutting of a new trail from Zone 1 to Zone 3 - first a revision of latitudes for the vegetation regions described on pg 70-79 is required based on an altitude of 670 ft for the Caseta and 180 ft for the Zone 3 nesting area - will use these as references and consider them correct. Changes are based on these reference points and data of today plus those latitudes taken on Sep 3 and Sep 5 1969 -
Region 1 - Caseta to Pond #1 area) - 670-530 ft.
Region 2 - 50% cover area below – 530-500 ft. Caseta pond #1.
Region 3 - long, steep grade - 500-310 ft.
Region 4 - open area and just above - 290-310 ft
Region 5 - 260-290 ft - area with rock pile is 285 ft.
Region 6 - 190-260 ft - area with big boulders is 235 ft.
Region 7 - Zone #3 nesting area - 180-190 ft
Left the Caseta about 0715 and went directly to the Zone 1 pond area. The correct altitude for the ponds are estimated as follows using Caseta as 670 ft -
Pond #1 - 520 ft
Pond #2 - 490 ft
Pond #3 - 475 ft
Pond #4 - 460-470 ft.
(Pg 118) From just above pond #4 and passing on its W side we cut a new trail directly SSW and SW (varying a little from time to time). There were easy to follow donkey trails from the pond and down at least another 100 ft or so; the area looks like good habitat for tortoises; however only a few droppings were seen; most of the tortoise activity seemed to drop off immediately below pond #4 and indeed most is centered around the three higher ponds. At about 100 ft below the pond we began to hit very rocky boulder strewn areas with increasing frequency until the entire ground was a mass of this sort of material; large piles of lava rocks were scattered here and there and we circumvented most of these - on the whole this looks like a lousy area for tortoise movements at about 340-350 ft we (Pg 119) . . turned more WSW and began heading more directly toward Zone 3; right after making the turn and still within this very rocky, boulder covered area, we saw the first tortoise since leaving pond #4 in Zone 1. #1033 ♀

At about 270-290 ft we turned directly W and headed for Zone 3 and hit the trail in a short while, maybe 1 km or so at most. The trails join at about 260 ft at the very lower end of region 5 - actually might best be considered the region 5-6 border and it is about 0.2 - 0.3 km above the area with large boulder which is in Region 6.
From here I headed down to the Zone 3 Nesting Area to check on instruments. Reached here at 1200 hr. All the instruments in the nest seem in good condition - * Weather instruments - the evaporimeter is dry and Chappy says it was dry last Thursday (Sep 25) when he was here - thus the evaporation since Sep 5 , 1969 when set up has exceeded 28.7 ml and is probably more like twice that much. Anyway for 20 days it was > 28.7 ml
The rain gauge reads 0.56" since Sep 5 but there has probably been considerable evaporation. (Pg 120). Emptied ran gauge and refilled the evaporimeter which was reading 1.6 ml when set up. Chappy says he saw no new nests when here last week, so I wandered around in some of the most obvious places for about 45 min and discovered 2 new nests.
Nest #14 - This is just beside #7, about 4 m away from it. In the immediate area around these three nests are about six "false starts" on nests (actually a few of these may be old nests from last year that merely look like recent scrapings. However I think all but two of these were here previously and should thus probably be associated with the ♀ that made nest #7; however, two are new and at least one of these is obviously connected with the new nest, at least temporally, if not that the same ♀ is responsible for both. This one is quite deep 5-8", and has several fist-sized rocks in it. (Pg 121) . . . and it is obvious from the mud clods and the smooth areas on the upper sides of the hole near where the back foot rest were that the ♀ released a goodly amount of cloacal fluid in constructing this hole, only to apparently finally give it up. There is also some damp soil in the bottom of the hole under the rocks. Incidentally under one rock where the soils was damp (about 2 x 2" rock), there were about 60-65 isopods (c.f. Armadillidium). The nest itself seems about as recent as this hole; it has a wide roundish, domed cap of about 12" diameter and the cap is superficially dry and slightly cracked; however, I broke out a small piece of the cap and it is damp inside only a few cm within - thus I suspect this nest is relatively recent. - maybe 1-2 weeks old at most and probably less. But it is certainly more than 2-3 days old because of the surface drying. The nest is in a very open area, the nearest trees being as for #7; there is considerable blooming mallow and some of plant #1 around it. The ♀ scattered a lot of loose, dry, red soil, sticks, dead vegetation and even some live stems of mallow, and small rocks over the nest in covering it.
Nest #15- This nest is just 2 m away from nest #4 and in the same general area. There have been three obvious and recent attempts to dig made (Pg 122). . . in the area of these three nests probably by the same ♀ which made #15; all three of these area very close to the rock wall around #4. All three ended when hit rocks rather quickly and there is no sign of any cloacal fluid having been dropped in any of them. The deepest is only about 3" down. As with the successfully dug nest in this area, there is no indication of the digging problems seen at the CDRS pens. The new one has a hard cap and the general construction looks like that of #12. However, it must have been more of an engineering feat because it was made right in the middle of a bunch of rocks and has some standing live vegetation (plant #2, herbaceous) dropping over it. The broadest diameter available in the area without hitting these rocks is about 15-18" and the ♀ seems to have used all

the non rocky area available right up to the circle of rocks. The rocks (Pg 123) extend out beyond this so that she did not have a larger area of open soil around the digging site to work with in filling the nest in and making the domed cap - thus must have largely used that which was removed in original digging. The cap is dry, hard, and cracked and I suspect the nest is at least one week old; it is definitely older than #14. The surface is covered with some loose soil, twigs, other dead veg. And a few live sprigs of plant #2.
Made the transect from NA to the Caseta and recorded tortoises.
Region 7 - NA- 1245 hr - #1055 (♀ probably, but small) resting under a tree in the shade near nest #3, 6, 7, 9, 14
Region 6 - big boulder area, 240 ft. #1151; ♀ probably but smallish feeding on some small herbaceous stuff abut 15m off of the trail.
Region 5 - 260 ft - #109 ♀ probably, but smallish.
Galapagos activity from NA to and including Region 5 was slight in appearance - few trails and droppings. (Pg 124).
Region 4 - 290 ft - central part- much tortoise activity - trails, feces, burrows abundant. There was a break for a short distance above the Region 4 central area in which there was little or no galapagos sign. However at about 310 ft or so just at beginning of Region 3 began to see much disturbances; abundant trails, feces, burrows; continued in this fashion for several hundred meters and at about 310-320 ft found #53 ♂, just off the trail; large and about right size to have caused this disturbance. He may be eating plant #1 but at any rate is knocking down great quantities of it in walking. Right up the trail a few dozen meters - #423 ♀ pointing downward. (Pg 125).
Still Region 3 - in strong ascent portion at 370 ft - #991 ♀? - feeding on herbs just off of the trail; pointing downward.
Just up trail a few meters - #216 ♂ - also pointing downward and in middle of the trail.
Another 10-20 m up the trail - #62 ♀ also pointing downward and in middle of the trail.
From look of the trail, I think #226 is using it to descend - wide swath in it.
Region 3 - upper portion - 470 ft - #268 ♂or♀? - could be a very large ♀; tail is sort of in between in size - I think maybe a ♀ of very large size.
Region 2 - 500 ft - beginning of region - #136 - sex as in #368 - I think maybe another large, old ♀ in trail eating grass.
Region 1 - Caseta Pond #1; #274 ♀ eating just off of trail;
Region 1 - #258 ♂ feeding in trail at about 550 ft just above Pond #1.
Region 1 - just a little higher #270 ♀ in trail; pointing downward. (Pg 126)
Region 1 shows much sign of tortoise activity -
4 Oct 1969 - Very cold last night - 56° F lowest temp; [Marginal note: Clear, open sky all night; could really feel it.]; a large ♂ tortoise was burrowed way into a clump of the large Juncaceaeoss (spelling) like stuff (which is common around the low wet areas around the Caseta) when we got up at 0600; only his very rear end was exposed and he did not move till 0830 even though the sun was hitting his rear end from a little after 0600 on - completely clear, sunny day so far (0930 now).
1900 was clear and sunny all day with only light scattered cumulus clouds. Very pleasant except that I punched a hole in the fly for the tent being a bit overzealous in putting in a few grommets - thus we had to sew some grommets - what a bitch of a job that is!! (Pg 127).

Otherwise we worked on camping facilities and got the tent and fly in final, good condition. Weather data - Max 84˚ F; Min 56˚ F; Evaporimeter - 28.9 ml (= 3 ml in 24 hr); Rainfall - 0.0 mm; sky is clear now and can really feel the cold outside of the tent.
5 Oct 1969
0700 cloudy upon arousal at 0600 with heavy dew - not sure when it set in but min temp was 57˚ so I could guess it was clear for a good part of the night.
1200 stayed cloudy till just now - now clearing and becoming bright and sunny.

1900 - was clear till sunset and still is largely so - noticed a large ♂ tortoise already burrowed in at 1630 hours just below the Caseta and another (#274 ♀ in the Pond (#1) below the Caseta moving around slowly at 1645. Found ♂ #31 asleep in the middle of a tortoise trail near the Linblad restrooms at 1700 - perhaps these early retirings are related to the cold nights, even though the sun is still out and quite pleasantly war. Put up the radiation shield today at the Caseta to cover the max-min and evaporimeters - looks at if it may give good protection from 0900 -1500 at most. But probably adequate. (Pg 128)
Max 80.0˚ F; Min 57˚ F; Evap. 3.0 ml, now reading 1.6 ml, but changed (filled) at 1200 when had just reached 30.0 ml (was 28.6 last night at 1900). Rainfall 0.0 ml.
6 Oct 1969. (Caseta weather: rainfall 0.0 mm, evap 4.2 ml (reading 5.8); max 81˚; min 56˚.
Came down to Zone 3 nesting area, leaving Caseta at 0600 and arriving a few minutes before 0800. Main purpose is to record temperatures from thermocouples.
Was clear at dawn and remained so on S side of the island till 0730 - about then a cloud bank moved in and obscured the sun rather thoroughly. On my way down I saw eight tortoises along the trail, in all zones except #7 (Nesting Area). All were still resting for the night when I passed at varying times between 0600 and 0800. I did notice that those in region 1, 22, and 3 seemed to be more burrowed into the veg than those in lower zones - this is (Pg 129) . . . tantalizing with regard to nighttime low temperatures but the sample size is too small to decide much; also the soil is more abundant deeper, more damp, and softer and the veg more luxurious at the higher altitudes and thus may account for a greater relative ease to construct these nighttime retreats.
Started taking measurements at 0800, and am doing so each hour at both nest #9 and #12 (for temperature). Am taking moisture readings only every 2 hours as I doubt there will be much change - weather conditions are noted below.

Time	Weather conditions
0800	Completely cloudy and cool
0900	Cloudy almost all the time - sun peeks out occasionally.
1000	Sun coming out now and then but cloudy majority of the time
1100	Between 1030-1130 sun out off and on, but out most of the time
1200	Sun out full; occasionally shaded for a few minutes, but looks as if will remain out for the afternoon - has been out almost all the time since 1100-1130 period
1300	Bright and sunny - very few scattered, thin clouds.
1400	Same as 1300
1500	Same as 1300 and 1400, but scattered cumulus (thin ones) are moving in more heavily now and will probably start resulting in more shade the next hour. (Pg 130)
1600	Bright and sunny; clouds never amounted to much; occasionally sun is somewhat shaded but only very slightly and briefly.

1700 Still clear and bright, but of course sun's intensity strongly slacks off around 1630 - sunset at 1800.
1800 - From 1730 - sunset (1800) sun partly obscured about ½ the time, but little effect anyway since solar input is so low for last 1-1.5 hr anyway.
2000 - Clear, star-strewn night so far; humidity feels high, but no dew or garua yet.
2200 - Same as 2000.
0600 - Next morning - clear; sun arose about 1600; was cloudy just before sunrise, but because so sometimes between 2400 and 0500; lifted and blew off quickly about 0530.
0800 Still clear and bright
1100 – leaving; has remained clear and sunny almost all morning except for occasional shading by cumulus clouds but only for a few minutes at a time. Looks as if will remain sunny all day. (Pg 131)

Nest #9 Switch #1, thermocouples in the nest

Time	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	2000	2200	0600	0800
Position															
1	22.0	26.1	32.0	39.2	43.5	45.9	45.3	44.0	39.5	34.7	32.1	27.0	24.1	19.4	20.8
2	21.0	23.6	27.6	31.1	36.0	38.9	40.0	39.7	37.5	34.5	32.5	28.4	25.6	20.7	21.3
3	22.0	22.5	23.9	25.1	27.7	30.0	31.5	32.7	33.3	33.1	32.5	30.5	28.4	23.5	23.0
4	25.0	24.5	24.2	23.7	24.1	24.9	25.5	26.1	27.5	28.4	29.1	29.5	29.3	26.3	25.7
5	25.3	25.0	24.8	24.0	24.4	24.9	25.3	25.9	26.8	27.6	28.3	29.0	28.8	26.6	25.9
6	26.0	25.8	25.5	25.0	25.1	25.2	25.3	25.4	25.8	26.2	27.0	27.5	27.7	26.9	26.3
7	25.6	25.5	25.5	25.0	25.1	25.0	25.3	25.4	25.8	26.6	27.0	28.0	27.7	26.9	26.3
8	26.2	25.9	25.6	25.4	25.5	25.0	25.3	25.4	25.8	26.0	26.5	27.2	27.1	27.0	26.3

(Pg 132)

Nest #9, Switch #2, control - (in soil beside nest)

Time	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	2000	2200	600	800
Position															
1	23	28.4	34.5	42.5	49	50.2	50.3	46.5	35.7	31.5	29	24.6	22	18.5	23.1
2	22	26	31	37.2	42.3	44.4	45.1	43.4	36.3	32	30.4	26	23.7	19.5	22
3	21	23.9	27.4	31.5	35.8	38.3	39.5	39.3	35.8	32	31	27.5	25	21.1	22
4	22.2	23	23.2	24.9	26.8	28.6	30.4	31.5	31.9	31	30.7	29.5	27.9	23.9	23.3
5	24.6	23.8	23.4	23.8	24.5	25.4	26.4	27.5	28.3	28.7	29.1	29	28.1	25.5	24.5
6	24.9	24.8	24.4	24.3	24.5	24.8	25.3	26	26.4	27	27.5	28	27.7	26.3	25.4
7	25.4	25.4	25	25	24.5	24.8	25	25.5	25	259	26.5	27	27.2	26.6	25.8

Nest #9, Switch #2, control - (in soil beside nest)

Time	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	2000	2200	600	80(
Position															
1	22.4	25	33.3	40	42.6	48.1	43.6	38.2	31.8	29.1	27.4			17.9	21.5
2	20.5	22.5	27.4	32	36	39.6	40.5	37.6	33.6	30.9	29.9			19	2(
3	20.3	21.8	25	29	32.3	35.7	37.5	36	33.6	31.2	30.5			20.4	2(
4	20.7	21.5	22.5	24.9	27.5	30.3	32.8	33	32.8	31.2	30.7			21.5	21.5
5	21.5	22	22.1	23.2	25.3	27.1	29.2	30.2	30.5	30	30.2			22.9	22.5
6	22.7	22.8	22.5	23.4	24	25	26.9	27.5	28.4	28.7	29			24	23.4
7	23.5	23.6	23.2	23.1	23.5	23.8	24.5	25	26	26.5	27.2			24.6	24.3

Note: readings at 2000 and 2200 omit for later hours - difficult to find in dark.

Pg. 134

These readings are, of course, not all being taken simultaneously, but in sequence - the sequence is standardized and is as follows-

Nest #9, switch 1 - the hour - 5 minutes after

Nest #9, switch 2 - 5 minutes after - 10

Walk from one nest to the other - 10-20

Nest #12 - 20 minutes after - 25 minutes after

Moisture measurements in nest #12

Time	0800	1000	1200	1400	1600	1800	0600	0800
Cap	22%	22	22	26	28	25	19	19
Eggs	56	56	56	59	60.5	61	61	57.5

While taking measurements and observing the sun all day long, discovered that all three probes become shaded earlier than we had anticipated. That in Nest #12 becomes shaded at about 1530 hr and remains so the rest of the afternoon. Probe (- switch) #2 near Nest #9 becomes shaded at 1600 and Probe #1, Nest #9 becomes shaded at 1615. This is at first glance problematical but except for the difference in timing for the three probes, I do not think that this is unrealistic and unnatural because of the rock wall for (Pg 135). . . the following reasons.

1. From about 1700-1715 till sunset at 1800 the sun is so low that no light would hit the nest even if the were exposed completely. During this period almost no light hits the ground; that getting there being only small "sun flecks".
2. From 1530 on, the sun is low enough such that some of the trees begin (Bursera, Piscidia, Cordia) casting long shadows, such that even some completely exposed (and previously used for nesting in recent years) areas which could contain nests become shaded at this time.

These same comments probably apply to 0600-0700 in the case of comment (1) and 0700-0830 in the case of (2). Therefore the maximum potential direct solar radiation being lost by the nest surrounded by wall is worst in the consideration and yet it amounts to no more than 3 hr per day; in addition these 3 hr are hours of weak light and not strong radiation. In the particular case of Nest #12 the actual potential loss is less I'm certain since it is rather well shaded by trees on its E side. Will add more comments to these later, especially in reference to the morning hours. (Pg 136)

Examined evaporimeter at 1200 and at 1600. At 1200, it was reading 15.0 ml. (at 1200, Oct 3, started it reading 1.6 ml at that time); this makes an evaporation total of 13.4 ml for a 3 day period. At 1600-1630 set up radiation shield and refilled evaporimeter full - was reading 18.5 ml when changed H20 at 1630. At 1900 this evening - no rainfall; evaporimeter reading 0.5 ml. ; i.e. total since Oct 3 1969, 1200 hr is rainfall - 0.0 mm; evap 17.4 m.

7 Oct 1969 - 0830 Arose and took follow up readings at all three probes at 0600 and 0800; clear and sunny this a.m. with no cloud cover or interference yet. In sum, I think yesterday, and the day before (Oct. 6, 1969 and Oct 5, 1969), were very similar so that the 24 hour curves in this nest would be very much alike - although I was not in the Zone 3 nesting area on Oct 5, we could see from the Caseta that it was a clear sunny day all the (Pg 137) way to the coast and virtually all day long except for some scattered clouds in the first 6 hr after sunrise. This is precisely what it was like on Oct 6 at the nesting area, the only difference

perhaps being more cloudiness from 0600 till noon on Oct 5 - in other words the days were not equal but at least similar - Oct 6 was probably the warmer of the two and it had more clear solar input (noon - sunset for Oct 5 vs. 10:30-1100 - sunset on Oct 6).
The nest and soil temperature curves seem to reflect this similarity if one looks at the whole day of Oct 6 and then compares the 0800 temps on Oct 6 with that of Oct 7.
This type of day is probably not excessively common during the garua season, but occasional spells of 3-5 days with clear sunny weather of from ½ - all day do not seem too rare - i.e. we had one such period in late August and another one now (see notes for Oct 2-7, for Caseta & Zone 3 N.A.) and perhaps there were some in between. However the long overcast spells with some garua is probably more the rule, as witness the past weeks (Chappy says it rained at the Caseta all week of Sep 22-29) and from the CDRS this seemed true of both that period and the previous week if the cloudiness and grayness in the highlands can be used as a guide. Also note rainfall of 0.56" on gauge at Zone 3 N.A. on Oct 3 (from Sep 5 - Oct 2). The question remains (Pg 138). . . . however as to how much difference there is between Zone 3 N.A. and the Caseta. It would seem likely that it clears in the former much more often and the weather records certainly show less rain and more evaporation there for the month of Sep, 1969 than at the Caseta.
Also, I confirmed my prediction about the shading of the nests:
1. From 0600-0700 sun is so low that the nests don't get any light anyway.
2. From 0700-0830 the tree cast fairly long shadows, some of these falling on nests and potential nest sites.
3. Nest #9 switch 1 is first hit by direct sunlight about 0815; switch 2, a little before 0800; Nest #12 probe, about 0830.
Yesterday while roaming through nesting area between taking of temperatures I noted a number of sites where tortoises had attempted to dig nests, but all had ended in failure because of underlying rocks near the surface. I am certain these (Pg. 139) attempts have all been made since Sep 3-5, 1969 when we were last here because the same areas were looked at then and were devoid of such diggings. Only one of these looks as if any cloacal H20 was used, and it also was not completed, being at deepest only about 5-6". All the rest were very shallow; these sites were all between Nests #12 & 4 and the area around Nest #2.
Also saw 4 tortoises in the nesting area- all small and all just moving about slowly and eating -
1. #1055 (♀ probably) near Nest #4 - moving SE (she was in same general area on Oct. 3).
2. #1157 (new marking) (♀ probably) CL 58.5; CW (CDRS) - 64 cm; CW VanDenburgh 60.5 cm;
3 & 4. Also saw two others which did not identify because taking measurements - they were both about the same size as the above two. At 1115 Evap reading 2.3 ml - i.e. total since Oct 3 at 1200 is 19.2 ml.
[Marginal note: no rain since Oct 3]
At 1115 departed Zone 3 NA for the Caseta, having completed measurements and protected and hidden the instruments. Before leaving I implanted two soil blocks in the ground just beside (but outside the wall) Nest #12 (W of it) to serve as a comparative control of those two in the nest itself. These two were put in at the same depths as those in the nest - namely 14 and 5 cm. I implanted them by digging a straight columnar pit and then put them into the side of the pit, thus avoiding excessive disturbance to the soil; then refilled the pit (Pg. 140) . . . . with soil in the same order in which it was extracted, occasionally tamping it down to provide some extra packing similar to the original condition. Took some altimeter readings during 2 hr trek up to the Caseta - with Thommens - weather same all the way: Zone #3 NA - 160 ft; Region 6 big boulder area 200 ft; Region 4 - central - 240-50 ft; large open area, Region 2/3 border - 470 ft; Caseta Pond #1 520 ft; Caseta 660 ft.
These match up fairly well with altitudes decided upon on Oct 3 1969 and these show about 20-30 ft too low though the Region 2-3 border area and 10 ft too low for Regions 2 and 3; perhaps these are however all deviating same amount - if so will have to revise altitudinal limits a little for Regions 2, 3, 4, 5, 6, probably. Perhaps 2 should be 480-530 ft and 3 should be 300-480 ft, 4 should be 270-300 ft, and 5 240-270 ft, and 6 190-240 ft. (Pg. 141)
Saw the following animals on the trip.
Region 6 - Big boulder area (230-235 ft) #1151 - same area as on Oct 3, 1969.
Region 4-3 border - 290-300 ft - #62 ♀ CL 67.5 cm.; CW (CDRS) 73.5 cm.; CW (Vdenb.) 68.5 cm; She has come down considerably since saw here near trail in steep ascent part of Region 3 on Oct. 3 1969 - Took a reading in exact spot where she was on Oct 3 - about 380-390 ft (could identify place because of condition of trail caused by large ♂ on Oct. 3 - see previous notes).
Region 4-3 border - just above #62 ♀; ♂ #104, very large; on trail, resting.
Region 2 - just above 2-3 border (about 0.1 km I guess) - ♂ #216, at about 490 ft; he is up considerably from the other day and verifies that one can't judge direction of movement from the way in which an animal

is pointing in the trail. This animal has clearly been using the trail to ascend - can see swath for several hundred meters.
At Caseta pond #1 - #274 ♀ feeding just to E of pond
#645 (♂ prob - difficult - in between length) feeding in trail just above pond
At Caseta - near tent - #73 ♂
#31 ♂ (he was at Lindblad toilets on Oct 5 1969) - moving around Caseta area considerably - (Pg. 142)
Went down to Pond #1 at 1700 just for fun - found (1715) a large ♂ #376 (maybe 372 since 4 mark is difficult to decide upon) feeding in trail halfway to pond - 200 m down trail from Caseta. On return at 1730 he had burrowed in.
On Oct 6 Jan noted a large ♂ which burrowed in at 1630 hr for the night (it was a clear, sunny, but windy day all day) and saw him become active at 0745 the next morning.
Caseta weather - another clear, sunny day all day;
1900 - clear, starry night; Max 80.5˚; Min 58.5˚; Evap 1.8 ml (reading 7.6 ml); Rainfall 0.0 mm. (Pg 143)
8 Oct 1969 - Completely overcast this morning, a bit gusty, and actually feels chilly (although the temp is near 70˚ F).
We are going to the Zone 1 pond area to mark trails and look things over.
#307 ♂, only 150 m below Caseta on trail
#444 ♂ (was at Caseta on Oct 1, 1969) On trail just 50 m above Caseta Pond #4, toward Caseta - moving along trail.; CL 100; CW 108.5 (CDRS); CW 101.5 (V) White growth increments very nice and noticeable. Jan photographed these - Roll #19, photos #23 and 25.
In area 2 mi from Caseta, 570 ft, where we saw ♀ #268 on Oct 1 1969 - furthest E sign have noticed till Oct 1. Got distance by using pedometer set at 2.5 ft gait and following trail all the way -
#248 ♂ in path sleeping; same area white growth rings very noticeable. Correction on furthest east business - large ♂ tortoise was just at turn - off to Zone 1 ponds along Reserve border - directly N of these ponds - this was on Oct 3 1969. Distance is 2 3/8 miles from Caseta. (Pg 144)
Went down trail to Zone 1 ponds - #1 is at 560 ft and is about 0.5 mile directly S of the Reserve border - along trail and at point mentioned above. No tortoises visible here today; two pintails on the pond and it is absolutely totally covered with Azolla. It is about 40 m N-S by 25 m E-W and is sort of oblong, but has an irregular border.
#2 is about 0.5 mi. SE of #1 and is at 540 ft. It is about 50 m x 20 m. and is quite oval in shape and is surrounded by a thick and tall stand of Rodilla de Caballo; whereas #1 had only a very low stand of this plant 1-2 m, they stand 3-5 m high all around Pond #2. [Marginal note: no tortoises today- one on Oct 2] It has no Azolla and is quite full of H20 now (although I'm sure it can hold much more in the rainy season).
#3 is about 0.5 mi. directly S of #1 at an altitude of 520-525 ft - it is about the same (Pg 145) . . . size and shape and directional situation as #1 except for a small "teat" on the S. end. It has Azolla only in this little nipple of an area the rest is clear and it has abundant H20 in it. It is open on the entire E side, having only manzanillos and herbs. The other sides, however, are walled up by R. de Caballo, as in all around #2 and most of #1.
No tortoises here today but was one on Oct 2 and there is one approaching now (can hear him lumbering along in the brush).
Saw 2 other animals - #333 - [marginal note: ♂ prob but could be large ♀) - same location as on Oct 2 - using this little small pond area (where is no standing H20) to make great mushy, muddy wallows and feeding on grass on its bottom.
#636 ♂ - same general area - bit further S toward pond #3; feeding on grass.
The areas around all these ponds are densely covered with plant #1 in great luxurious abundance - there is much open area - perhaps 80-90% in some portions - these open areas alternate with little patches of guayavillo - Scalesia forest (mostly guayavillo and only scattered Scalesia). The whole area reminds me of that between the Caseta and Caseta Pond #1 very much both in altitude, vegetation and general (Pg. 146). . . . topography - although the slope is less sharp here.
Return - Caseta Pond #4 - large ♂ #220 near it; eating grass; there is some shallow H20 in a few little holes near this pond. This ♂ was just up the trail a few hundred meters from here on Oct 1 1969. He has good white growth increments along the scutes also. CL 120.5 cm; CW 143 (CDRS); CW 132 (V). Have been noticing that many animals of virtually all size classes (and both sexes) when can distinguish) are showing these white increment lines along the borders of the scutes; especially noted it in the "60 cm. CL" sized animals seen in the Zone 3 N.A. on Oct 6 and 7 and between there and Region 4 of the Zone 3 - Caseta trail. Also noted today in the medium-large sized ♂♂and fairly large sized (Pg. 149) ♀♀ we have seen.

Will be interesting to see if this is a year long phenomenon or seasonal and whether or not the largest ♂♂ and ♀♀ show such things very often. Checked some map distances and put in Zone 1 ponds on the map - have put in trail to Caseta and Zone 1 pond trail from border. Distances are more or less correct as shown on map. The border beyond the Caseta trail turn off (running W) and cut up to N-NE where trail again crosses and continuation of this beyond this point and cut to NW where trail above Caseta hits border are all more or less closed now. Apparently not maintained because Caseta trail accomplishes the same.
Caseta weather for today: 1900; Max 78˚; Min 62˚; Rainfall 0.0 mm; Evap 3.3 ml (reading 10.9)
Was very overcast when we arose at 0600 and remained so till about 1430-1500 - then sun out off and on (out majority of time) till 1700. Then out till sunset at 1800 - sunset with completely clear sky and remained clear till at least 2200 when I went to sleep. (Pg. 149)
9 Oct 1969 – Feliz 9 de Octubre!
0700 - left for Chato; gray and totally overcast at sun's arousal and remained so still.
#307 ♂ [really moved since yesterday maybe 0.4 km] - just above Caseta at border.
#305 ♀- just along border a bit
#97 ♂ - a few hundred meters into mora.
#106 ♂ - 3/8 mile along border from Caseta trail intersect; alt is 790 ft.
Alt of place where large ♂ # ---- was grinding up veg in late August is 800 ft. The area he disturbed is 5/8 mile from Caseta trail intersect and is now almost all re-grown over with a luxuriant mass of Passiflora and grass.
From this pint to about 2 7/8 miles saw no sign of tortoises - i.e. about 1 ¾ miles of no tortoise sign. Those we have . . . (Pg 149) seen appear to be working out either from the Caseta area or the El Chato area respectively along the reserve border - Actually have not seen any in the Chato area but from the point mentioned above which is quite near the Chato "turn- off" toward the turn - off there have been quite a few trails and burrows near and crossing the border.
The turnoff is at 2 13/16 miles beyond the Caseta trail border intersect and the altitude here is approximately 790 ft or so.
Found♀ #320 (maybe ♂?, medium tail) [marginal note: could be a large ♀] just beyond turn off in mora.
From here followed border directly toward Naranjo - soon left mora and went into Forest of Guayavillo and Scalesia like El Chato - lots of lianas an bromeliads-
At 9/16 miles past El Chato turn off encountered some sign of tortoises. Altitude here is about 725 ft.
At 5/8 miles again, some sign of a rather large tortoise - then soon saw a very large ♂ #155 in an open area of grass under some large guayavillo (measurements CL 133; CW 145.5; 132.5; see page 154) [he had no visible white increments along scutes and shell is very smooth] - he had clearly been grinding up the area and grazing a lot for an acre around .
At 1 3/16 miles again some sign of a very large tortoise but no animals seen. Naranjo is at just about 2 3/16 miles pats the El Chato turnoff - it is very open - for several acres around with much scattered medium sized guayavillo and luxuriant stands of plant #1. The altitude read about (Pg. 150) . . . . 605 ft, which would equal 745 ft if the deviation of this morning at the Caseta still holds. [Corrected to 670 ft (see page 157)]. Will check this on later trips and this afternoon. Anyway the area is very reminiscent of that around the Pond 1 area below the Caseta, but a bit more dry, probably due to the more westerly location. There is a circular pond of about 20 m diameter which is full of small boulders, grass and a little drying Azolla. It is dry now, but about 1 month ago [Marginal note: actually Sep 19 1969, 20 days ago] Julio says it has a little H20, plenty of mud, and quite a few tortoises around it. Have seen no tortoises in the region yet, but some trails and drying droppings.
The pond and area around Naranjo are even more similar to those ponds and areas around the eastern and northern base of Chato in terms of their present condition and vegetation; the (i.e. Sep-Oct.) (Pg 151) main difference being that there is more open area at Naranjo and it is drier. Walked around a little in the area and discovered some fairly fresh droppings and trails which must be less than one week old or so. In my general impression is simply that the animals are spread out quite a bit as everywhere else now.
Proceeded directly SW of Naranjo area to Zone 4 (only a 15-20 min walk) and saw many fresh droppings and crisscrossing trails all the way down.
Saw one tortoise at about 3/16 of a mi along this trail - large ♂ #534 about 80 ft below Naranjo in altitude [Marginal note: 590 ft]. The Zone 4 area is very open and covered with much plant #1 and scattered guayavillo; mixed in with the plant #1 are large amounts of grasses and sedges, and often the latter from large masses and patches purely by themselves.

There are a scattering of small low areas with rocky beds which are now covered with grasses and sedges and are dry - however these obviously contain H20 when it is very rainy. The plant #1 is a little less luxuriant here than at Naranjo and the water holes are drier. In general it is a drier area than that directly above as would be expected. The altitude is about 85 ft below that of Naranjo [Marginal note: 585 ft] and the distance is about 5/8 of a mile directly SW (however the trail twists a bit). (Pg. 152)
Went a little below the open areas of Zone 4 and encountered more galapagos' trails, droppings, and burrows; also areas of grass clipped down close to the ground by tortoises. Found a very large ♂ #580 here. Has a rather smooth shell on top and part of sides, but can still see growth rings on lower costals and marginal scutes and some white growth increments are visible along the borders of all the scutes, but not as strongly noticeable as in smaller animals. CL 128.5; CW 139.5 (CDRS); CW 128.5 (V)
Another a bit further on - 50 m or so - ♂ #254 (could be 654 but chipped probably) ; CL 126 cm; CW (CDRS) 138; CW (V. Denb.) 127.5; shell much as in previous animal but white growth rings very noticeable and clear along all scute edges. -
Back in Zone 4 open area - unmarked ♀ (large one) new number #1158; (Pg 153) faint new growth (white increments) on her along scute edges, but not pronounced; however old growth rings still well developed on all scutes - not smoothed much at all or worn. CL 104; CW 111.5 (CDRS); 104 (V).
Back at Naranjo, wandered around a little and found a fantastic lava tunnel which is partly collapsed and has some very nice ferns in one lighted portion which forms a tunnel that is broken in on each end. There are remains of former fires in the area under this tunnel which forms a rather nice natural shelter (given that it does not rain 30 inches /month). Also sign of pigs and a pig skeleton near the fire area.
Much of the Naranjo Zone has nice guayavillo forest (with mixed Scalesia) around it and in areas where the canopy is thinner (30-35%) there is a lot of open area on the ground covered with a lush growth of passion flower (it is still flowering here and there, by the way).
Found a large ♂ only 200 m from the Naranjo pond in this passion flower covered forest floor - in fact is eating the plant - #760 ♂; has very nice white growth increments between the scutes. Measurements: CL 112; CW (CDRS) 122; CW (v.d.) 112.5 (Pg 154).
The Naranjo forest is very similar to that above the Caseta near the Reserve border and that around the trail into El Chato from the Reserve border "turn-off". There are some areas here where the tortoises have clipped the grass down very low in typical fashion.
Took measurement on #155 on return. CL 133 cm.; CW (CDRS) 145.5 cm.; CW (V. Denb.) 132.5 cm.
A tortoise just to N of Chato - in mora feeding - #621 (probably a ♀ but has an intermediate length tail) reason think it's a ♀ is size is large for ♀, but only medium for a ♂, yet the shell looks very old and worn; however she has a fantastic case of the white crumbly scute condition which may be a fungus- perhaps this is why the shell looks so worn and deteriorated; the carapace scutes are not worn smooth as (Pg. 155) . . . often is the case with very large old ♂♂ (e.g. #155 above). She has faintly detectable white increments along the carapace scute borders- CL 89 cm; CW (CDRS) 94.5; CW (VD) 89.
She had a live land snail riding along on one of the costal scutes and I collected it for identification.
A tortoise at Chato turn off and Reserve border intersect. - in mora in open feeding along and mowing a path - #549 ♂, very large - scutes mostly worn but growth rings evident at edges and white increments are visible but not extremely distinct. Has dried red mud on forelegs like those around Chato ponds - perhaps recently there? CL 140.5 cm; CW (CDRS) 156; CW (V>D.) 146.5
#144 ♂; quite large; near pond at El Chato turn-off. Very smooth shell but white increments very clear and large; CL 130; CW (CDRS) 144.5; CW (VD) 134. Carapace scutes do have a very tiny closely adpressed growth rings around borders.
Pond has mud in it and tortoise wallows are abundant. In late Aug it was dry, completely.
Just beyond pond on border (toward Caseta) - ♀ #1059; nice white growth increments but they are not too large. She has red mud on legs as if has perhaps been at El Chato ponds - CL 95 cm; CW (CDRS) 102; CW (VD) 92.5. Just a little beyond this and off of the border a bit ♂ #445 (or 405), 40 mark is poor)
Very large, with very smooth shell and only faint white increments (Pg 156). . . . along scute edges - some areas along the edges lack this growth insignia - CL 136.5; CW (CDRS) 151.5; CW (VD) 137. He has thoroughly smashed down an area of grass and Passiflora and is still grazing along. The area must cover at least 100 square m or so. This is in the edge of the mora.
On return saw #106 ♂ about 2/8 mile further along toward Chato than was this morning - clearly using trail and eating grass in it.
Also #97 ♂ about 3/8 mile into mora now - has probably moved ¼ mile -

1600 hr - These animals both active in afternoon sun, fully exposed. Sun has been out only off and on since noon and would be interesting to get an idea of how long they can withstand such exposure.
On return from Naranjo, checked a series of altitudes with the Thommens again - the weather changed almost none on the return and therefore I think these are accurate and can correct them (Pg. 157) using Caseta as base, with altitude of 670 ft.

Time	Location	Alt. Reading	Corrected to Caseta
1230	Naranjo	660 ft	670 ft
1430	Area where #155	715	725
1450	Chato turn-off	780	790
1600	Caseta	660	670

Again overcast when arose today at 0600; remained so almost all day, but occasionally a few minutes of sun at a time from 1200 to 1600; sun out and clear sky from 1600 till sunset. Still clear sky and beautiful starry night now (1930); heavy dew setting in already whereas last night no dew at all.
(Pg 158 unnumbered)
10 Oct 1969
0600 Arose- again overcast day completely, after a nice starry beginning of a night.
0640 - Left for Puerto Ayora and CDRS to see Sr. Black; when left Caseta Thommens read 600 ft. Will check some distances (pedometer) and altitudes on the way -
1. Corner of reserve N-S and E-W borders - about 4.5 miles beyond the Zone 1 trail - border intersect. =5 7/8 mile from Caseta.
2. Trail to Aldas is 75-100 m below this corner in distance, on the N-S running line.
0810 - 3. Only 1/8 mile from the corner is the river bed k- alt. Now says 480-490 ft on Thommens ; therefore probably really is 550-560 ft using Caseta as base reference).
4. Saw no definite tortoise sign along trail any further east than 3/8 of a mile past the Zone 1 turn off. #284 ♂ in same area as O)ct. 1, '69.
5. Point which I think is junction of N-S border line and trail to main camino Alt. Reads 310 ft; distance from 1 above - 2 13/16 miles.
6. Main camino - distance from 5 above is 3 15/16 miles - Alt. Reads 170 ft. CDRS Lab - total dist from Zone 1 turn off - 15.5 miles.
Therefore total distance to CDRS from Caseta is 17 7/8 miles.
(Pg. 159 unnumbered)
Rainfall at the Caseta based on book there:
1967

July (last 5 days only) -	0.31 inches = 7.87 mm
August - total -	2.18 inches = 55.42 mm
Sep - total-	2.30 inches = 58.42 mm
Oct - total	2.47 inches = 62.74 mm
Nov - thru 23rd only	1.82 inches = 46.23 mm
Dec - total -	2.49 inches = 63.26 mm

1968

Jan - total -	1.61 inches = 40.89 mm
Feb - thru 26th only -	3.035 inches = 77.09 mm
Mar thru 29th only -	1.91 inches = 48.51 mm
Apr thru 19th only -	0.00 inches = 0.00 mm
May - total -	0.9 mm
Jun thru 15th only -	1.8 mm
Jul - total -	105.08 mm
Aug total -	203.1 mm
Sep thru 28th only -	110.7 mm
Oct thru 27th only -	53.7 mm
Nov thru 29th only -	76.6 mm
Dec thru 29th only -	88.0 mm

(Pg 160 unnumbered)
1969

Jan - thru 30th only	64.5 mm
Feb - thru 26th only	161.8 mm
Mar - total -	730.6 mm
Apr - total -	100.9 mm
May - thru 23rd only	155.3 mm
Jun - total -	130.6 mm
Jul - thru 30th only	33.4 mm
Aug - total -	12.0 mm
Sep - total -	62.8 mm
Oct - total	16.85 mm
Nov - total -	42.8 mm
Dec - thru 30th only	67.1 mm
Total	1578.65 mm

Devine's 1969 - monthly totals

	Inches	MM
Jan	3.07	77.98
Feb	6.11	155.19
Mar	36.35	920.75
Apr	3.17	79.50
May	8.45	214.63
Jun	5.80	147.32
Jul	1.66	42.16
Aug	0.54	13.72
Sep	3.58	90.93
Oct	0.89	22.60
Nov	2.08	52.83
Dec	3.31	84.07
Total	74.87	1901.68

Editorial note: loose sheet in back of this notebook contained various camp recipes (muffins, pancakes etc.) and a few misc. notes on tortoises that are undated and hence not entered in this file.

Isla Santa Cruz Notebook #4
Field Notebook of Craig G. MacFarland

Oct 1969 – Nov 1969
(Pg 1)
10 Oct 1969. Continued—
Jan took weather at Caseta this day while I was at CDRS.
1900: Rainfall—0.0 mm; Evap.—2.5 ml (reading 17.0); Max—84.0º F; Min—57º F

11 Oct 1969
Returned to Caseta—using a fresh unused pedometer, checked a few distances—
Zone 6—2 5/8 mi. from Caseta on trail
Zone 1—2 1/8 mi. from Caseta on trail
Turn off points along Reserve border.
See 8 Oct notes (Book #3)—got distances of 2 3/8 in to Zone 1 t.off—Caseta—perhaps due to other pedometer being rather beaten up.
About exactly ½ way between these 2 turnoffs saw ♂ #753 (rather large) on the trail—this is the furthest E have actually encountered an animal.
Weather at Caseta—1900 hrs.
Max—82º F; Min—63.5º F; Evap.—4.1 ml (reading 21.1); Rainfall—0.0m.

Jan saw #376 ♂ retire on 10 Oct at 1730 hours by burrowing into the base of a clump of vegetation; then the next morning the animal became active at 0735; both these days had cloudy, overcast mornings up till about noon, but were warm and sunny in the afternoons until sunset.

(Pg 2)
12 Oct 1969
Just taking it easy today and collecting plants and making some general observations. We went down just below Caseta Pond #1 to look at what we think may be a rail (Nesocrex) nest. In the process we circled the pond and observed a few tortoises. The following animals were noted:
0800: #376 ♂ just below the Caseta about 30 m; off of the trail, active and feeding.
0820: #1006 ♀ halfway between Caseta and the pond, resting in a brief moment of sunlight in the trail.
#102 ♀ on the S side of the pond; dried mud on shell; has been in pond or wallow recently probably.
#390 ♀ W side of Caseta Pond # 1—about 30 m from pond, feeding on grass.
#885 ♀ ½ way between the pond and the Caseta, just coming onto the trail.
My general impression of this area after this brief sampling and

(Pg 30)
*Note: Caseta Pond #1 down at least 5-10 cm since late Aug—early Sep.

from looking at the trail, burrows and droppings in the area is that perhaps there is a slightly greater concentration of animals and use of the area now than when sampled in late Aug—early Sep. There are certainly more animals around the very immediate few acres of the Caseta and along the mora portion of the Reserve border between the Caseta and El Chato now than in that earlier period.

Finally, this afternoon went up to Pond 2 and 3 area above the Caseta—the open area just below these ponds, the area immediately around the ponds, and the area in the woods just E of these ponds has definitely been used much more just recently than when sampled in late Aug-early Sep ’69. The entire area is crisscrossed with trails, and dotted with many night-time burrows and droppings. This is all very fresh and certainly has occurred within the past 2-3 weeks at the latest. It of course could be due to no more than 4-5 animals, but at any rate in

late August the area showed evidence of at most 1-2 animals. Also the 4 animals seen along the trail from Caseta to the border and the first part of the border in to the mora on Oct 9 indicate more activity in this area. Today saw the following animals in the areas around the ponds and just below them and on the trail up: [Marginal Note: Ponds here and #1 below Caseta are drier--#1 and #2 about 3-5 cm lower; others above Caseta all dry.]

(Pg 4)

#505 ♂– just above Caseta at about 150 m—on trail.
#258 ♂-- just below ponds in open area.
#688 ♀--smallish-medium in size—in most easterly, dry pond area of the ponds
#608 ♂ Just beside pond #2.
#305 ♀--same area as on Oct 9, '69.
Has been overcast and cool since arousal at 0600 (was overcast last night also). Sun was out for a few 10-15 min periods in the morning but not at all this afternoon. Garúa finally began again at just about 1500 and rained steadily till 1630. Noted something of great interest: #376 ♂, which had been active around the Caseta all day burrowed in under vegetation just 5-10 min after the garúa started (see notes on activity periods during sunny days of last 10 day period and for this particular animal on

(Pg 5)
Oct 10-11, 1969.) Also large ♂ #31 had been active around our tent all day and I had last seen him feeding there at 1400—when saw #376 burrow in I went to look for #31 (1515) and found him also burrowed in up against some vegetation just W of the tent in an area where he has been burrowing in and active for the last 5-6 days at least. His was not well up under the plants as was #376, but was covered in front ¼ of body and was inactive and asleep. In sum it looks as if the cool garúa may have driven these 2 beasts into shelter after 10 days of nice warm days with sunny afternoons on which most animals we saw were not retiring till about the 1630-1745 period. It would also be interesting to know whether or not the burrows are deeper and more extensive during garúa periods vs**.** clear days/nights—no real data on this yet, but my impression is that the burrows are similar in both situations, only the time of retirement varies.

Caseta weather—1900: Max—82°F; Min—61°F; Rainfall 1.1mm; Evap—1.5 ml (reading 22.6)

(Pg 6)
13 Oct 1969
0800—O. Chappy and I arrived at Zone 3 N.A.; the evaporimeter was totally dry! Filled it completely full at 0845 hours. Also, no rainfall at all in the raingauge. Julio San Miguel had placed good walls of the correct size (1 ½ m diameter and 1 m high) around Nests # 14 and #15. He did this on 8 Oct 1969. Left Caseta 0700, Thommens reading 500 feet; cool overcast day. 0845—2 and 3 N.A.—40 feet (wrong!). Proceeded SSE cutting trail to La Fé (about 150°); about 10 m alt. below Z3N.A. began to pick up a lot of *Opuntia* trees of good, large size (i.e. 30 feet according to Thommens today!)
New #1159—small; probably ♂. CL—56.5; CW—(CDRS) 58.0;CW (V.D.)—54.0
Alt. reads 30 feet; area is mostly palo santo, *Pisonia*, matazarno

(Pg 7)
with understory of croton—very rocky.
At about 10 feet began to see a lot of Jasminocereus trees as well as *Opuntia*, but dominant are still matazarno and palo santo with some *Pisonia* and a heavy mixture of croton underneath—about sapling size at largest, mostly smaller, but forming thick understory. About 0 to –10 feet began to notice that almost becoming a forest of the 2 cacti species, but still a lot of the 3 main tree species and croton still the understory dominant. At –10 turned more directly to SE—just recently crossed westward extension of what to the E is a reasonably high

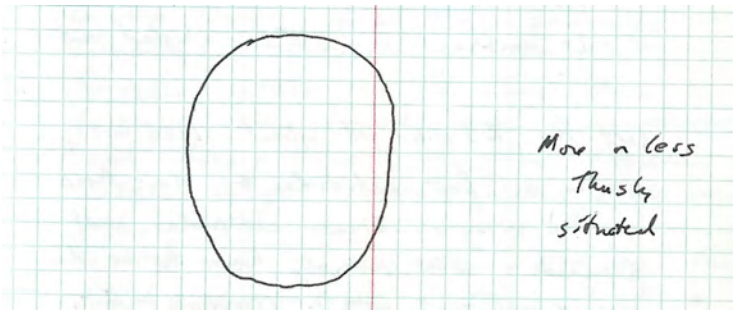
barranco according to Oswaldo C.—very rocky now with large lava piles with little valleys in between. About ½ km after turning more SE, a small tortoise—not marked; only took measures—CL—55 cm; CW—(CDRS)—56; CW (V.D.)—51 (**New #1161)** Resting in shade.
Since turning veg almost entirely palo santo, large *Opuntia*, and large Jasminocereus. However we came back slowly to original direction within 0.25 km. We are now going SSE again.
Am not going to take any more altitudes because they are obviously very incorrect and the weather is changing rapidly and becoming warmer.

(Pg 8)
Went quite a ways further and then turned more directly SE—even a bit more to E than SE and began heading directly for the nesting area we think. Saw a very large female not more than ½ km after turning thusly--#169, but did not take measurements. Finally stopped at 1430 and returned to Zone 3 N.A.—very hot, tired and dehydrated—took 2 hrs. of straight hard walking to get there**.** [Marginal Note**:** Caseta weather**:** Max—80; Min 63; Evap.-1.9 ml (reading 24.5). Rain-0.4mm. Cloudy mostly, sun out a bit now and then.]
14 Oct 1969
Returned again by old route leaving Z.3 N.A. at 0645—took 1 ½ hrs. to reach old spot. On way saw a new small galapago just a short walk above the second one seen; yesterday and about the same size as those 2 seen yesterday which were unmarked—This one also unmarked. [Marginal Note: #1162 See P.13] Location is right

(Pg 9)
near the first of the 2 large carapaces encountered while coming down SSE from Z.3 N.A. (These 2 killed by fishermen; O. Chappy thinks are 5-6 years old). Further on saw an even smaller one (5-7 years old?) about in same general area as #169 ♀ yesterday—also unmarked. CL—40.5 cm; CW (CDRS)—42.0; CW (VD)—39.5.
Only 20 min cutting beyond stopping point of yesterday and we hit the La Fé nesting area!! Wow! Explored it quite a while—1 ½ hrs.—saw only 3 areas where ♀♀ obviously had dug and then struck rock within a few inches and quit. The area is wide open with a sparse cover of small sapling—small tree-sized Croton and very scattered tree cacti of both species; mostly just a solid mass of small rocks and boulders with open areas of bright red "pampa colorado" soil in between—soil areas vary from a few x a few dm to a few x a few m, but in all parts seen, the soil is extremely shallow almost everywhere, forming a layer of only a few cm at most of soil over the underlying plate rocks; exceptions occur but they are few—I expect the ♀♀have great,

(Pg 10)
and arduous times making nests here. But M. Castro has found nests here before and O. Chappy says he found 2 old corrals from last year on his trip here in Aug with J. Villa (see previous notes)—They found no nests then either and only one attempted nest, but he says they saw a few tortoises. So far we have found only one small tortoise, probably a male in the area—resting in shade of an Acacia.
New #1160 CL—58.5; CW (CDRS) 62.5; CW (VD) 58.5.
Strangely enough, while being marked he dropped at least 1 pint of urine! Rather expensive in this hot dry place. Urine was yellow and rather thick in consistency—concentrated. The area in general seems to be about 3-5 times the size of that in Zone 3 and will have to be checked further later with

(Pg 11)
the pedometer—it seems to be oblong in a N-S direction, being not much wider than the Z#3 n.a. is long in a N-S direction—



Will get measurements later. There is a pond at the southerly end, dry now and O.C. says dry in late August, 1969 also; probably only full after heavy rains in rainy season; it is open in the middle and at 35 m x 25 m and surrounded by a solid but sparse stand of R. del Caballo. The bed of the pond is full of rocks and cracked dry brown soil. Also, all around the pampas coloradas areas, small areas of deeper (in color) red-brown soil can be seen mixed in with surface boulders—They are deeply cracked now and indicated that the area in general may be covered with H_2O in really rainy years—at least a shallow layer of water anyway.

(Pg 12)
A few reference points from the center of the La Fé n.a.—
C. Bandera—0°--directly N; Pantado—22°E; La Cumbre—27°E—highest point can see.
Left for Z3n.a. at about 1030 hrs., taking a few altitudes and directions on the way—These altitudes were not accurate and will simply have to be done over and are not worth recording now.
1) Course from La Fé nesting area runs at about 265-285° for a while; just beyond this area becomes very rocky—all lava with variations between low areas and great piles about 20-35 feet higher around these—mostly high areas. Travel on this course for about 1 ½ -2 km. The vegetation is primarily large trees of Opuntia and Jasminocereus with some palo santo and a little Croton underneath all this.
2) Course is about 330° almost entire rest of the way to Zone 3 n. area. It varies a bit from time to time around 320° to 340°, but

(Pg 13)
mostly is 330°. For most of the way is still same general vegetation, but last 2-3 km rises rather quickly to Zone 3 n. area; This rise results in a petering out of the cactus trees; first the Jasminocereus completely disappear and finally the Opuntia give out as large trees and becomes only small ones and scattered only here and there. As this happens begin to get more and more palo santo forest, then a mixture of P.S. and much matazarno and all this has a brown, thick understory of Croton. As P. S. and matazarno increase so do numbers of Pisonia, but there are scattered large Pisonia all the way to La Fé and in no areas are these trees abundant. Will have to describe all this in more detail later. Found 2 small tortoises abutting front to rear in exact place where second one was seen yesterday. It almost looked as if the new one was attempting to mount the one from yesterday, but this is only a speculation as nothing was definitely seen—both had small tails and are perhaps females, but impossible to say**.** [Marginal Note: White increments obvious in #1161 and [they are] there but less in #1162.
New Marked
One from yesterday--#1161 (all measures there)
#1162 CL—57.0 cm; CW (CDRS)—59.0 cm; CW (VD)—54.5 cm.
At 1300 hours and about 300 m SE of the central part of the Z#3

(Pg 14)
nesting area, found a very small tortoise which I would guess is about 3 ½ -4 years old from its size—it was marked, as #1054 (perhaps #1055 but probably only a chip in the shell)—CL 26.8 cm; CW (CDRS)—28.5; CW (VD)—26.5. This animal is in an open area on top of flattish rock and no obvious large boulder piles or other hiding places are close—resting in shade when I arrived and perhaps eating Plant #2. The sun has been out off and on all day—about ½ time out.

#436, large ♀ about another 100 m closer to Z#3 n.a. central part; resting under a tree in the shade.
Z#3 n.a.—checked evaporation of rain when left at 1400. Evap—7.0 ml; Rainfall—0.0mm.
Following tortoises seen on 2 hour trip up—sort of completed run from La Fé, but this is not a good complete sample as all the walking since 1030 was done rather rapidly:
#1151—still Region 6, but about

(Pg 15)
400 m more S of big boulder area—very little altitude drop. #423—exact same area almost (20-30 m. S) as last sighting—on Oct 2, 1969. Border of 4-3 Regions. Region #3—lower part—both—about 100 m. apart—along trail—each off it a bit. # 351 ♀. #933 ♀. Just beside Caseta Pond #1—a bit S, 50-75 m--#216 ♂--up even higher than on 7 Oct 1969; #296 ♀. About 300 m above Caseta Pond # 1 on trail--#368 ♀--also up considerably since Oct 3, 1969 sighting. Also—one burrowed in a bit higher at 1535 hrs.—could not see number and #31 ♂ feeding 50 m below the Caseta at same time. Of further interest in terms of activity periods—Jan saw #376 ♂ go in today at 1515, but did so by first trying to bull his way through a large and long mess of 1 ½ meter high vegetation—Jan thinks from watching him that he was simply trying to get all the way through and just finally gave up—he had pushed about 2-3 m under when finally stopped—she saw him active yesterday at least as late as 1600 and saw emerge today at 0915; last 2 days have been cool and mostly overcast here with

(Pg 16)
sun out only off and on and then only briefly. (see notes on activity of this animal—11-12 Oct 1969). Jan witnessed a case of male-female aggression today. At 0915 this morning ♀ #1006 was moving along trail from Caseta to tent just as ♂ #376 was removing itself from a burrow. When they were about 5 feet apart they became aware of each other; #1006 pulled into shell, but #376 remained fully outstretched. They then were both immobile for 3 min, then #1006 began to move across the path in front of #376. #376 raised up on all four legs and headed directly for #1006, the latter moving away at top speed till it was about 15 feet away from #376. The latter did not chase #1006 very far; his initial charge seemed to be sufficient. There was no hissing, head raising, mouth opening or any other usual aggression signs. The chase was certainly deliberate and #1006 obviously wanted

(Pg 17)
to get out of the way. At 0943 feeding movements around the Caseta trails brought #376 in behind #1006 at a distance of only 3 feet. #1006 became aware of #376 and slowly grazed away. #376 appeared to look up and notice #1006 and began to chase as before. The latter again moved away rapidly over the little hill to our tent, quickly putting about 25 ft. between herself and the larger animal. #376 did not press the chase beyond 5-6 feet and again this seemed sufficient to cause the smaller animal to move far away quickly. Again no head raising, mouth opening, etc. as seen in more similar-sized animals. The animals never faced each other. *Jan took 5-6 photographs of the chase episode on Roll #22. Jan also noted that #376 rummaged all around under the Caseta today and also searched through the ashes of an old fire pit there—sniffed it a bit. Another animal apparently ate all the paper, match boxes, etc. in our fire pit some time today and when Jan discovered the animal it had even consumed half of the paper on a tin can and had the can in its mouth. In sum, these tortoises seem more like, real,

(Pg 18)
true pigs every day. #376 spent almost the entire day except for these few instances under one Guayavillo tree eating the fruits of this species which were on the ground—about 4 ½ -5 hrs. Caseta weather today: mostly cloudy, sun only occasionally for a few moments—Max—82°F; Min—63°. Rainfall—none. Evap—2.5 (reads 27.0)

15 Oct 1969

Taking it easy to rehydrate and expecting Mr. Perry this evening. About 1100 saw #376 ♂ return to beneath the same Guayavillo tree after wandering down the trail below the Caseta about 50 m on so; he obviously very deliberately came back up the trail to the same tree by the Caseta where he fed yesterday and began working his way around the tree picking up guayavillo berries. While watching him ♀ (large) #819 came along the trail between the Caseta and the tent

(Pg 19)
toward the male. He did not seem to see her when she first stopped about 20 feet from him; she however noticed him and looked at him for about 3-4 min; she then suddenly moved directly toward his front-side area and when about 5 feet away he saw her, turned to face her directly, and moved toward her in a lunge with mouth wide open—he appeared to aim his lunges (3 of them) toward her head, with the first lunge she retracted her head and forelegs with a sharp hiss and after the second two rapid lunges she took off rapidly away from the male. The lunges were rapid in succession only a few seconds for the whole series. He followed directly behind her. She stopped 3 times, about for 2 min—after moving maybe 8 feet each time. In each case he came right up behind her and rested his chin on the rear of her carapace. After the 2nd and 3rd stops, he appeared to sniff her general rear area by poking his snout under the rear of her carapace a few centimeters. After the 3rd stop, she turned and looked back at him for the first time since running away. At this point, he moved his head around just above the rear of her carapace and also looked as if he might try to mount her, but nothing ever came of it. Finally he started poking his head a bit under her carapace in the cloacal area and it appeared as if she lowered the rear or the carapace a bit in response to

(Pg 20)
this by relaxing rear legs and raising the forelegs a bit. She then moved forward a bit; he again followed close behind. At this point she simply ignored him and began eating guayavillo fruits. Within about 2 min he began eating fruits also and she gradually moved to about 10 feet away, both feeding all the while. They then fed for about 45 min within clear view of each other with no further interactions. They are now (1345) only 30 feet apart under the tree, feeding and completely ignoring each other. Also watched them eating the fruits—about ¾ of those they eat are either already a bit smashed or get at least partly crushed in mouthing them and tossing them back into the throat after picking them up with the beak. I imagine this results in much better digestion of them and would account for the fact that as a food these might be useful—especially since the whole

(Pg 21)
unruptured ones so often pass through the gut with no digestion being noticeable at all (on the basis of the droppings we have examined). Jan got a few photographs of the aggression (or whatever it should be called) and of the male eating the guayavillo fruits; also of the fruit all mushed up and all over the ♀'s face and beak—<u>they really are pigs!</u> Saw #376 retire at 1520; at approx. same time #819 was attempting to make a burrow in a low area near the Caseta, but gave it up and moved off E—did not follow her. Other animals below the Caseta were not yet burrowing at this time—Cool and overcast most of the day with some few periods of sun this afternoon for 15 min at a time. 1900—weather at Caseta: Max—82°; Min—70.5°; Rain—2.5 mm; Evap.—2.0 ml (reading 29.0). Changed Evap. at 1900, refilling to full line. It is interesting that it was so warm last night in comparison to all the earlier part of the month—perhaps due to being so overcast (?). Anyway, I wonder if this will have much of an effect on the arousal time of the tortoises???

(Pg 22)
16 Oct 1969
O. Chappy and I left Caseta to cut a trail from El Chato to the nesting area between Cerrito and Cerro Gallina at 0700 hrs. Along the first ¼ of the trail, we encountered 4 tortoises (medium size males) and all were active and feeding. This was between 0700 and 0720. It is an overcast morning with a very faint breeze, but it was warm last night (67° F minimum) with only a light garúa and perhaps this is an early arousal time as a result of the warm night?? We came into El Chato along normal pathway and went around to S side where we began the

trail to Zone 5. Around Chato saw at least 15-20 tortoises, all but 2 being active and eating (0800-0810). These were a mixture of large males and medium sized animals (using ♂♂ as a reference base). The two exceptions were semi-active and alert but in a mud wallow sort of slopping around some. They, of course, could have been in here for days. The other major thing noted was the condition of the ponds.

(Pg 23)
[Marginal Note: "But is some H_2O in pond #1 very little (a spring?) in a shady spot; mostly dry"]
All those seen in our circuit which were dryish (with some mud) in late Aug-early Sep are now dried out rather well and have lush stands of Plant #5 growing in them—and all their Azolla is dried up and gone. They also have a goodly covering of low grass in places which the tortoises seem to be keeping well mowed down. Those ponds which had water are now mostly thick soupy mud with a little bit of standing water here and there. They have all been rather heavily used by tortoises for wallowing and are extremely well churned up—as a result there is almost no sign of the Azolla which covered some of these abundantly in the period mentioned (1 Aug—early Sep). The tortoises certainly can still use these for drinking both because of a little standing H_2O and the possibility of pushing depressions into the mud and then drinking the H_2O which fills into these. In fact saw one tortoise drinking from a shallow depression in some very oozy mud in one pond and another with his entire face and head covered with fresh, wet mud, which indicates he had had his head pushed down into the gunk. These observations coincide with the dropping of the water level at the Caseta ponds and the rainfall records for the past 2 weeks in particular at the Caseta. There are a few small ponds (2 x 3 m or so) on the very S side of Chato which are well shaded by large manzanillos

(Pg 24)
and which still contain water and a thin cover of mostly green Azolla. Moved rapidly down to Zone 5—most tortoises were along first ¼ of trail between S side of El Chato and Zone 5 where there are lush open areas covered with grass and ponds with a little water and mud wallows. In Zone 5 itself then saw 5 animals, one huge male in a dry pond there and 4 other medium sized ones (♂♂ standard) active and moving (feeding); 3 of these were seen on a side jaunt of 10 min in the Zone 5 area. Then proceeded rapidly to Cerrito seeing no more tortoises, but found 2 in the nesting area below Cerrito. One of these was actually slightly above the nesting area in a rocky area and was of a small size (± 15 years old?). The other was of a similar size and was in the SE corner of the nesting area near the 2 nests found by O. Chappy on

(Pg 25)
Sep 3, 1969. Zone 5 lies about 45 min steady walk SSE of El Chato and the nesting area is about the same time and distance SSW of Zone 5 with Cerrito in between the two. Took a few measurements while in transit at various locations to aid in mapping. 1) Climbed a tree at the NW corner of the nesting area—compass readings Cerro Gallina—250° W; Cerrito 15° E. 2) Climbed Cerrito—compass readings from southern edge of top—Cerrito Gallina—233°; Center of Floreana (Charles Island)—170°. On the return trip took altitudes and made notations on the vegetation, trails, tortoises, and our new trail. These follow; the trip from the nesting area to El Chato took 1 ½ hours steady walking, excluding writing time. 1) The nesting area below Cerrito: We only went to the NW corner or border of the area. O. Chappy estimates that from here it runs another 1 ½ km E and 1 km S. He says it is all rather uniform. The area is mostly lava blocks and rocks covered with a lush herb layer of Plant #2, and with a forest of primarily Pisonia but with a lot of matazarno and palo santo mixed in. The trees are only 15-20 feet maximum except

(Pg 26)
for a few "caco porotillo" (=Erythriana) trees which go up to 35-40 feet. Interspersed within these rocky areas are small areas of 5-10 x 5-10 m which contain mostly the red soil as in the Zone 3 n. area. These are the areas where the ♀♀ lay eggs. No areas as big or open as the open central area of Zone 3 n.a. were seen. Instead, the whole area reminds me very much of the part of Zone 3 just a few hundred meters below the Z#3 central nesting area where the soil, rock and vegetative conditions are almost identical. We found one nest, just in the

NW corner, today (#16) and built a wall of 1 m high and 1 ½ m in diameter around it out of lava stones. Right near here there was a bit larger area where in 3 places females had obviously dug and quitting each time because of rocks; in one case a lot of cloacal fluid had obviously been used and the hole may have been as

(Pg 27)
much as 8 in deep in one part, but it was full of stones all over the bottom and no eggs were laid. The other 2 excavations were very shallow, having hit rocks very near the surface—no evidence of cloacal fluid. The cap of the nest we found was very dry and the nest certainly not too recent (however, O.C. says **not her definitely** on Sep 3, 1969). There are no signs of pigs disturbing nests, and the only disturbances in the area appear to be that some of the red soil patches have been used by goats and/or burros to roll in (as at La Fe). The altitude here is about 170 feet according to the Thommens upon leaving at 0200. 2) From the nesting area our trail runs directly toward the W flank and base of Cerrito and actually runs right along this W base. One is on rocks from 170 feet to about 270 feet according to the Thommens—the rocks peter out as you start going up rapidly just beside Cerrito. As go up over these rocks, the palo santos, Pisonias and matazarnos all increase in size, but the palo santos become less important and the matazarnos moreso; the Pisonias change from being the dominant tree, consisting of a thick mass of small stems

(Pg 28)
all over to fewer but larger trees. The dominant herb is still Plant # 2, but some others gradually come in in higher part. This area reminds me very much of that just above Zone 3 n.a.—region 6 of that trail; but a little drier. 3) Along base of Chato rapidly go up from 270 feet to 400 feet on its W side. The veg now becomes very dense rapidly with many viney—liana like plants all over the trees. The dominant tree seems to be large Pisonias, but in general the veg is really only thick here and not much greater in altitude than the rocky area below—trees only 25-35 feet. There are almost no rocks here, mostly a nice easy to walk on soil bed. The area does not exactly remind me of any area along the Caseta—Zone 3 n.a. trail; it especially is strange in that it has such dense shrub growth. 4) Top of Cerrito—465 feet. 5) From 400 to 465 feet go up rather gradually and steadily from western base of Cerrito to Zone 5 area; this entire route has a well-used,

(Pg 29)
very clear trail (with some side branches near Zone 5) made by a combination of tortoises (mostly) and some other animals (some burro sign; maybe pigs too?). For a short way above Cerrito the trail is a bit rocky but most of it has a soil base. Even in the rocky area it is well worn down and the rocks show it. The vegetation changes over this part of the trip are very much like that in passing from Region 5 lower end through the Region 3 lower or Region 4/3 border of the Zone 3-Caseta trail. As go up the trees become larger and Palo santo mostly disappears with matazarno becoming more important all the way and Pisonia also becoming fewer and fewer. Finally as get near Zone 5 the Guayavillos become more and more prominent and finally dominate the forest. The max forest height here is about 35-45 feet. Till just at the southern end of Zone 5 at 465 feet the veg is rather closed and thick—a lot of Rodillo del Caballo shrubs. At the latter point the forest opens up and begins to vary from large open areas with no trees almost and much Plant #1 to about 30-40% tree cover (canopy). 6) Zone 5 itself is a leveled off area at about 465 feet consisting of mostly large open patches of Plant #1 surrounded

(Pg 30)
Guayavillo forest. There are also scattered groves of manzanillos. The area reminds me very much of the Region 4—Region 4/3 border of Zone 3 n.a.—Caseta trail; the main difference appears to be that the Zone 5 area is a bit drier since the Plant #1 is both thinner and not as high (only 0.5-0.75 m). There are some scattered open areas covered with grass here, but the dominant herbs are Plant #1 and others and not grasses. There are 2 ponds in the area, both dry now. One has a very rocky bottom, is completely dry and is surrounded by Clerodendrum bushes of large size. There are only 2 open areas in it, each about 10 x 15 m.; the rest of it is

being encroached upon by R. del Caballo. The other pond is similar, but parts of it along its edges are shaded by manzanillos groves and in these areas there is still a bit of damp soil on the pond bed which supports a nice

(Pg 31)
growth of green herbs. Otherwise the pond is also dry and surrounded and partly covered by Clerodendrum. On the whole Zone 5 is a very open area like that of Region 4 below the Caseta, with the open places separated by guayavillo forests. There was a huge ♂ animal in the first pond mentioned above--#507♂ (maybe #107, hard to tell). CL 144.5 cm; CW (CDRS)—147.0; CW (VD) 137.5. This animal's carapace is very badly broken and chipped/scarred along the edges and he has got a good case of the disease (fungus?) or whatever it is that results in the flaking condition of the scales. Large areas of almost every carapace scute are flaking off and have the consistency of layered, thin paper or mica. The flaking material is amber in color and some of the semi-soft areas where the flaking will soon begin are a deep amber color. He has almost invisible white increments between some scutes and virtually not at all along many of the scute borders. 7) From Zone 5 to S side-base of El Chato—465 to 500 feet. This is a gradual rise all the way. As go up the vegetation becomes more and more lush and the trees layer. The forests along all the trail are dominated by guayavillos, but these become more and more plentiful as (you) go up, and increase in girth and height. There

(Pg 32)
are some Pisonias and matazarnos mixed in which if anything decrease in numbers, but increase in size as go up. Most of the way is covered with a rather heavy canopy of 50-85% but all along the way there are open areas. The first half of the way has open areas here and there which are covered with Plant #1 and which have some small dry ponds with manzanillos around them; in sum, the area is much like the upper part of Region 3 and Region 2 of the Caseta—Zone 3 trail, except it is a bit drier (both further W and a little lower, but not much different in altitude). The upper half has even more open areas. These mostly covered by dense grass of 1-2 dm high. These areas are also quite lush and there are small ponds here and there surrounded by large manzanillos—The ponds vary from dry to quite muddy, and a few even have 5-15 cm of H_2O and some Azolla in

(Pg 33)
them. This area is quite like the upper Region 3—Region 2 area of the Caseta as far as the forest goes but the grass is much more plentiful here than any places around the Caseta. Toward the very upper end of the trail some Scalesia starts showing up in the forest. Along the entire way to Zone 5 there are many areas with thick Clerodendrum molle as an underbrush beneath the forest trees. There is a trail all the way from El Chato to Zone 5, and in the upper half is often just a tortoise-wide mowed grass lawn. There was tortoise sign (trails, droppings) along almost the entire way between the two areas. Passed through El Chato area from 1615-1645—it was just swarming with animals. Most animals seen between 1615-1630 as passed around E side—were almost all active and feeding. A few (of a variety of sizes) were rather completely burrowed into the mud—There is very thick, swampy mud and they were buried in it literally up to the very edge of the front end of their carapaces—had just enough room to leave nostrils sticking out here to breathe. About 2/3s of carapace and all of limbs and rest of bodies are thoroughly beneath the mud. Between 1630-1645 passed 3 animals

(Pg 34)
between base of El Chato and El Chato turn-off—all were active. Saw one more just after turn off was moving toward Caseta—(at 1645)—it was burrowed in. [Marginal Note: Turn-off alt at 1645 was 790 feet.] From just soon after this turn off there is (as on Oct 8) no further sign of tortoise activity until about 3/8 –5/8 mile area from turn off to the Caseta. This indicates that tortoises are working out from Caseta and El Chato but not much yet and rest in between (not used) except perhaps for a few isolated animals. The farthest W animal (from the Caseta) is #9♂ who is in the Camote patch just W of where the border changes directions. He was active and eating at 1700. #73♂ was another 150-200 m E of #97 and was active and eating at 1710. At 1730 saw one more along trail from border to the

(Pg 35)
Caseta—it was burrowed in. It was warm last night and is warm now. At 1732 reached the Caseta and the temperature here is about 70°F. Altitude reads 575 feet, i.e., about 95 feet too low. The above altitudes could be rechecked using this as a base since the day was cool and overcast all day; however, they should be rechecked again with the Thommens! If these corrections are proper then Zone 5 and the Cerrito nesting areas is a good bit higher in altitude than the same regions they resemble of the Zone 3—Caseta trail!!! Saw one piece of interesting behavior today—a huge male, #139, was up against the rear of the carapace (sideways position) of a medium-sized male (#252). What is potentially interesting is that the large male may have been attempting to mount the smaller one—but am not sure. Discussed some of nests and other data with O. Chappy he's taken this year. He found #'s 10 and 11 on Sep 3, 1969, in the SE corner of the Cerrito nesting area; the 2 nests are 3 m apart only, made in red soil.

(Pg 36)
#10 was accidentally opened because lost control of machete while probing because it slipped in his hand and broke one egg inside—half the embryo which is quite well developed preserved (see notes of _____). However, did not open 11 and did not count eggs in # 10. Put walls around these 2. On Sep 4, 1969, found #13 in lower part of Region 6 of Zone 3—Caseta trail. Also did not open, and built wall around. This was a fresh nest, very recent, and was made in dark grey-brown soil. Altitude is about 215-220 feet. **[Marginal Note: July?]** Other potential nesting areas: La Torta—O. Chappy visited there in (_____) and searched for nests; found no nests but saw many small animals and therefore assumes must be nests. He does not know if M. Castro or others have found nests there. He says that there are large places of red soil covered

(Pg 37)
areas ("pampas coloradas"), smaller than that at La Fe, but rather extensive in sum total. La Fe—no nests found this past year, but found in past there by M. Castro; in 1968, O.C. found 3 fresh nests one morning about 0800, all destroyed by pigs. Cerro Gallina—again, large "pampas coloradas" areas, but he does not think anyone has found nests there before. He feels sure that there are some in this area especially to the W of the base of C. Gallina; he has seen many small animals here also. O.C. also does not think many more likely nesting areas near coast between La Torta and La Fe and the latter, and C. Gallina and C. Gallina and the far W of the tortoise Reserve. He bases this on spotty visits along the coast--mostly rocky. However, he thinks that nesting areas like in Zone 3 and Cerrito may be fairly common all across the southern end of the island. Last year (early 1969 actually) apparently many young tortoises were killed because of the heavy rains in Feb and Mar. He says there was standing water in such areas as Zone 3 nesting area. In some cases, apparently the eggs never hatched after being covered by water. Also, some that were hatched were

(Pg 38)
apparently unable to get out of the nest because they filled in with thick heavy mud. For example, on Mar 21, 1969, he found one nest in the Cerrito nesting area where 1 young tortoise was trapped inside in this mud. Should ask M. Castro more about all this and get some dates from O. Chappy. Caseta weather: very overcast and cloud all day; slight winds; Max.—77.0; Min.—67.0; Rainfall 1.1mm. Evap.—1.2 ml) (reads 1.2)
17 Oct 1969
0730—Left Caseta to make a trail to Salasaca. Just after left Caseta saw 3 tortoises, 2 burrowed, 1 just emerged from burrow.

(Pg 39)
0800—El Chato turn-off—Thommens altitude—660 feet. Cut trail directly NNE from Naranjo to W side of Lechoso. As went up here (gradual rise), guayavillos became very large and more and more Scalesia—in parts main canopy is the latter, but on the whole it is a mixed forest. By time just W of Lechoso, guayavillos about 35-50 feet max. height, Scalesia 25-35 ft. max. and as large as I have seen in any traveling so far. The canopy

varies from about 50-90% but almost all areas really a true forest. A few open areas here and there. The forests are damp and cool and much of the ground cover is Passiflora punctata and Commelina nudiflora. 1100—Hit the new National Park boundary just W of Lechoso and began going NW on it along a line of 345°. After a very short way the border turned NE to 50° and we continued along it toward Salasaca. The altitude where first hit border is 950 feet. This first half of the trail had very much sign of pigs (trails, fresh droppings). However, no tortoises seen since Naranjo and if they are here must be very scattered because saw no

(Pg 40)
droppings or burrows and no definitely identifiable trails. Went along N. Park border quite a ways and then turned directly E and went along with clear trail (O.C. says old—pigs, cows, now people use) directly to S base of Salasaca right where the Santa Rosa—Bellavista trail peters out. This was forest all along the way and very similar to that below, mixed Scalesia and Guayavillos—both very large. One new element in the vegetation near Salasaca was large agaves, the vegetative parts reaching up to 2-2 ½ m—sometimes several of these big plants in a clump. [Marginal Note: "but Commelina and Passiflora not impt. herbs]. On S and SW side of Chato there are quite a few ponds. Saw 3—2 were dry and covered by thick 1-2 ½ dcm. high grass; one smallish—20 x 20 m.; the other largest oblong 35 x 75 m. The small one has large agaves all

(Pg 41)
around its edge. O.C. says these 2 were full in late Jun to early Jul 1969. The third pond is also large, 35 x 50 m, and still has a good amount of Azolla covered water in it. This pond has much of Plant #9 around it and even a goodly amount of this shrub growing right in the pond. The altitude of these ponds at 1200 hrs was 1220 feet. One tortoise eating grass in the large dry pond. # 143 ♂ CL—117.5 cm; CW(CDRS)—125.9 cm. He has white increments visible in only some scutes, but many lack them completely. He also has the flaking fungus disease all over the back of the carapace. There may be a scattering of tortoises over this last half of the new trail we made and around Salasaca, but again no definite sign was seen and they are certainly not abundant either in the forests or around the ponds. O.C. says used to see them around Santa Rosa and other parts of colonized zone—only a few animals, but scattered throughout. This was 5-8 years ago—but now only a few carapaces—therefore, he feels people have killed off most of few that remained in colonized

(Pg 42)
zone in the 1960s. In late June—early July he and P. Villa found a recently slaughtered animal in between Salasaca and Piski-Cacha. 1900. Weather Caseta. Max.—75.0; Min.—67.0; Rainfall—0.3mm; Evap.—1.9 ml(reads 3.2ml). Cloudy all day till just before sunset. Very little bit of garúa.
18 Oct 1969
0730--Jan and I going to El Chato. 0745—Left Caseta—alt. 540 feet. 0800—Intersection of border of Reserve and trail from Caseta—alt. 565 feet. #852 ♀ Faint white increments; CL—88.5; CW(CDRS)—91.5; CW(VD)—86.0. #305♀ CL—105.0; CW(CDRS)—118.5; CW(VD)—108.5. Same area as last sighting; white growth increments not visible at all; but feeding and defecating a lot. Just a bit further on, right after leave forest and enter mora--#277 ♂; CL—91.5; CW(CDRS)—100.5; CW(VD)—93; hardly any white increments at all; mostly none visible.

(Pg 43)
#320 ♂ on C. Chato trail before Chato turn-off. CL—87.7; CW(CDRS)—97.0; CW(VD)—91.0 very faint growth increments. Two tortoises sleeping in sun, just where trail enters forest to go down to El Chato—0900 hrs—both sleeping in cleared, well mashed down areas of the edge of the mora—both out in full sunlight—clearly basking.
#609 ♂ CL—87.3; CW(CDRS)—93.7; CW(VD)—87.5
#252 ♂ CL—103.3; CW(CDRS)—112.0; CW(VD)—105.0
(Note: He has moved about 200 m since afternoon of Oct 16, 1969). Both have faint growth increments—almost invisible.

#92 ?. (7 or 4, both marked)—about ½ way between base of Chato on E side and Chato turn off. 0930 hrs. In the forest in an opening, sleeping and basking in the sun.
#142 (could be 149 - faint mark) ♂ bit further down trail; also in forest opening; basking and sleeping in the sun.
#164. Bit further down trail #164 ♂ basking asleep in open spot in forest (direct sun). CL—101.0; CW(CDRS)—106.05; CW(VD)—96.0. 0945. Same area of forest.
#71 ♂. CL—120.0; CW(CDRS)—136.0; CW(VD)—127.5. feeding in forest.
#990 ♂. CL—93.3; CW(CDRS)—100.3; CW(VD)—93.5. sunning and sleeping in open spot.

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#445 (or 405)? ♂. 0955. A bit further down in the forest—off of the trail a bit in shade, feeding. At Chato pond # 1, two tortoises, one feeding on plants in center, the other all stretched out, sleeping and basking.
#68 ♂. CL—118.5; CW(CDRS)—126.2; CW(VD)—117.5
#372 ♂. CL—121.7.; CW(CDRS)—134.0; CW(VD)—123.0. [Margin Note: "definitely correct (#372), not 172; other one must be 172.] 1200 hrs. Following area on circuit from pond #4 to pond # 1 and back to Caseta.
#161 ♂ CL—128.0; CW(CDRS)—145.3; CW(VD)—133. Near pond #2 in grassy area; feeding #10 ♂--near pond #4 eating grass; just emerged from soupy mud of the pond. Can't see any white growth increments.
#209 ♂ feeding on grass; near pond #4; also just recently emerged from mud wallow; no white growth increments visible at all.
#61 ♂ just entering mud wallow of a small pond just W of Pond #3.
#151 (♀ I think) beside same mud wallow as #61; also has fresh, wet mud all over carapace. some white increments can be seen, but they are not very noticeable: CL—85.0; CW(CDRS)—92.5; CW(VD)—85.5.

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#318 ♂, E side between ponds 2 and 3; feeding in a semi-forested area off to the side of a grass covered opening. CL—120.5; CW(CDRS)—132.5; CW(VD)—121.0. This animal has fairly obvious white increments between its carapace scutes and certainly the most clearly defined and well developed one we have seen in the entire El Chato area today so far.
#1163 ♂; E side of Chato between ponds # 2 and 3; in a grassy area—open; burrowed up under a R. del Caballo; mostly cloudy now with fleecy white ones—but is warm and little breeze. Has nice well developed white growth increments, best ones of the day so far. CL—95.8; CW(CDRS)—102.0; CW(VD)—94.0.
#863 ♂; in bed of pond # 2; under a Clerodendrum molle resting in shade. However, very little sun now; white growth increments are visible but not as nicely developed as on #1163. CL—87.4; CW(CDRS)—89.0; CW(VD)—80.0. (probably male but could be medium-large female).
#567 ♂ just W of pond # 2, base of Caballo—eating grass; white increments barely visible here and there. CL—140.0; CW(CDRS)—153.0; CW(VD)—141.5
#176 ♂; same area as #567; very clean and well developed white growth increments. CL—111.0; CW(CDRS)—124.5; CW(VD)—113.5.
5 more tortoises in this same area near pond # 2; all feeding on grass and herbs.
#281 male (♂)—he is very large and has nice visible white growth increments.
New #1165 ♂. CL—82.5; CW(CDRS)—88.0; CW(VD)—81.5.

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#130 ♂ (perhaps 30, 100's mark very poor). CL—131; CW (CDRS)—139.5; CW(VD)—127.5. Very large. Eating grass.
****Note:** just noticed that this animal has good growth increments visible between lower scutes of carapace, but not up on dorsal surface—scraped some on the lines between the scutes with my knife and found to my surprise that these areas were simply full of encrusted dirt and that nice growth increments were visible beneath. Therefore, all notes today are probably questionable concerning this question—especially since most of the animals around here have been wallowing in mud. In fact most probably have good growth increments!!! But

notes of previous days are valid because have tried this scraping each time question of dirt obscuring the line was possible before and scraping usually showed no increments.
#144 ♂ (could be 544 but 500 mark, i.e., 4 scute) is very unclear). very large animal. Eating grass.
#132 ♂ (could be #136), scute chipped). CL—128.8; CW(CDRS)—132.5; CW(VD)—121.5.
#16 ♂ half way between Ponds # 1 and 2 on trail, eating grass. CL—115.8; CW(CDRS)—131.5; CW(VD)—121.0.

(Pg 47)
Back at Pond # 1; #537 ♂, off to side eating herbs and grasses. CL—93.4; CW(CDRS)—99.5; CW(VD)—88.5. Could be large ♀ since tail is rather hard to guess at—intermediate length.
1400—Leaving for Caseta; very cloudy with white cumulus clouds; light breeze and pleasant temp. Thommens reads 715 feet at base of Chato at edge of Pond # 1.
On return trip--#97 ♂ eating Camote leaves and stems in Camote patch. CL—122.6; CW(CDRS)—132.0; CW(VD)—127.0.
#277 ♂ on border eating grass—he is about 200 m W of position at 0800—now 1500 hours.
1510—Caseta—Thommens reads 660-670 feet, about correct. Weather did not change during return, so measurements are probably correct. At various points along border between Caseta and El Chato, the altitudes read 750-820 feet or so as pass through the mora. Implanted a water height stick in the lowest part of Pond # 2 which is now dry (at El Chato). Also placed a Tru-Chek rain gauge at 1 m on a tree stump and a Piche evaporimeter with a radiation shield (25 x 50 cm white board) right beside it. The Piche disc is also at 1 m. These instruments are essentially exactly like the arrangements at Zone 3 n.a. and the Caseta. Began them functioning at 1200 hours, no rainfall and the Piche completely full.

(Pg 48)
1900—Caseta weather: Max—83.0° F; Min-62.0; Rainfall—0.0mm; Evap.—2.3 ml (reading 5.4 ml).
Cloudy most of day, clouds being large white, fluffy cumulus type. However, some sun this morning between 0900 and 1230 hrs.—sunny about ½ of the time during these hours; cloudy all the afternoon and early evening till about sunset; cleared off about sunset and can feel the chill now of the open sky.
*Will withhold judgment on tortoise activity periods—saw #1006 ♂ burrow in at 1600; yet a large male #255 was still feeding at 1730 below the Caseta on the trail to Pond # 1 and 2 small-medium sized animals were active in the pond water eating grass at 1700—theses 2 burrowed into mud about 1720 and 1725 respectively (estimate both about 80-90 cm cured length in size).
*Put in a water height stake at Caseta Pond #1 in deepest part—now reading 35 cm. of H_2O. Am sure the level is down at least 5-10 cm since late August-early Sep; conditions at

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El Chato (See notes of 16 Oct 1969 and 12 Oct 1969) coincide with this.

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19 Oct 1969
Arose 0600—overcast completely; preparing to go to Region 4 of Zone 3—Caseta trail to put in some instruments. 1100—Region 4; just completed implanting Tru-Chek rain gauge and Piche (evaporimeter)—put in an open area of Region 4 just 75 m W of the large pond there. This area used probably gets surface water over it when have any extremely rainy period as this past Mar (1969). Instruments emplaced in standard fashion as at Caseta, Zone 3 n.a., and El Chato. Also put water measuring stake in the Region 4 pond. [Marginal Note: Reading 30 cm at installation.] This still has abundant H_2O; was not able to get more than 20 m into the pond because it is surrounded and spottily filled with R. del Caballo (Clerodendrum molle) so that I only went as far as was practicable to cut a trail in and still also, be able to read the stick from the bank of the pond. It may be a bit deeper further in, but I doubt it; the pond is about 60 x 60 m, fairly round and is covered with Azolla in its green phase. The pond's water height is probably partially a result of the abundant Clerodendrum shrubs of 2 – 3 ½ m in heights which are so prevalent around and in it--thus

(Pg 50)

offering a great amount of shade; the biggest open exposed areas of H_2O surface appear to be of a diameter of 6-8 m at most and are shaded partly except for the 4-6 hottest hours of the day—and of course, there is always shade on the H_20 under the Clerodendrum shrubs which are as large as 3-4 m in diameter. Also installed a column of thermocouples in standard fashion in a regular plastic rod in an area of open soil off to the side of the open area where rain gauge and evaporimeter are. The soil here is dry down to about 10 cm and cracked and marked on top indicating flooding last spring (Mar period). It however, is as deep or deeper in most areas as at Zone 3 n.a. and tortoises should theoretically be able to dig nest sized cavities in it. It is a darkish grey-brown in

(Pg 51)
color and not unlike the soil (in color and surface texture) where nest #13 was made. One thing, mitigating against use by the tortoises besides the climate and moisture levels here is that the soil is quite hard below 10 cm now and is packed into a very hard, slightly damp, mud (which seems to contain a good amount of clay). It might be that this would be hard to dig in. Also, the upper dry, cracked level of stuff might not easily be broken up and made into a mud with cloacal fluid—also making digging more difficult. [Marginal Note: Lots of surface lava and small rocks underneath, but no worse or = to Zone 3 n.a.]. In sun, the soil here might prevent nest laying more directly even than the climate—this remains to be seen, after taking weather and soil temps. and humidities here and also collecting some soil. There is certainly a lot of organic matter in this soil, but I wonder how malleable it would be to a ♀ tortoise. Also, the present condition of the soil profile here could be the result of the standing H_2O here last spring and thus more or less of a rare situation?? Anyway put plastic rod in after drilling a hole directly down to lava rock at 38.7 cm with soil auger. Rest of installation and equipment standard. T.C's at the following locations correspond to the following numbers on the switches:

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Position on Switch	T.C. depth from surface
1	surface
2	1 cm
3	3 cm
4	5 cm
5	10 cm
6	15 cm
7	25 cm
8	Lead – blank
9	35 cm

Also sat in 3 bogus soil blocks by digging hole, measuring proper depths and implanting blocks in side wall of hole and then refilling hole with soil in proper order in which it was remove (as at Zone 3 NA) Implanted at 5 cm, 14 cm, and 20 cm.
This area is swarming with tortoises. Have seen at least 10 of small – medium and medium sized (♂ as standard) in the general area, and in just 2 small open spaces in the pond itself (6 x 6 cm each) saw 6 animals drinking, wallowing

(Pg 53)
in mud and /or eating surface grass around edges; must be many more in the pond as a whole.

Note: Much Plant #1 blooming in Region 4; many, many trails through it all over!!] These were of varying sizes but only one large sized male and no tortoises as big as the big El Chato types.

Then saw another 6-8 animals as walked along only about 1/5 of ponds border (out of pond, feeding and walking) and back the 75 m to where implanting instruments. The area is swarming with animals and should be checked more carefully; certainly seem to be more here now than when wandered near pond and around in general (more extensively than today) in late Aug – early Sep period of this year. Also, 2 of animals were unmarked I noticed, 1 a large ♀. We spent at least twice as much time in the area and there were 3 of us looking separately instead of 1 (me today) yet we encountered less animals then. This phenomenon agrees with apparent concentration in El Chato area now as against late Aug –early Sep Cannot say where animals are coming from but they are certainly more concentrated in each of these areas (where there is water standing in ponds still) than in the former period, 1.5 months ago. It would seem reasonable that the steady low drying conditions of the last 1.5 months (especially last 20 days) might be related to the movement into pond areas. Same

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phenomenon may be occurring at Caseta ponds, but have not gotten a good resample yet; however in general, there do seem to be more animals around Caseta, then, along trail to pond #1 and in and around #1, based on casual Sunday and daily observations, than there were in former period 1.5 months ago. Also there certainly are more around upper Caseta ponds - this is definite.
Quickly ran down to Zone 3 NA and checked a few things:
1530 hrs; Rain fall – 0.08 inches; Evap. 31.0 ml.; Refilled evap full and emptied raingauge at this time. Also checked available soil moisture.

1) in nest: Cap (5 cm deep) – nothing on lowest line (i.e. < 15 %); Eggs – 46% (14 cm deep)
2) for soil beside nest – 5 cm deep – just slightly above lowest line; 14 cm deep – just slightly above lowest line. [same reading about a 15-17%]

(Pg 55)
Saw 3 smallish tortoises while walking around, but am in hurry and can't check; #1144; #918; 1 unmarked. All about 60-70 cm CL type size.
Also examined some of the marked nest in Zone 3; did this because on 13 Oct '69 noticed that nest 37 had a rather large opening (1- 1.5 cm in diameter) in one side of the hard cap.
Upon closer examination discovered that this opening had lead directly down into the same nest and eggs were visible. Then checked other nests and found that of those not opened or open but rebuilt on top using mud made with water, that all were in good shape and had no openings, even small ones – this include #'s 9, 12, 13, 14, 15 (9 and 12 opened, but cap carefully rebuilt). Of the opened ones, examined 1, 3, 4, 6, 7 and found large openings as in #7 only in #1; #3, 4, and 6 had very small centipede sized holes along the edges of the hard cap, but they seemed to be in good condition [Marginal Note: covered these holes with loose soil]. Did not have time to carefully check #1 and just covered hole with a flat lava rock and some soil.
When felt and looked into #7, discovered that of 6 eggs, which I could definitely tell were there, that 3 were crushed on top. The other 4 were about 2/3 – 3/4s buried and were OK on top – left in place. The 3 broken ones were removed and discovered that 2 still had good membranes on the top and did not smell rotten at all. There were some ants on one of these, on the

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membrane, but this still seemed to be in good condition. The third was broken in through the membrane and quite rotten and stinking. Removed it and discarded it but replaced the other 2, filled soil in on top of all eggs, replaced pieces of hard cap and then covered over whole cap with loose soil. All 3 were cracked open on top in position in nest and were the upper most 3 in the nest – were all a bit higher than the other eggs and actually sitting in interstices of the lower eggs – i.e. at least 2 layers.
Several points are of interest here;

1. Cracking probably due either to O Chappy forcing them back into place improperly after marking or due to a rat or mouse entering through the hole. I favor the latter, in that all 3 were cracked open in same

places where O.C had marked them with red pencil, and the small fingernail sized pieces of one of the egg's shell were originally found ouside the nest on the ground beside the hole, as if had been drug out by some small animal. Also, when originally

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seen the hole leading into the nest had some finely ground up soil around which looked as if a small animal had dug into the nest or at least enlarged a hole already there in getting into the nest.

[Important – see notes of Oct 20, '69]

2. I think what is happening in these opened nests is that light rainfall and drainage into the nest is occurring around the edges of the pieces of hard (which O.C. removes in opening the nest) where it is replaced. He does not use H20 to re-solidify and make uniform the cap after opening the nest and thus a crack is left when the eggs are replaced in the nest and the hard cap piece is put back in place – this forms a natural place for soil to sift through with time and weathering. This is dangerous in that it allows H_20 to go directly into the nest with little or no normal percolation and also allows an avenue of entry for small rats and mice – I think normally the hard cap prevents these things from happening. The unopened nest show none of these problems, whereas all the opened nest (i.e. opened by O. C. without reconstructing hard cap) show at minimum small holes around the piece of cap removed, which open into the nest; as noted, in 2 of these nests the

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opening is large and perhaps a severe problem (will check #1 later).

2. O. C. says that after opening the nest, removing and marking and counting eggs, he replaces eggs, fills in soil on top of them and then replaces piece of hard cap where entered. Yet in #7, when opened, there was an air space between the hard cap (about 4-5 cm) and the top of the eggs which was about 6-8 cm in depth. In fact, as noted, the top 3 eggs with cracks had soil only around their very bottoms and the bottom layer of eggs were about ¼ -1/3 uncovered. One is tempted to conclude that the soil which was loose below the hard cap in the original construction actually has settled into the nest around the eggs below the hard solid cap.

Perhaps rain soaking through helps this; in fact the opening described above even where minutely small may have enhanced this due to allowing seepage H20 in more easily; the question which

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remains is whether or not this same settling occurs to the same degree in normal , unopened, undisturbed nest and to what degree. This remains to be investigated. Nest #7 is about 2 months old, having been found on 19 Aug 1969. It originally contained 11 eggs, but 2 were broken and were discarded; of the 9 remaining I could see and or feel 7 and threw one of these out.

Jan got a few numbers of animals in Region of #4 of Zone 3-Caseta Trail while I was at nesting area –

206 (small- about 50-60 cm CL)

1058, 408, 102 (smallest seen – probably about 40-50 cm CL) number is questionable maybe 109? [Pencil note: Yes]; 1074 ♀, 693.

Saw #3 ♀, large, on trail in center of Region 3.

On return saw an animal burrowing in lower part of Region 3 at 0500. However, saw 3 more in this region active during 1700-1720 period. About 1730-35 passed 4 animals in Region 1 while approaching Caseta from Pond #1; all were burrowed in and at Caseta #1006 ♂ was burrowed in (0545) at same place exactly where burrowed last night; saw

(Pg 60)

him emerge this morning at 0710 and when left at 1000 he was feeding on SE slope beside the Caseta.

1900 Caseta weather: Max 83.5 F; Min 63 F; Rain 0.0 mm; Evap 2.3 ml. (reading 7.7). Overcast most of day but sun out this afternoon for several periods of 15-20 min at a time. No rain recorded here but here was a little rain in Region 4 about 1030 –1100 as we were setting up the instruments.

20 Oct 1969
Came down to CDRS. Discussed the problematical nest in Zone 3 with Juan Black. He has been on trips with Miguel Castro and O Chappy and watched them open nests, remove eggs, discard bad ones and replace eggs and close up the nest. He says that when he watched them (note that O. C. learned his techniques directly from M. Castro) that they: 1) did not refill loose soil in on top of eggs always, after

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having replaced them in the nest (note: this could account in part perhaps for the air space seen in #7); 2) as I suspected, they simply removed a good sized chunk of the hard cap and then either simply stuck it back in the hole thus made or even just put some lava rocks and or sticks over the hole – this of course is what I observed and certainly accounts in part for the enlargement of openings later due to weathering and also perhaps the problem of rats or mice entering the nest.
J. Black agrees that opening the nest is perhaps not wise, unless, as on Duncan, there is a program of moving the eggs elsewhere for incubation.
Also discussed the problem of the wardens making large enough corrals around the nest encountered and then dispersing the rocks after the nests are finished and the young dispersed. He agrees that a corral of at least 1.5 m in diameter is necessary and that the rocks could best be piled up in small heaps for use in ensuring nesting season instead of spread all over the ground and thus obscuring and perhaps covering useful nesting soil for the next year.
(Note: See note on #1006 for this day under notes of 28 Oct 1969)

(Pg 62)
Voided by CGM

(Pg 63)
28 Oct 1969
Returned to Caseta after 1 week's absence, last night.
Today will take a sample from the area immediately around Caseta pond #1 to see how it compares to El Chato and ponds above the Caseta for changes between late Aug and mid – late Oct
#3 ♀ about 35 m below the tent, near an obvious night time burrow.
At 1330 hrs CL 96.5 cm; CW(CDRS) 104.3; CW (VD) – 94.5
[editorial note by THF- apparently CGM is aware of difference in the way the CW is measured by CDRS personnel as opposed to the way it was done by van Denburgh in his tortoise monograph]
This ♀ is interesting because she appears to be quite old and perhaps represents a large one for the porteri subspecies. Oldness criterion is carapace appearance. Most of the area of almost all her scutes is smoothed over and worn down with no visible growth rings; the only growth rings visible are very narrow and closely pressed together around the very outer borders of the scutes; also, there are fairly wide deep grooves between some of the scutes, especially the marginal – marginal junctures and marginal junctures with costals and vertebrals. These grooves are bout 2-5 mm wide depending upon location – this adds to the appearance of an old, worn –down carapace. She looks very much like the very large and obviously very old males around El Chato area. The borders of her carapace around the edges are also

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worn in appearance, but not as chipped and broken as in the large males of El Chato. There are only faint white growth increments visible after scraping away the dirt from between her scutes. [Marginal note: Has a little of the "flaking" disease on the a few rear scutes- particularly the supracaudal] She appears very domed to the eye and of medium size in male tortoise scale terms; her tail is very, very short. Secondly, we saw her on 19 Oct 1969 beside the Zone 3 – Caseta trail pointed in an upward direction in the steeply ascending part in about the center of region #3. She has in other words come up quite a distance since then – 250 feet in alt. approx. and

about 2 –2.5 km in distance. There is some slight mud on her carapace and she may have been in a pond. Is now eating some lush green grass.
#117♂ - almost to C. Pond #1; eating grass in trail. CL 97.8; CW (CDRS) 104; CW (VD) 96.0. Has some slight flaking disease here and there on scutes; white growth

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increments are very faint, but present.
#278 ♂ near C. Pond #1; mud on shell is wet; recently in the pond, obviously. CL 117.2; CW 118.4 (CDRS); CW (VD) 110. Has very flared marginals in both front and rear; visible white growth increments.
#416 ♂ on edge of mud of pond; eating grass in recently exposed area where water has receded. CL 83.0; CW (CDRS) 89.3; CW (VD) 82.5; very thin, fine, white growth increments.
#885 ♀; same area as 416; appears to be eating Azolla as do the next 3 in a row. Has very thin white increments, not very well developed or noticeable. Has flaking disease in some abundance, but scutes not excessively worn and smoothed and growth rings visible over most of entire carapace scute surfaces – CL 79.4; CW (CDRS) 85; CW (VD) 78.
#862 ♀, another large one – scutes worn smooth a bit in center, but most of rings visible; also some flaking disease especially around lower edges of costals scutes and on marginals in front and rear of carapace. White increments very faint to missing between most scutes. CL 96.5; CW (CDRS) 104.5; CW (VD) 96.0.
New - #1165 ♂; thin white increments visible; small – medium in size. CL 79.3; CW (CDRS) 82.5; CW (VD) 76.3.
2 others in pond crawling along slowly now and again; eating Azolla; can't get to in order to identify.

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#123 ♀ just a short ways from pond; dried mud indicates has been in pond; CL 77.7; CW (CDRS) 85.5; CW (VD) 80; Fairly large ? ♀; just center knob of scutes worn, other rings all visible; only a few spots of flaking disease; and white increments thin lines, but clear between all the scutes. Feeding on herbs in guayavillo forest near pond edge.
One of the above 2 unidentified ones is #102 ♀ - on SW side of pond in H20 – she was in the same exact area on 31 Aug 1969.
#909 ♀ (tail is a bit intermediate, but we think it is a female) largish animal. Mud indicates has been in pond; is now about 30 m away from it; white growth rings increments clear and obvious. No flaking disease; CL 90.7; CW (CDRS) 95.8; CW (VD) 89.0.
New #1166 (♂ probably); dried mud on shell indicates previous pond wallowing; this is one of the smallest animals have noticed this high up in altitude. Very fine thin white growth increments

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between scutes; no flaking disease. CL 74.5; CW (CDRS) 80.3; CW (VD) 73.0; E side of pond in open area.
3421 (♂ probably) CL 82.6; CW (CDRS) 91; CW (VD) 84.; very round and domed; very fine, thin white growth increments; E side of pond in open area.
#274 ♀ I think, rather large; tail small but tending toward intermediate – E side of pond in open area.
**time now 1530; all animals here still active. This one has wet mud on shell indicating recently in pond. Only very center of shell's scutes are worn and smoothed; rest have good clearly visible growth rings. No flaking disease. CL 91.2; CW (CDRS) 101.2; CW (VD) 94.5.
#117 sleeping in burrow on our return at 1550 - first have seen burrowed in. It was overcast all day today, but almost no garúa but a few light sprinkles of only a few min duration. In spite of a slight breeze it was rather warm and comfortable. Tortoises were all just grazing about whether in or out of the pond.
[Special note: On 20 Oct 1969 we arose at 0515 and went over to Caseta at 0530. Discovered that #1006 was out of his burrow and looking around – had backed out of it away from veg clump a few feet turned and had his head out. The air temp at this time at 1 m above the ground was 67 F. We had noticed this

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animal the night before in this burrow and sleeping at about 1700. We watched her for a number of hours while inside the Caseta preparing to go to the CDRS. Am sure we were not disturbing her since we were inside virtually the whole time and only looked at her from the window. She simply sat and rested from 0530 till approx 0850 when she finally started moving and grazing. During this entire period it was overcast, but it warmed up slowly into the low 70's and some slight radiation of course was hitting the carapace of the ♀].
As to today's sample around the Caseta pond #1: As per my notes of 18-19 Oct 1969, and late Aug –early Sep 1969 (vol. 3 and 4) it is fairly clear that there are more tortoises and more signs (burrows, droppings, and especially trails) of tortoises around the El Chato area, ponds above the Caseta, and Caseta pond #1 and its immediate area and area right around the Caseta and between it and pond #1 than [Marginal note: also Region 4 pond are of Z#3 – Caseta trail]

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in these same areas in late Aug – early Sep – this is discussed in my notes of 19 Oct 1969 in more detail – still can't say if this concentration of the last 3 weeks involved "vertical" movement or simply tightening up around pond from all immediate sides and areas - but movement upward of #3 ♀ might indicate something?
That a general drying is occurring even while some slight garúa is continuing is clear – today the water level at C. pond #1 stake reads 33 cm – a 2-cm drop in about 10 days in spite of 10.4 mm garúa here in the last week.(1800, 19 Oct to 1900, 27 Oct)
Weather data – 1900 hrs; max 75 F; min 67 F; Rainfall 0.45 mm. Evap. 1.2 ml (reading 18.6 m., al since 0700, 20 Oct 1969)

(Pg 70)
29 Oct 1969.
To Zone 3 NA to take nest temp and moisture measurements.
Stopped at region 4 on the way and found rainfall of 0.27 inches (=6.9 mm) and evaporimeter was dry. Refilled it full at 0715 and proceeded on.
In Zone 3 NA at 0815; rainfall there of 0.17 inches (=4.3 mm); evaporimeter also dry and refilled full at 0830.
N.R. no registration on instrument; i.e. , 15%-20% soil moisture measurement starting today at 0900.

10-29-69		0900	1000	1200	1400	1600	1800	2000
Nest 5 cm		NR	NR	NR	15%	15%	NR	--
14 cm	30%	30%	30%	31%	30.5%	30.5%	--	
Control 5 cm	NR	NR	NR	15%	15%	NR	--	
14 cm	22.5%	22.5%	25.0%	28.0%	27.0%	24.5%	--	

10-30-69	0600	0800	1000
Nest			
5 cm NR	--	NR	
14 cm 29%	--	30%	
Control			
5 cm NR	--	NR	
14 cm 18l%	--	20%	

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Nest #9, probe 31 in nest Time

Position	0900	1000	1200	1400	1600	1800	2000	2200	2400	0200	0600	0800	1000
1	29.3	34.9	47.5	48.3	39.5	31.7	28.7	26.7	--	25.1	22.9	24.7	30.0
2	27.3	31.0	41.2	42.0	38.2	32.7	30.0	27.8	--	25.9	24.0	24.5	28.8
3	25.6	27.0	35.5	33.3	34.5	33.2	31.3	29.5	--	27.6	25.8	25.5	27.0
4	25.6	26.0	28.7	26.8	28.5	30.0	30.2	29.8	--	29.0	27.5	27.0	27.0
5	25.9	26.0	26.5	26.2	27.9	29.1	29.7	29.5	--	29.0	27.8	27.5	27.3
6	26.4	26.3	26.3	26.0	27.1	27.8	28.3	28.5	--	28.4	27.8	27.5	27.5
7	26.0	26.3	26.3	26.3	27.3	28.1	28.5	28.5	--	28.4	27.5	27.1	27.5
8	26.0	26.5	--	26.3	27.0	27.5	28.0	28.1	--	28.4	27.5	27.1	27.5

Nest #9, probe #2, control , beside nest.

1	30.9	36.8	42.8	52.6	37.5	29.0	27.0	25.4	--	24.0	22.3	24.5	30.0
2	29.0	33.0	36.5	48.0	38.0	30.8	28.3	26.5	--	24.9	23.4	24.5	30.0
3	27.0	30.0	29.6	42.7	37.1	31.9	29.1	27.5	--	26.0	24.5	24.5	28.9
4	25.1	26.4	26.0	32.0	33.4	32.3	30.5	29.1	--	27.7	26.5	25.6	26.9
5	25.1	26.0	26.0	26.3	26.4	28.0	29.0	29.1	--	27.7	26.5	25.6	26.9
6	25.6	26.0	26.3	26.4	28.0	29.0	29.1	28.8	--	28.7	27.5	26.6	26.9
7	25.8	26.3	26.3	26.0	27.0	27.9	28.2	28.0	--	28.2	27.8	27.0	27.1

(8) 26.3 Note at bottom of this table suggests a juxtaposition of data from probe 1 1200 hr readings to Probe 2; i.e. probe #1 reading appear in #2 column and vice versa. –**This change has not been made – data were entered as originally written but change should be considered in any use of these data.**

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Nest # 12 probe in nest

Position	0900	1000	1200	1400	1600	1800	2000	2200	2400	0600	0800	1000
1	29.0	31.4	41.5	46.8	34.4	27.6	--	--	--	21.3	23.7	29.1
2	26.5	29.0	35.6	42.0	35.7	30.3	--	--	--	22.6	23.5	27.0
3	25.7	27.6	32.7	28.5	35.3	31.0	--	--	--	23.3	23.6	26.4
4	24.6	26.0	28.9	33.3	33.8	31.5	--	--	--	24.4	24.2	25.4
5	24.6	25.5	26.9	29.6	31.5	30.5	--	--	--	25.3	24.8	25.2
6	24.6	25.0	25.9	27.1	29.4	29.5	--	--	--	25.8	25.4	25.2
7	24.8	25.3	25.3	25.1	26.9	27.5	--	--	--	26.3	26.0	25.2

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Weather conditions and comments while marking readings today.
0815 – Overcast light breeze; overcast as far as can see
0900 – conditions still same; some slight radiation coming through the clouds but not enough to make even slight shadows; can feel the slight warmth however.
1000 – sun out for about 5 min right around the hour and just before and while reading probes in nest #9; by time got to nest #12 again overcast; slight radiation coming through occasional thin parts of clouds as they move overhead making very faint shadow but still basically and mainly an overcast day with light breeze.
1200 – remained overcast almost all the time except for a few very brief partial breakthroughs of the sun from 1000 till 1140; at just about 1140 –1145 the last of the cloud front moved away to the N and the higher altitudes and the sun came out full; at the time of taking measurement at 1200 was clear and a brightly sunny and could really feel the air heating up.
1400 – still bright and clear since before 1200; for last 2 hrs. big, fluffy cumulus moving over giving brief 1 seconds to few min respite from the blazing sun, but sunny damn near the whole time. Light breeze.

1600 – Remained sunny till 1430; from then till now mostly overcast with weak radiation coming though now and again; had cooled noticeably and is at this moment gray overcast and light breeze.

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1800 – Remained overcast all of time till now since 1600; just now clouds have cleared from ocean to about directly overhead but still blocking sun which is of course well in the W and almost down.
2000 – warmish night; partly overcast, but spottily clear sky; especially in direction of sea to the S can see some stars. Can feel that it is warmer here than at the Caseta at same time of day – maybe 7-10 F warmer here? Light breeze blows now and again as it has all day long.
2200 – Same as at 2000 basically; air temp – 74° F.
30 Oct 1969
0200 – Remained overcast mostly from 2200 till 0145 when began a light garúa; took measurements in rain.
0600 – rained from 0145 to 0430; then clouds became somewhat thinner but still overcast up to and including now.
0800 – sun came out for a few minutes at 0730, but still overcast rest of the time till now; some weak radiation coming though thin clouds now and then.
1000 – last of clouds passing over soon; then will probably clear by 1100-1200 and remain so for part of afternoon; has been overcast since 0800 and only weak radiation coming though clouds now and then.
1030 – leaving – clouds breaking up some more.

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While here today Jan took some black and white photos of probes in nest #9 and photos of nest #7 wall and some of digging activity around this nest. Also took some of nest #14 and its corral and immediate area. Scouted around some of the obvious potential nesting areas, around nests 1, 3, 6, 7, 14, 15, 4, 12, 9, and 2. A little W of #3, 6, 7 area and a little NE and E of the 34, 15, 12, area – saw a little evidence of tortoise attempted digging in this latter area but no nests; in all other areas saw no new signs which were not present 10 days ago or on Oct 7-8 and Oct 13-14, 1969 visits. There were no large "laying size" ♀♀ in the areas searched at all. In fact only saw 3 tortoises all day - #1144, still here, and another small one of about same size (CL 59 cm approx.) – the latter measured but unmarked; did not have time to mark him. Did see a small bit of what I think was fresh pig droppings in the nesting area – but no destroyed nests seen and the corrals of all the above mentioned nests are in fact in good condition.
Reexamined the nest in the area in view of my discoveries of 13 and 19 Oct 1969 and discussion with J. Black about the techniques of M. Castro and O Chappy. First, I am now convinced that the air space in these nests above the eggs is largely a result of O. Chappy's not putting soil back in on top of eggs after he opened nest, removed, marked, and counted eggs and replaced them

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in the nest. J. Black testified to his normal failure to do this, and the solid hard cap of the nest makes a nice roof which would allow one to remove and then replace the eggs without replacing the loose soil originally taken off of the tops and from around them.
Secondly, nests #13, 14, 15 which were never opened are all in very good condition – hard caps in good solid condition, no "leaks" of fine soil into the nest as far as can tell from the top, no rat, mouse, or insect holes, and no signs of any other problems.
Nests 9 and 12, opened by me and then reclosed carefully like found, loose soil replaced on eggs and a mud cap constructed above, are also both in perfectly good condition as 12, 14, 15. On nest # 12, the cap is superficially cracking a little as it dries out very thoroughly, but I think it is solid all the rest of the way through. Finally, all the opened nests (Castro-methodology) were in questionable condition; the case of # 7 was described in 19 Oct '69 notes.

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Found that in all the other nests examined, O. Chappy had done same thing—after failing to replace loose soil on top of eggs, between them and the hard cap, he simply used a piece of lava or two and/or a few pieces of the broken cap from where he opened the nest and plugged up his entrance hole with them—then spread a little loose soil over the top of all this.
Examined Nests 1, 3, 6, 7, 4, and 2. Found small holes where loose soil had sifted down in to the big artificial cavity which O.C. had created in nests # 3, 6, 4, and 2. In 3, 6, 2, all the eggs I could see and/or feel after removing rocks or dirt clods of C. Chappy were O.K.—but insides of nests were noticeable, very dry to the touch—problems???? In 4, the whole hard cap had broken into about 4-5 main big pieces, I think due to the weakening caused by the chunk which O. C. had removed and then loosely replaced without recentering it into the whole structure. As a result, one piece of the hard cap had slipped down and crushed in the top of one egg. The egg was completely eaten out inside by insects and only the shell remained. Removed this shell; all the other eggs seemed O.K.
I refilled all 4 of these nests with fine loose soil so that the eggs were covered inside and the space between the hard cap and the eggs filled to give

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support to the cap from below and protection to the eggs in case the caps crack up over time. For Nest # 7 had done this same thing previously. Finally, made some mud and restructured part of hard cap O. C. had broken up in nests # 3, 6, and 7. In 4 and 2 did not do this because of limited water supply and extensive reconstruction. they would require; however, the simply filling of these with fine soil should help considerably in case of heavy rains—will absorb some of H_2O and tend to cut down on flooding of nest—this is probably one of greatest dangers of Castro technique—exposes egg cavity to easy filling with rain water, almost like an earthware pot!
Nest # 1 was like #7, but with an even layer open hole leading into it; opened it and could see and/or feel 7 eggs; 5 were O.K. but 2 uppermost were broken into, but on their sides in relation to the top—looked clear that a rat or mouse had opened them up and there was a

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rat fece in the hole in fact. Both eggs were partly eaten out, rotten, and covered with ants. Removed them for later examination; filled in the hole with loose soil and packed it in around the top where the hard cap used to be complete—i.e., where O.C. opened it up—lack of H2O prevented reforming mud cap, but did same as with nests # 2 and 4.
Will try to finish repairing nests 1, 2, and 4 when have more H2O to spare.
30 Oct 1969
Arose 0530 and began measurements again at 0600 (also took at 0200 in the rain las night—very unpleasant!)
Something of interest: At 0615 while still cloudy, found #1144 out and moving along, very active—this is of interest because he was clearly active till at least 1730 last night as was the other unmarked animal of similar size. This contrasts with the patterns at the Caseta where arousals have been occurring normally between 0730-0800 and retirements anywhere from 1515 to 1715, but with a majority from 1600-1700; these 2 small ones may have been active even after 1730 but did not keep track of them beyond that time—were still not "burrowed" then.
The air temp at 0630 was 71.6°F, certainly at least 3-5°F above present time at Caseta at a minimum.
At 0745 saw small unmarked one moving along toward area of nests 3, 6, 7, 9, 14; about 50-60 m straight line from where he was last night. He is very near, 10 m, #1144. Certainly must have been active for a while

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this a.m. already because I searched the area he just crossed at 0630 and could not see any sign of the little beast.
At 0830 saw another small unmarked one (CL—62.5 cm) just a 70 m stretch or so S of the above 2; also active and moving about.

In past day and this morning have walked over most of the big open part of Z 3 n.a. and made 3-4 short side trips out from it; in all this, still have seen only these 3 small ones; no large females!
Went down S and checked Nest # 5; it had a large (3 cm diam.) hole caved in to one side of the nest—this was the place where O. Chappy had removed a piece of the hard cap in order to enter the nest. The soil around this area is loose and had sifted in and partly filled over on top of the eggs—about 4 cm of soil covering them; I removed this and checked top 2 eggs I could see and feel—O.K. Refilled hole full of the loose soil and placed 2 lava rocks over the hole and then covered this all over with loose soil; perhaps will reconstruct hard cap at a later time.
Between main open area of Z. 3 n.a. and Nest # 5, did not see any

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tortoises in looking around for about 1 hr. However, found 2 more nests destroyed by pigs –both not too far from the one O. Chappy and I had found previously on Oct 13-14 trip to La Fe—one of the new ones was between Z. 3 n.a. and the old one, the other between the latter and nest # 5. Neither was extremely fresh—the lower one looked like the previously discovered one and is undatable; the upper one may be only 1-2 weeks old as the shell fragments are still a bit limber and there is some moist soil in the hole where the pig rooted around—however, this could be rain seepage—yet the old one and the lower one had no moisture at equivalent depths and locations.
--Anyway, took photos of all 3 nests with black and white and Kod. II (Roll# [_____]). These photos include general shots of the area where nests are being made here.
--All 3 of these nests are located in soil of the same type and places like Nest #5: fine (**very fine**), medium brown soil (not like the darker brown, layer clumped type of Nest # 1) and in areas where most of surface is covered by scattered rocks and boulders and enough solid for nesting is scattered very irregularly here and there—in this sense it reminds me of the nesting area before Cerrito; most of the area in this overall region is fairly solidly covered with rocks, and these little open spots and low places where nesting is possible are scattered all about through the general terrain. These areas are not as open and clear as those in the red pampa area of the central part

(Pg 82)
of Zone 3 nest area.
The 2 newly discovered destroyed nests are interesting because both were made right in between some large, imbedded lava blocks—quite a feat for a rangy, gangly ♀ tortoise. The photographs will show this fairly well; the digging area the tortoise had to work with was only about 20 x 20-35 cm in each case yet a successful (in sense of getting eggs in ground and a cap on top) nest was made; the nests seem to be of normal depth (10-25 cm for eggs) as far as I can detect—although it is hard to picture the nest clearly after the pigs have ripped it up. On one nest there was clearly a soil constituted hard cap made—mud and all. On the other new one and the old one no hard cap material was obvious but there were some small lava rocks covered with a little dry mud and some small pieces of what was wet soil now crumbles, which were probably parts of the hard cap.
These nests certainly verify that nests could at least theoretically be dug in the patches of soil occurring higher up in region 4 where the

(Pg 83)
new thermocouple rod has been installed; there are open patches there among the lava blocks of both layer size and I think deeper total soil depth than the areas here where nests are being made.
Found some brand new fresh pig droppings down near Nest # 2 at 0835 this morning but nest is O.K.; these droppings are extremely fresh and were not here yesterday afternoon around 1530 hrs.
At 0830, the 24 hr. totals were: Rainfall—0.033mm; Evaporation—47.ml.
1030 hrs.—leaving for Region 4; total of evap. to now since 0830 yesterday—5.2 ml; rainfall 0.033mm.
Region 4—arrived 1115—overcast, but below us on first half of trail was sunny; may be overcast at Zone 3 n.a. again now however.

Total Evap. on arrival—5.2 ml; rainfall, a bit of moisture in bottom but not enough to register.
Soil block measurements of moisture:

	Time									
Depth	1200	1400	1600	1800	2000	2200	0600	0800	1000	1200
5 cm	30%	30%	30%	30%			27%			
14 cm	20%	20%	20%	18%			19%			
20 cm	20%	20%	20%	19%			19%			

[Editorial Note: Under 2000 and 2200, notation of "not taken"; under 0800, 1000, 1200, notation of "not taken—instrument not functioning" was made.]

(Pg 84)
Weather comments
1200—Overcast still complete here—don't think has been truly sunny here yet today; some radiation coming through thin clouds however; at Zone 3 n.a. I think it is now clear and sunny from looks of lack of clouds to our S; probably got some sun there in spots from 1030-1100 and cleared off at 1115-1130 or so and has been sunny there since, would guess.
1400—Still overcast here and has been so since arrival; weak radiation coming through thin parts of clouds now and then. Looked clear and sunny in Z. 3 n.a. all this time.
1600—Sun came out about 1540; before that time clear and sunny at Z. 3 n.a. (and still is) but overcast here.
1800—Sun setting; clear till sunset although probes not getting much light after 1700 because sun so low in sky.
2000—Clear, starry night since sunset; feels cool; clear in Zone 3 n.a. too I would guess.
0600—Became overcast sometime after 0200 and remains rather heavily cloud covered now; does not look any clearer now in Zone 3 n.a. either.
0800—Conditions still the same; faint occasional breeze; fully overcast; also overcast in Z. 3 n.a. but perhaps lighter cloud cover there—maybe more weak radiation getting through than here—very little of the latter here.
Continued on page 88.

(Pg 85)
Will take samples of animals in Region 4 and around its pond from 1300-1400 and
1430-1530: Covered area around pond only–one big loop.
#1359 ♀ near weather instrument area; same area as tortoises below—See notes re: 891 faint growth increments CL—92.8; CW(CDRS)—97.7; CW(VD)—89.5
#206 or 906 ♀ (prob.?); the 7 mark for the hundreds is very peculiar; but will remark as 206 because think that is right. Has nice, well developed clean white growth increments; eating Plant #1 (which is drying out somewhat here now). In same area as #135. Mud (wet) on carapace; has been in pond.
CL—; 69.3CW(CDRS)—71.5; CW(VD)—65.5
New: ♀(prob.) 1167, same area as above 2 tortoises; resting in "shade" from weak radiation. Very clean, with white growth increments. CL—74.0; CW(CDRS)—75.0; CW(VD)—68.5
#713♂ (#13 possibly) 7 scute appears to have been cut. Fairly clean thin white growth increments. CL—91.7; CW(CDRS)—96.8; CW(VD)—89.0. Near same group of tortoises as above. Edge of dried pond area.
#891 ♀ Same area as above tortoises—both 7 marks poorly made - will recut. Clear growth increments. It and #135 were hard to read; #135 retracted as though the loser in an aggression. CL—70.4; CW(CDRS)—80.5; CW(VD)—75.0
#1168 ♂(prob.) Coming from dryer part of pond—fresh Azolla and mud on shell. Faint increments—not complete between all scutes. CL—73.1; CW(CDRS)—72.7; CW(VD)—66.0

(Pg 86)

#694 ♀ (fairly large). Near pond on its W side—faint but distinguishable growth rings, center of carapace scutes are worn smooth, but the growth rings are very visible. Almost no flaking disease. CL—90.0; CW(CDRS)—98.0; CW(VD)—90.0. Obvious wet mud on shell—recently in pond.
#450 ♂(?) Tail in between length; will remark—all marks indistinct; in pond, but dry portion (no standing water) (pond), eating herbs; very faint but clear growth increments; CL—68.5; CW(CDRS)—71.5; CW(VD)—66.0
#502 ♂--Fairly large (not Chato-sized) animal; good case of flaking disease; faint but clear growth increments in mud at edge of pond (largest animal yet seen in Region 4 by us. CL—109.6; (too far in mud for other measurements)
3 in areas of standing water and mud (area of 3 x 3 m). One animal as large as #502 and 2 of 75-80 cm CL animals; unable to reach for mud.
#1135 ♀ (maybe). Side of pond on drying mud; has recently been in pond; clear growth increments. CL—65.2; CW(CDRS)—68.0; CW(VD)—63.0
#693 ♀ Nice growth increments; shell in similar condition to #694—no flaking disease. CL—82.3; CW(CDRS)—85.2; CW(VD)—77.5
1 in water near areas as above 2 (similar size to 693). Can't get to it to read number or sex.
#406 ♂ out away from pond; extremely well-defined growth increments yet is old for each scute central area is worn smooth and growth rings are evident only around borders of scutes. CL—123.2; CW(CDRS)—131.6; CW(VD)—120.0
Also saw #1074 moving S just on edge of Region 4/5 border as we were coming into Region 4 at 1105 hrs.
Total of 17 animals and certainly many more in center of pond we didn't see.

(Pg 87)

Region 4. Probe in Soil Column

	Time									
Position #	**1200**	**1400**	**1600**	**1800**	**2000**	***2200**	**0600**	**0800**	**1000**	**1200**
1	36.5	36.8	35.4	25.9	23.3	Not	22.2	25.8	36.5	32.0
2	34.9	35.1	34.4	26.2	23.6	taken	22.2	25.4	34.5	31.3
3	31.8	32.9	32.8	27.7	25.1	flashlight	23.0	24.5	30.0	30.5
4	29.4	30.8	31.1	28.5	26.5	failed	23.8	24.5	27.6	29.5
5	26.1	28.0	28.7	28.8	27.5		25.0	24.9	25.5	27.1
6	25.2	26.4	27.3	27.9	27.6		26.0	25.5	25.1	26.0
7	25.2	25.5	25.9	26.5	26.9		26.4	26.1	26.0	26.0
8	25.8	25.5	25.8	26.3	26.4		26.4	26.0	25.8	26.0

*Not taken; flashlight failed

(Pg 88)
Weather cont**.** (30-31 Oct)
1000—sun broke through for about 10 min just before 1000; otherwise since 0800 overcast, but clouds becoming a little thinner all this time and therefore weak radiation coming through then increasing over this period, especially from 0900-1000; looks as if same conditions prevail at Zone 3 n.a.
1200—Still mostly overcast completely; from 1000-1115 clouds thin and weak radiation coming through; from 1115 till now heavier overcast again and looks as if will be so for a while; very little radiation. Condition at Z #3 n.a. as far as can judge from here must be similarly overcast with perhaps thinner clouds most of the time.
1300 and on—See P. 93ff.

(Pg 89)

31 Oct 1969
Arose 0530; rather warm feeling due to completely overcast sky; doesn't look as if it will clear very early this morning if at all.
At 0730 check weather instruments to get a 48-hour total—1) Rainfall: 0.0mm; 2) Evap.: 9.0 ml
Will continue measurements this morning to complete the 24 hour cycle; will comment upon the * general macro-meteorological conditions of 29-31 Oct after finish the measurements today.
Am exploring the area of Region 4 a bit more and will record any animals seen:
0815-0840: made a big loop out from weather instruments to S and W of pond and back around to starting point. The entire area covered with low guayavillos, matazarnos and an occasionally Pisonia; Plant #1 forming a dense understory, which is mashed down, perhaps over ½ of the total area viewed (several acres at least) by tortoise pathways. Activity has certainly been great in this area for the past 2 months or so judging from this, since this species was not high enough to be crushed down thusly making such a strong visual impression, until late Aug or early Sep. It is not possible to judge how long ago these trails were made since they remain this way for a long time—have seen some made in late Sep—early Oct which are still as when first encountered, only a bit drier, like the veg in general now. No animals encountered in this loop, although saw a variety of

(Pg 90)
droppings in various stages of drying—none more recent than a few days old. In general, get the definite impression that the animals are concentrated in around the pond now whereas in early Sep they were more spread out over the general terrain—e.g., we saw scattered individuals all through the area just surveyed, as well as along the trail where it cuts through Region 4, W of the pond. Now there are almost none along the trail here, none in the area just covered (at least saw none) and yet most are in or right around the pond itself.
0840-0930: Wandered over areas to the W of the trail and the pond. In general a bit more lush veg., especially at herb layer, but probably due to denser canopy and general lack of as open an area as that nearer the pond and around the open rocky covered areas (like that in which the weather instruments are located) which are scattered here and there to the E.
Canopy largely same species, with small guayavillo, 20-25 feet and matazarno (up to 30-35 feet mostly), being the dominants. Thick undergrowth of small

(Pg 91)
seedlings—sapling sized stuff, Plant # 1, morning glories, other vines and viny herbs.
Somewhat less sign of tortoise activity--#s of smashed down veg trails and area they cover are considerably less. Also, most of droppings seen are older and drier than in areas more to E and around the pond. But some slight recent activity—a few fresh droppings and some trails.
Saw following tortoises in this area just W of the trail:
#908 ♀ Nice clear white growth increments; c. (carapace) scutes worn smooth only in very center and growth rings visible over almost all surfaces. Has dried mud on carapace indicating has been in pond recently. Only a very little of the flaking disease on front marginal carapace scutes. CL—78.6; CW(CDRS)—86.0; CW(VD)—79.5. Only animal seen.
This area certainly has generally taller trees, by 5-10 feet, a denser canopy in overall sense, and is more dominated by guayavillos (maybe ½ that species, ½ matazarno) than the area between the trail and the pond, which instead has the open areas mentioned above scattered through it and very few guayavillos; the tree height in the latter place is less and some areas, though not open in sense of having just herbs and rocks, have only shrubs over large areas (e.g. Clerodendrum molle).
Returned to weather instrument area at 0930 and found 2 animals in open area near where tarp is set up.
#206 from yesterday.

(Pg92)

#245 ♂ prob. Hard to sex because tail is sort of intermediate in size. White growth increments very fine, but present, not well developed however; this is the first animal have seen in this Region 4 area without obvious mud (dry or wet) on the shell indicating having been in ponds recently. Coming into the area?
CL—78.1; CW(CDRS)—86.0; CW(VD)—77.5
Went back to pond in Region 4 to read meter stick and take readings; in one very small area with limited visibility right around the stick can see 7 animals and hear 2 others. Two of these are large males and can see enough of #s so that I do not think from yesterday—almost certainly positive. Others are in water and can't get to. Did check 2 of them which are on dryer ground.
#304 ♂ Very faint growth increments. CL—110.5; CW(CDRS)—121.5; CW(VD)—113.5. Has just been in pond (mud and fresh Azolla on carapace).
#717 Nice clear white growth increment. CL—82.0; CW(CDRS)—88.0; CW(VD)—81.0
Just as was leaving saw another one heading into the pond also. On way back to W instrument area saw 3 more; #502 ♂ (yesterday) and 2 new ones; #76 ♂ (general size of 502) and an unmarked smallish animal.

(Pg 93)
#502 was leaving pond, small one entering it, and #76 grazing on Plant # 1 30 m W of the pond. I am quite convinced that there are at least 2-3X as many animals in this pond as we actually saw yesterday and it is certainly clear that the animals of Reg. 4 are concentrated in the pond area and are extensively utilizing it (as the general conditions become drier through the past month-2 months).
As in the case above, can see and hear a total of 10 animals in a space of perhaps 20 x 15 m.
Pond depth—24 cm (drying up); 1130 hrs
Weather instruments as leaving; 1200 hrs. Rainfall: 0.0 mm; Evap.: total of 10.4 ml since refilled at 0720 Oct 29, 1969.
Took some photos of pond and tortoises in it in Region 4; also of rocky open area where weather instruments are located (with tarp and Jan); these are on Roll # 27.
Returned to Caseta at 1315. From looks of sky below us, opening up and very clear and blue, I would guess that it is now certainly clear at Zone 3 n.a. and will probably remain so to sunset and after. Probably same at Region 4 area. In general, I think that Oct 29 and 30 were very similar days—i.e., cloudy till just before noon at Zone 3 n.a. and then clear till sunset; cloudy at Region 4 most of day till 1530-1600 and then clear till sunset. Thus the data for these 2 days on nest temps and soil moisture should be comparable and any differences due to altitude and soil types and not to macro-meteorological patterns; today, however

(Pg 94)
was certainly different—cloudy longer in Zone 3 than 2 previous days—till 1245-1300 at least, and clouds little sooner in Region 4 than 2 previous days—at 1300 or so instead of 1530-1600. However period of taking temps lasted only till 1200, so data probably fairly comparable.
1830 hrs (at Caseta): as predicted, clear till sunset and still clear all below us to the ocean; also cleared here at 1600 and still so; can really feel how much cooler it is here after dark (and even this afternoon) than in Region a4 or Zone 3 n.a.; however, to some extent this comparison to Region 4 may be due to clear sky here tonight and overcast one last night there; but was clear on 29th at and after sunset in Zone 3 n.a., so this feeling is certainly correct.
*Did not sample on return to Caseta but did notice 2 animals move just 100 m after leaving Region 4 campsite; i.e., really still in that region—both new, one unmarked and the other marked but failed to get its #, although it had not been seen during sample taking period, even though walked through the area where it was this morning

(Pg 95)
At Caseta saw a number of old timers still in the area immediately around the house and tent.
#31 ♂, #1006 ♀, #205 ♂, and #3 ♀ who just arrived here within the last 10 days from Region 3 below. (See notes of 28 Oct 1969).

Just after returning (1330) heard a groaning sound coming from near the tent—it was a slow, deep groan, maybe once/15 sec. although did not time it. Listened to this for about 5 min and then went to investigate; stumbled upon #205 ♂ mounted upon the back of #3 ♀ about 10 feet in front of the tent. She was down flat on her plastron, completely drawn into her shell (head) and with legs drawn in about ½ way; did not seem to be either repulsing or aiding the male—couldn't see her rear end but did not appear to have it either raised up or lowered to the soil—definitely not the latter anyway because forelegs not supporting body at all. The male was up in "normal" tortoise mating position, at about 45° angle to the ground level, with forelegs extended and forefeet extended and on the front—upper surface of her carapace—these seemed to definitely partly supporting him in his angular position. His plastral concavity was covering and fitting onto her upper-rear carapace surface. He had his neck stretched out very far almost parallel to the ground level and curved down a bit; his head was arched downward almost directly above the nuchal area of her carapace—i.e., if one

(Pg 96)
dropped and perpendicular from his head it would pass to her nuchal notch area; he was "looking" at the front of her carapace and letting out these groans; by time I got there did not see any movements or hear any more groans after this first one. Jan had arrived first and says she did not detect any obvious movements by either of them even thought she heard several groans while watching. In sum, we don't know how long all this happened, or whether it was a successful copulation or not.
Soon after we both arrived, the male saw us and within a few minutes dismounted, swiveled about and crawled away slowly; the ♀ sat a while and then crawled off also. We did get about 3 photos (Roll # 27) before the demounting occurred. Anyway, it is of interest that an attempted copulation occurred at this time of year.
Weather –1900 first readings since this time on 28 Oct 1969. Max.—82.5° f; Min—65.0 ° F; Rain—0.5 mm; Evap. 8.3 ml (reading 26.9).

(Pg 97)
Also took some photos of Region 1, open area around the Caseta, of Zone 3 n.a.—Caseta trail (Roll # 27).
1 Nov 1969
Tried to get to El Chato to check weather instruments, but thwarted at ½ way (camote patch) by a huge Guernsey-type bull, apparently escaped from farms above—won't let me pass—So checked a few tortoises on way back to Caseta—at 0830-0840 all of these are <u>just now</u> coming out of burrow along trail (Reserve border) between right angle turn near camote patch and trail down to the Caseta.
Saw 2 animals moving around in camote patch 0850-0900; these others seen at above time and just emerging.
#305 ♀ seen along here many times before, now about ½ way between rt. angle turn and top of hill with large trees which is ¼-3/8 mi. from Caseta trail turn-off.
--106 ♂ at top of hill mentioned immed. above. CL—94.3; CW(CDRS)—98.8; CW(VD)—92.0
--277 ♂ ½ way between hill and where "forest" starts—i.e., where Reserve border enters forest above Caseta; i.e., he has not moved far since seen on 18 Oct '69.
--#98 ♂ (prob., tail tending toward intermediate, but is longish); 100 m W of where trail (border) enters forest. CL—105.5; CW(CDRS)—118.0; CW(VD)—109.0
#505 ♀ (prob.) just a bit to W of where Reserve border enters forest. CL—108.5; CW(CDRS)—114.5; CW(VD)—104.5. Tail is intermediate length—tending to small.

(Pg 98)
Has some large patches of flaking disease in front and rear on marginals. However, shell is not worn smooth except for small patches of 1-2 cm diam. at very center of scutes. Otherwise, growth rings clearly visible; given this and the size, wonder if could really be a large female—certainly does not look nearly as old and worn as definitely identified old females like #3, #131, etc. which are even a bit smaller animals than this??
Went up to closest Guerrero's house just ½ hr. walk to NE of ponds above the Caseta; passed through dense Scalesia forest all the way to their property line, just a short distance below the house. While on trip looked for sign of tortoises and found that there were trails and droppings and occasional burrows in Scalesia forest just to

E and N of the Caseta upper ponds—i.e., around Devine's cut and a little bit E and N of this—would estimate that furthest sign from pond area only about 0.2 km at most; But there is abundant activity and evidence of tortoises at and all around the ponds and the open area below them (in between the Reserve border above the Caseta and the ponds).

(Pg 99)
Made a quick sample around the ponds in between Devine's 2 cuts and down to the Reserve border—i.e., a big square area; just wandered randomly through this open area and looked at all the ponds—saw the following animals:
--#627 ♂ just above Reserve border eating grass in open area. CL—104.2; CW(CDRS)—119.0; CW(VD)—111.0
--#265 ♂ (prob.; hard to tell because tail is partly smashed!); just below ponds about 20 m; CL—100.0; CW(CDRS)—111.0; CW(VD)—99.5
--#258 ♂ same area as # 265 at 1000; at 1130 saw again, at pond # 2 eating grass and then in water at 1300. CL—115.3; CW(CDRS)—129.8; CW(VD)—119
--#852 ♀ in Scalesia forest, about 75 m E of ponds. CL—89.0; CW(CDRS)—91.8; CW(VD)—84.0
--#692 ♂ moving from Scalesia forest just W of Devine's eastern cut into clear area below ponds. CL—101.4; CW(CDRS)—111; CW(VD)—102.5
--#1072 ♂ at pond # 2 on edge eating grass. Very nice clear white growth increments. CL—123.8 CW(CDRS)—137.7; CW(VD)—127.5
--#505 ♂ at pond # 2 on edge eating grass; Note: has moved up here from Reserve border trail since 0900 this morning; now 1200 hrs.
--#134 ♂ just E of pond # 2, extending into mora just this side of Devine's western cut; lots of trail areas in this area out into mora, but all end; fresh droppings in most of these trails! CL—96.4; CW(CDRS)—102.8; CW(VD)—95.5
#598 ♂ (prob. int. tail length)—under dense shrubs and cannot make measurements—near pond #2.
Tortoise are using pond heavily - wallows; disturbed. Also took photos (Roll 28) of drying condition of pond. Still standing H2O, but mostly mud and little Azolla left.

(Pg 100)
While in pond area found an animal which had obviously been slaughtered fairly recently (maybe 6 months?). We took 1 photo on Roll # 27 and 21 on Roll # 28 of these remains and general area. The animal had obviously been killed by some person(s) and then moved under a tree and partly hidden there by the dense vegetation (herbs and shrubs) and low overhanging branches. One half of the plastron had been completely cut away—it was cut down the center (knife marks evident) and then cut through cleanly through the plastral bridge area on one side (knife marks also obvious in the bones and scutes in the bridge area). Then, apparently, the meat, fat, etc. was removed through this opening. The legs (skin and bones) are completely missing, and also could not find the head or the chunk of plastron which was removed; this indicates killed elsewhere and then hidden under the tree, as mentioned. Only parts found were carapace, part of plastron (1/2) still attached to carapace, vertebrae, and skin of tail. Hard to judge age, but scutes are all free of the carapace bones and came off easily when

(Pg 101)
simply touched; also no meat on vertebrae or inside carapace and no stench of rotting remains at all—under the carapace found a big compost pile made up of rotting vegetation and vertebral parts—covered inside with ants, cockroaches, etc. Carapace bones still fully intact and sutures in good condition.
Will save scutes and carapace—
Animal's # is 427 and from what remains of tail could be a ♀; but will have to check Station records as can't be sure. This animal was definitely not here in Aug 1968, but could have missed seeing it in Aug-Sep of this year because fairly well hidden. One possibility is that it was killed by Devine's men while they were cutting one or

the other of his new cuts which come down from the N to the Reserve northern border; they obviously spend some time in the pond area because cut a small trail in from their western cut to ponds (only 20-30 m) and there are some old camping scraps, plastic bags, etc. in that area; also, easy access by Guerrero's trail from Devine's eastern cut to the same pond area. Anyway, will investigate these possibilities to the extent possible.
Also took a walk down to Caseta pond # 4 for exercise—this pond is now dry and full of tall (1/4 - ½ m) Plant # 5; has been dry since late Aug-early Sep except for some mud in early Oct; are a few

(Pg 102)
small holes around it which had H_2O in them in early Oct but are now only thick, drying mud. Just in one area around this area saw 4 animals; ♂♂#s 104, 220, 712. One more animal of # and sex which could not identify because of being thoroughly burrowed in (1600 hrs.).
Weather data (1900 hrs): Max.-- 79°F; Min.--63°F; Rainfall--0.0 mm; Evap.--2.7 ml (reading 29.6 ml). Refilled evaporimeter full at 1900.
Was overcast all day, but clouds thin enough for short periods of 10-15 min this afternoon to allow some weak radiation through. Overcast tonight and can feel that it is warmer than under clear sky last night.
2 Nov 1969
Went over to El Chato early to check weather instruments; had to pass the same bull, but sucked up my guts and strode by him—obviously nothing happened—however, am now at El Chato and still have to pass him on the return trip.
On way over noted some things of interest about activity periods--I passed 6 animals by time reached camote patch. This was

(Pg 103)
between 0725-0735; all but one of these was out of its burrow, still near said burrow, but already grazing a bit on grass, Passiflora and the like. In fact, one animal (#305) has already moved about 15 m from its burrow along the Reserve border. The one animal still in its burrow was ½ out of its when I saw him at 0730 and was awake and looking about. Most of these animals were same ones as noted activity on yesterday—checked some #s—1072, 98, 627, 305, 277.
The point of interest is that at this time it was still overcast and a light breeze was blowing. Yesterday at about 0830, these same beast in nearly the same exact locations were not this far along toward emerging—every one of them yesterday between 0830-0840 was either still completely in its burrow or at least ½ inside; most of them were awake and just beginning to move and look about—the interesting point is that the night and early morning of Oct 31-Nov 1 was with a clear open sky and was cooler than last night. (Taylor min. temps at Caseta—Nov 1: 63°F; Nov 2: 63°F). Perhaps this accounts for the beginning activity times—not min. temp. but total # cool hrs.? Sunshine or lack thereof could not because both days were overcast at sunrise and well afterward. **[Marginal Note: "Overcast and rain last night—no clear sky at all!]**
At Chato—things about the same, only veg a little more lush and high, but general drying trend continues. For example

(Pg 104)
many of the ponds which had soupy mud and/or a little standing H_2O on visit of Oct 18, 1969, are now only a stiff mud in consistency. Pond # 4 fits in this category. Pond # 3 which was full of thin soupy mud (and wallowing tortoises) still has the tortoises (3 huge males) but the soup volume is way down and the mud thicker and the big boulders in the pond bed are beginning to stick up out of the pond clearly now.
As to tortoise #s and activity—appears to be about the same—one difference is I have noticed a lot, (6-8) of smallish ones (60-80 cm curved length) this morning and do not recall seeing many of this size before. The guayavillo forest and semi-open forest on the hill to the N and NE of the ponds and El Chato proper are crawling with tortoise and honeycombed with trails, smashed down and eaten veg areas, fresh and dried droppings, etc. In all tortoises and conditions are fairly

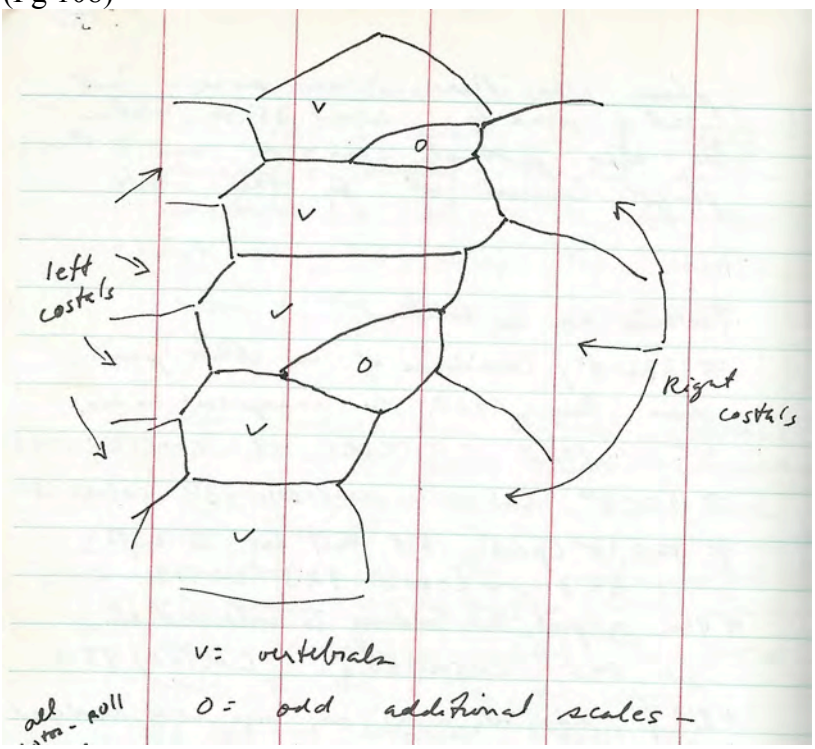
(Pg 105)
similar to 15 days ago, but everything is a bit drier. The animals have now extended their activities to about 0.3-0.4 km to the E of the El Chato turn-off along the Reserve border also—this is perhaps 0.1 km further than 2 weeks ago. Weather Data 0830 hrs.: Rainfall--0.40 inches (= 10.2mm); Evap.—29.9 ml. Refilled evap. full at this time.
On return checked locations and #s of some tortoises: on Reserve border and adjacent to it.
#73 ♂ (old timer from this area)—1/2 was between right turn and first hill away from forest (above Caseta).
#277 ♀ off of border 15 m to S in big open patch of Commelina, Echinoyappan, Plassiflora—eating Commelina. About 100 m to W of hill mentioned above (saw yesterday).
#291 ♂ same area as #277, but 15 m off of border on other side to N
#187 ♂ very interesting animal; has abundant flaking disease on almost all parts of carapace most on front and rear marginals; also very much on 5th vertebral and rear costals. He is of medium-large size, and probably not excessively old in that only the small central areas of the carapace scutes are worn down; growth rings are otherwise quite visible; also, white growth increments are fine and thin, but visible. The carapace is very clearly deformed in two areas—it is slightly depressed on the animal's

(Pg 106)
front right area, in the region of the first 2 costals; it is deeply depressed and almost twisted or contorted a bit on the animal's left rear, involving the last 3 costals and the last 2 vertebral scutes.
Also checked up Devine's western cut which is now full of luxuriant pangola grass about ¾ - 1 m high; found a group of animals concentrated in the cut, eating this grass and the other herbs which have grown in where the mora used to be; they are about 20 feet in altitude above the Caseta upper pond area and about 180-200 m above the Reserve border proper. Since the lower end of the cut has an undisturbed patch of mora abut 5 m thick separating the Reserve border and the cut, I think these animals got into the cut by way of the C. upper pond area by just plowing a short distance through a little mora; also, the forest extends to the cut in one

(Pg 107)
place where there is no mora, just W of Pond # 2 about 35-40 m—they also probably can and do come to the pangola covered cut by this route.
Tortoises are as follows:
#336 ♂ (evidence of my white paint from Aug, 1968 on carapace sides). CL—102.8cm; CW(CDRS)--113cm; CW(VD)—104.5cm;
#255 ♂. CL—120.4cm; CW(CDRS)--134cm; CW(VD)—120.5cm;
#720 ♂ (prob.; but tail int. in length). CL—84.3cm; CW(CDRS)—92.5cm; CW(VD)—84.5cm;
#782 ♀ (prob.—tail tending to intermediate). CL—84.5cm; CW(CDRS)—88.8cm; CW(VD)—83.0cm;
#819 ♀ (definitely a ♀) very nice well developed growth rings. CL—97.2cm; CW(CDRS)—111.3cm; CW(VD)—100.5cm.
Very odd carapace—on animal's left has 4 normal costal scutes, but on right only 3; has 5 vertebrals, but impinging on these and crowding in on them are 2 smaller scutes—one triangular and wedged in between 3rd and 4th vertebrals (resulting in their being misshapen); the other is likewise wedged in between 1st and 2nd vertebrals and is sort of arrowhead shaped.

This is hard to describe and is drawn in top view as follows:

(Pg 108)



v = vertebrals
o = odd additional scales

Returned to this area of Devine's cut at 1530 and took some photos of the above deformities of # 819 ♀.
Also took photos to N of Devine's western cut covered in part by pangola grass, and photos back toward pond area to SE showing little forest peninsula and mora and pond region above Caseta (Pond # 2) where these tortoises are coming from onto Devine's cut. [Editorial Note: At this point, there is an arrow pointing to continuing text at bottom of Page 109, which follows here, and not retyped on Page 109]
When returned to Devine's cut at 1530 found that # 336♂ had progressed another 75 m N and was along border of pangola grass and some berry fruited herb (in new strip Devine cut—1969) eating only Commelina. Doing virtually no damage to grass itself.
Also a photo showing that tortoises are not eating pangola or if so, very little; they are working up cut to N along edge of mora and pangola interface and mainly eating Commelina and a few other herbs in these areas. [Marginal Note: They are smashing down small paths through the pangola, but not damaging it.]

(Pg 109)
Also, saw #106 ♂ this morning at about same location as yesterday. At 1330 hrs saw #305 moving deliberately along Reserve border at a slow steady pace, just 50 m away from forest above the Caseta. This is interesting because yesterday at 0830 was in a burrow about ½ way between first hill and right turn in Reserve border (in between El Chato and Caseta). Then this morning at 0730 was seen near top of hill, but on its W side, eating grass and only 15 m away from last night's burrow. Then at 1030 this morning was about 75 m over (to E) hill and moving E steadily along the Reserve border. Looks as if is moving deliberately and steadily back to area of forest (just above the Caseta and right near the Reserve border) where was seen to spend about 2 weeks in mid-October, 1969. Apparently from there worked out and fed along Reserve border for about 1week and is now

returning over same route. Each time seen today except at 0730 (i.e., 1030, 1330) was moving along steadily and not feeding. This would give the beast a movement rate of about ½ mile in 3 hours.

(Pg 110)
From trails seen, all the other animals are still lower down and further S, although only saw #815 of the other 4. On closer investigation found that have not been entering Devine's cut by way of forest peninsula mentioned above (not as yet anyway!). Instead there is a "one tortoise wide" path from Pond # 2 up through the mora along a natural depression and into his western cut—apparently all 5 beasts got here by way of Pond # 2 and this path—trails and droppings occur only in this one small area of the cut, rest to S or N of here and then into mora and to Pond # 2 as stated; trails in cut are all fairly fresh, and veg is pliable and moist; therefore I doubt any of these animals have been on his cut for any longer than 1 week at the most. The question remains as to whether and if so how many will work their way up to highlands along this newly opened pathway.

(Pg 111)
Devine visited today with his wife and he claims have always been a few tortoises near his house every year from late Nov—early Dec. till first big rains (if they come, or garua season if no big rains!); they then go back down after good rains or garua starts. His wife seemed to question this, i.e., as to whether there were many, if any there, and when. But they would not clarify their argument or comments. When I asked if tortoises used to get to his land through mora by simply slowly burrowing along, i.e., before cuts existed he said he guesses they must have. Anyway, this all is in some doubt since am not sure when he is semi-politically (in regards to CDRS and Nat'l Park) trying to impress one and when being honest. Of course, few tortoises on his land in past years could have been residents which never do more than shift around horizontally a bit and not true "vertical" migrants.
Checked by Pond # 2 on return (1600 hrs.) 4 tortoises in mud and H_2O; as further proof of directional movements to H_2O and deliberate movements—one of these in H_2O was # 305 ♂ from earlier today—i.e., another 100 m moved; the other was #692♂ seen moving this direction from E near Devine's eastern cut, yesterday, about 1200 hrs.

(Pg 112)
As returning to Caseta saw more tortoises:
#216 ♂ at Reserve border, just into open area below C. upper ponds. CL--123.4 cm; CW (CDRS)--132.0 cm; CW (VD)--120.0 cm.
#376 ♂ at Reserve border, Caseta trail intersect; has obviously been in pond recently because of H_2O plants on carapace along marginals. CL--113.3 cm; CW (CDRS)--122.7 cm; CW (VD)--112.0 cm.
Saw # 1072 burrowed in at 1600; still wide awake, so perhaps recent; This would make his activity period for today 0730-1600 or 8 ½ hrs. Should note that whereas he was burrowed in at 1600, several other animals were still active and several were in the pond above, inactive.
Took measurements on a S. Cruz tortoise egg, from Nest # 1; see notes of 29 Oct 1969: 63.9 mm x 58.8 mm; looks like normal egg; broken into and destroyed by a rat—probably.
Overcast all day but only immeasurable garua.
1900 hrs: Caseta: Max.—77ºF; Min.—63; Evap.—1.6 (reading 1.6; refilled Nov 1, 1900 hrs); Rainfall—0.2 mm

(Pg 113)
3 Nov 1969
Jan and I to Zone 6 and Zone 1 to sample. In upper part of Zone 6, at trail opening in trail since leaving Reserve border and heading S. Alt. is approx. 440 feet, was reading 580 when left Caseta 1 hr. ago (Thommens)—
At this location in small bit of guayavillo forest--#847 ♂; flaking disease in spots on marginals and very faint white g. increments. CL--128.5 cm; CW (CDRS)—145.2 cm; CW (VD)--133.0 cm.

The trail into Zone 6 is well worn and easy to follow through trees and only rarely blazed; I think this trail is probably heavily used by hunters from Bellavista. Continued S on winding trail to heart of Zone 6 area—it is very similar to Zone 1, but a bit more forested and the largest openings are only perhaps ½ the size of the 1-3 acre ones in Zone 1; the trail passes down through nice guayavillo forest similar to that of Region's 3 (upper part) and 2 of the Zone 3—Caseta trail. We followed the trail as far as it was clear and then it dissolved into burro and pig trails and we turned back—I would guess the trail runs at most, only 1 ½ - 2 km S of the Reserve border turnoff in a straight line.
The heart of Zone 6 is made up of alternating patches of guayavillo forest, big open areas covered mostly if not entirely by luxuriant, ½-1 ½ m

(Pg 114)
high Plant #1, and small patches of shrubs and vines, especially Clerodendrum molle, reaching heights of 3-4 m maximum. The area is dotted with clumps of manzanillo trees, some of these being magnificent, large, old specimens. The latter are especially common around the numerous small low areas which are scattered here and there in great abundance all through the Plant # 2 covered areas' most of these are no larger than 3 x 5 m or so and are now dry or at best covered with a very thick, solid, hardening mud. A few have some moist mud, and 4 of the largest and best shaded ones still have standing H_2O. There are 4 ponds worth numbering, all in close proximity and all now covered with some standing H_2O and red Azolla—in order as they are passed, on trail NW to SE in directions:
Pond # 1: small, well shaded by manzanillo grove, Azolla still green in part; about 12 x 12 m and squarish in shape.

(Pg 115)
Pond # 2: just a short distance on—largest found; about 20 x 12 m and partly (about ½) shaded by large Clerodendrum shrubs and manzanillo trees.
Ponds # 3 and 4: side by side; # 3 is square in shape, about 10 x 10 m; # 4 oblong—about 15 x 2-3 m in size.
All these ponds show signs of drying—protruding mud covered rocks, muddy banks, etc. The deepest 2 are #s 3 and 4 which have about 20 cm of H_2O.
Tortoises: a lot of scattered sign—trails scattered here and there in woods and open areas, but most activity is in open Plant # 1 covered area—droppings of various ages scattered widely; however, very few burrows seen; on trip in, walked over all of trail and in considerable portion of central area in some straight lines—saw only 3 tortoises but a lot of widely scattered trails. One tortoise, #847 was in forest 2 others in open areas (see below).
There is fresh sign of tortoises using all the ponds with mud—small wallows in each, very fresh.
In general, my impression is that there are many tortoises here, but very widely scattered and certainly not concentrated around ponds as near Caseta, El Chato, and Region 4. Of course, the ponds

(Pg 116)
here are small and there may be many more than seen, scattered just as frequently all over the whole region. But the general impression is of fewer animals here than in any of the above mentioned pond areas and fewer than in Zone 1.
The vegetation of the area seems to be in about the same degree of lushness and moisture conditions as at Caseta Pond # 1.
Other 2 animals, both in open areas near Pond # 2 and # 3-4.
455 ♂ clean, fine white growth increments; no sign has been in pond or mud recently; eating Plant # 1. CL—114.6; CW (CDRS)—122; CW (VD)—113.5.
#126 (♂ prob., tail tending to interm.) very clean w. g. increments. CL—90.4; CW (CDRS)—100.7; CW (VD)—93.5.
Put in meter stake at Pond # 2; now reading 10 cm; in central deepest part.
Also put up Tru-Chek and Piche evaporimeter in standard fashion at Pond # 2 and started them functioning at 1100 hrs.

(Pg 117)
Altitudes on return trip—
1230 hrs.—Pond # 2: 510-520 feet
1315 hrs—Turnoff to Zone 6 on Reserve border: 565-570 feet
1630 hrs—Caseta: 665-670 feet
Between (1/2 way approx.) Zone 1 and Zone 6 turn-offs on Reserve border:
#635 ♂ well developed flaking disease; and only very faint w. g. increments; trail showed had obviously just come out of guayavillo forest to S. CL--126.0 cm; CW (CDRS)--142.0 cm; CW (VD)--130.0
Zone 1:
#294 ♂ just in a ways from Reserve border, by small shaded pond surrounded by manzanillos (pond has a little H_2O still). Very little flaking disease; w. g. increments very thin and not completely visible. CL: 107.0 cm; CW (CDRS): 122.0 cm; CW (VD): 112.0 cm.
2 tortoises in Pond # 1—(one inaccessible; other is #1126 ♂ but can't get measurements.
3 tortoises in Pond # 3—actually 1 in, 2 getting in as arrived; can't get #s of any of them. One is sitting in middle eating a plant (aquatic rooted). This pond now has a nearly complete covering of Azolla which is in the process of turning red.
In open areas W of Pond # 3.
#11 ♂ (or 411, hard to tell); very large male; eating Plant # 1. Almost no discernable white growth increments. CL: 140.0 cm; CW (CDRS): 151.0 cm; CW (VD): 138.0 cm.
All scutes worn smooth all over; can't see any growth rings. Has a few rather deep patches of flaking disease.

(Pg 118)
#917, huge ♂; shell in virtually same condition as # 11's. Also, virtually no white growth increments visible; also eating Plant # 1. CL: 142.0 cm; CW (CDRS): 151.5 cm; CW (VD): 138.0 cm.
NEW: #1169 ♂; some scutes have very clean, very nice white growth increments; others have none: CL: 104.8 cm; CW (CDRS): 108.0 cm; CW (VD): 97.5 cm.
Saw one large ♂ between Ponds # 1 and 2, but failed to get # because moved off into thick brush.
No other animals seen on way to Pond # 2 and none in Pond # 2 (but lots of ducks and gallinules).
On return to Caseta:
NEW: #1170 ♂; (prob., tail small but tending to interm.); about ½ km W of Zone 1 turnoff on Reserve border—in an open spot of Plant # 1; very nice clean white g. increment; shell not worn much at all. CL: 88.2 cm; CW (CDRS): 97.0 cm; CW (VD): 89.0 cm.
#268 ♀ (almost positive is ♀). Just 75 m W of # 1170 in Scalesia—Guayavillo forest along Reserve border; very nice, clean, thick white growth

(Pg 119)
increments; CL: 79.8 cm; CW (CDRS): 86.8 cm; CW (VD): 81.0 cm.
Saw 3 more tortoises on return at 1630; all in vicinity of Caseta Pond # 4 and all burrowed in for the night—could only get 1 number--#104.
While in Zone 1, implanted a meter stake in deepest part of Pond # 1; due to rocks on bottom had to be satisfied with leaving the base depth 5 cm above actual bottom—therefore, this depth must be added to any given reading. When implanted there was 42 cm of H_2O in the pond.
1900 hrs: Caseta weather: Max.—83.0°; Min.—68.0°; Rainfall—0.7 mm; Evap. 2.4 ml (reading 4.0 ml).
Comments on #s of tortoises at Zones 1 and 6:
Very few obviously; Plant # 1, some grass, and other herbs very lush here still. Ponds have plenty of H_2O still, especially at Zone 1 and not any extensive use of ponds yet by animals as mud wallows. Was about same when was through here earlier in Oct in terms of #s of animals—but even more H_2O in ponds then, plants even more lush, and almost no tortoise mud wallows at all.

Seems that the area is so moist and lush still that tortoises have simply not started concentrating here yet—also, could be that are simply fewer animals in this area and in areas to S as compared to Caseta—La Fe line and El Chato—Cerrito line—will have to wait and see.

(Pg 120)
4 Nov 1969—
Beginning samples for Nov—Caseta to La Fe first.
Left Caseta at 0800, Thommens reading 520 feet (i.e., 150 feet too low).
Region 1:
#31 ♂, at the Caseta, side of trail
#416 ♂, 1/3 of way to Pond # 1, on side of trail.
--1 tortoise in Pond # 1 in mud, 3/4s buried; can't get #.
Pond # 1 alt. reading 420 feet, i.e., 120 feet too low.
--Stopped at lower part of Region 2 having seen only a little tortoise sign so far - will search in ½ open Guayavillo forest for 20 min. Thommens reads 380 feet, i.e., should be about 500 ft. more or less.
Very, very little sign of tortoises except immediately adjacent to the trail and in that case most trails are particularly concentrated around more open spots of Plant # 1 and up under and through Clerodendrum molle shrubs (these especially used for burrows; nearly gives impression that they are working along the trail (and the stream bed which

(Pg 121)
parallels it).
Back to trail—lower end of Region 2.
--#464 ♀; very old worn shell—all worn smooth; no visible growth rings; deep, wide "cracks" (2-4 mm wide) between scutes all over the carapace; especially wide and deep separations around all the edges of the supracaudal scute and the last marginal (rear most) on each side. Cannot detect any white growth increments; she is in the trail and was walking deliberately upward along it when spotted; alt still about 500 feet (true one). No flaking disease. CL: 102.0 cm; CW (CDRS): 118.0 cm; CW (VD): 105.0 cm.
I think we saw this animal in trail pointed "upward" on 31 Oct 1969, just a few hundred feet above weather instrument area in Region 4!!
Remarked because all numbers poor condition; especially # 4 of units position—perhaps even questionable.
--#262 ♂; a bit further on—Region 2-3 border; in an open Plant # 1 area, off trail a bit. Very clean, nice white growth increments. CL: 116.2 cm; CW (CDRS): 132.0 cm; CW (VD): 121.0 cm.
Region 3
#933 ♀ (prob.—hard to tell definitely): w. growth increments only very, very, thin and not complete between all carapace scutes. In trail—very upper part of Region 3, Guayavillo forest, just below Region 2-3 border. Alt. approx., 480 feet.
CL: 73.0 cm; CW (CDRS): 78.5 cm; CW (VD): 71.0 cm.
#304 ♂ At 390 feet in Reg. 3; very rocky area, guayavillo, matazarno forest; some considerable amount of mashed down trails in this area; white g. increments clean and well
[Marginal Note: See 31 Oct notes . Has moved way up from Reg. 4.]

(Pg 122)
developed; just off of trail 10 m crawling about in fairly thick undergrowth of herbs, seedlings, shrubs, vines.
CL: 110.2 cm; CW (CDRS): 121.5 cm; CW (VD): 110.5 cm.
At this location walked off into forest on either side for about 20 min; this included some along the drainage bed; Almost no sign of tortoise at all except along trail--very rocky area; anyway again get impression are working out from trail; clearly, if in woods much. They are very spread out.
Back to trail—Region 3
Bit further down, alt. about 360 feet.

#891 ♀ (prob.); clean white g. increments. just 1 foot off of trail; eating herbs. CL: 75.2 cm; CW (CDRS): 80.5 cm; CW (VD): 73.5 cm.
Marginal Note: See Oct 30 notes—moving up
Marginal Note: Region 3-4 border—moving in Reg. 4 really
A little lower down, alt. of 345-330 feet there is a region of forest which is slightly open, like that W of trail and ponds in Region 4; dominated by guayavillo, but certainly noticeably drier than up in Region 2 and upper Region 3; also some matazarno and Pisonias, but a flattened out area with lots of soil and fairly lush herb layer—not nearly as rocky as steep slope we just descended; and there are abundant tortoise

(Pg 123)
trails mashed down through the vegetation all around on both sides of the trail—very abundant.
Tortoises in this area:
#502 ♂; burrowed fairly deeply (up above marginal plastral juncture) in cool, dark brown soil (1045 hrs!); sleeping. Only very thin, white g. increments; just off of trail 10 m. CL: 109.5 cm; CW (CDRS): cant' get; CW (VD): can't get.
#242 ♂ (prob.); just off of trail a few feet; very clean white g. increments. CL: 85.5 cm; CW (CDRS): 89.0 cm; CW (VD): 81.0 cm.
#719 ♀; just off of trail a few feet, eating herbs. Unlike others in this area, this one has dried mud all around lower carapace and therefore must have been in pond (Reg. 4?) recently; has very clear, nice, white g. increments; very little wearing of shell. Tail length is very short, therefore, must classify as a ♀; plastral concavity is _____.
CL: 95.8 cm; CW (CDRS): 105.3 cm; CW (VD): 97.0 cm.
#406 ♂; seen on 30 Oct also, in Reg. 4 pond area—i.e., has moved maybe 2-3 km straight line; mud and Azolla on shell dry but shows has been in pond. Measurements taken before.
#717 ♂; also seen on 31 Oct in Reg. 4, actually in pond; has therefore also moved about as far as # 406.
It is fairly clear now that this open, fairly flat, only slightly rocky area (rocks all over surface, but not boulder piles as in Reg. 3 steep ascent part) extends from about 345 feet on down to Region 4 pond area; the area

(Pg 124)
(Editorial note: several lines crossed out here)
on both sides of trail continues to be well used all through this area. Made one foray of 15 min off into the area—went out about 100 m straight W, but in a big loop—as far as went still were plenty of trails, but did noticeably drop off some in density—most concentrated activity is near trail; but unlike 2 areas searched above, it is clearly a more utilized area here. The canopy here is about only 25-30 %, varying up to 50-60 % in places; lots of herbs, but drying out very noticeable for past 2 months. Especially abundant is Plant # 2, and tortoises are eating it.
Proceeded through Region 4, lower area, near weather instruments; signs of animals about as in above discussed area, but no beasts seen.
Then into Region 5; this is the area where the guayavillo ceases to be the

(Pg 125)
dominant and more and more matazarno, Pisonia and even a little Palo santo come in—all trees are smaller here in girth and height. The understory is now very shrubby and is dominated by Plant # 2 and especially a mallow which is now up to 1-1 ½ m in height nearly everywhere; the Plant # 1 is much smaller and no longer have large open patches of it as in Region 4 and those above it.
No tortoise seen all through Region 5; it did show quite a few trails and old burrow sites off of one trail, especially through first ½ of the region, but these petered out more and more and by time got to Region 5-6 border in "big boulder" area very little or no trail or other sign left. All of Region 5 is a semi-open very shrubby area; canopy mostly about 25-40% at most.

Region 6__very little tortoise sign—a trail here and there; it might be argued that trails and sign are more difficult to see here but this is not true, as those found in relation to tortoise in Zone 3 n.a. (Region 7) are clear and easy to detect. This region is really showing signs of the general drying out of the last 2 months; the herb layer is becoming dry, brittle and crunchy and the abundant Plant # 2 there is noticeable less green and beginning to dry in comparison to its green, flexible, lush nature in late Aug—early Sep The trees here are about as before--P. Santo's leafless, matazarno with only a few leaves; Pisonias

(Pg 126)
and guayavillos with leaves, but noticeable less dense than up higher. If there are tortoises at this altitude and region, and there must be some, they are clearly very low in density.
Arrived 1300 hrs. Region 7: (Zone 3 nesting area in part). Immediately after arriving saw 3 animals in central open part.
#325 ♂, quite large; very clear well developed w. growth increments. Some flaking diseases on marginal scutes, especially in rear, but not a very worn carapace at all. Resting under a tree, sleeping in shade (no sun yet today, but weak radiation coming through.) CL: 122.7 cm; CW (CDRS): 136.3 cm; CW (VD): 126.0 cm.
#127, large, old, well-worn ♀. She is under a guayavillo tree and in the shade, stretched out and resting, just N of nest # 9 by about 5 m. She has a very old, completely worn smooth shell with no visible growth rings and virtually no visible white g. increments. As with others, e.g., # 464 ♀, this size and age, she has very deep separation (2-4 or 5 mm) between most of her carapace scutes, especially the rear

(Pg 127)
marginals and the supracaudal. In fact, this separation and deep groove formation is so pronounced that the marginals all along the back ½ of her carapace and in rear have split and separated along outer edges so that they almost look as if cut between or notched as in the CDRS marking method (of course they are not). She has almost no flaking disease at all. Since she may be getting ready to lay, will leave her alone and try to measure later.
Looked all around the obvious open areas of the central Z. 3 n.a. and found fresh digging only right near Nest # 3—about 5 m away from it on open, bare red soil areas; found 2 spots, one completely bare and dug down about 9 cm then hit rock and apparently quit. The other is in an area with a sparse covering of drying up mallow; also hit rock here and quit, but soil is too jumbled up to measure. No signs of cloacal fluid at either site; also, these 2 spots were definitely not here on Oct 29 or 30, 1969, when we were last here and we did not see either # 127 or # 325, even though I searched this area reasonably thoroughly. Will watch her and see if attempts laying this evening.
--An unmarked animal just beside Nest # 6, under shade of a very low, flowering, very leafy Cordia; asleep; will mark and measure him later because do not wish to disturb the ♀ (127) because of close

(Pg 128)
proximity.
Checked weather instruments at 1200 hrs. in Region 4 on way down—Evap.—26.5 ml; refilled full. Rain—0.89 mm (.035 inches).
Also did same at Zone 3 n.area at 1330 hrs. Evap.—35 ml; refilled full. Rain—0.0mm.
Feral animals seen today:
1) 2 burros at E side of Caseta Pond # 1
2) a group of 4 pigs rooting in Guayavillo forest in Region 3, upper part.
3) Many goats in Region 6 and Region 7—very abundant sign, i.e., tracks, droppings, urine, scratched soil surface areas.
Also, heard a group of hunters and 4 shots, just a short distance to the S of central part of Zone 3 nesting area.
Made 2 loops out from Region 7 or Zone 3 n.a. central part—first went to W and NW in a big loop, probably getting about

(Pg 129)
500 m from central area at most, straight line distance; no real definable signs of tortoises; lots of goat disturbance to vegetation in form of broken down small (1-3 m high) Croton; the area is mostly covered with solid surface boulders and lava rocks, this then covered with a thin scattering of herbs (especially mallow and Plant # 2); and then goodly covering of small Croton "saplings" and fairly dense trees—almost all smallish—guayavillo, Pisonia, matazarno, caco porotillo; the big trees are few and far between and these are virtually all either Pisonia or caco porotillo. A few cactuses (Opuntia only) here and there, but none really large enough to have red-brown bark and most under 4 m tall. Here and there are some spots, usually low, with a bit of exposed soil, but almost all of these are underlain at only a few cm by flat rocks—also, most of these are goat-scratched areas as evidenced by abundant droppings and an occasional fresh urine spot. A few of these places might be suitable for a nest or two, but very, very, scattered and of low density; more scattered than in areas to S and SE of central area along first part of La Fe trial.
No tortoises seen in 1 hr of searching (1415-1515).

(Pg 130)
Then looped out to E and ESE from area of nests # 4, 12, 15; again virtually all rock covered and of similar description to above.
Saw following tortoises:
NEW #1171, maybe a ♂, but very small to be able to determine accurately; has nice, thin, clear white growth increments and shell hardly worn at all—growth rings very nice; no flaking disease at all. Out in very middle of a bunch of sizeable rocks, eating some of the common mallow of the area. CL: 60.1 cm; CW (CDRS): 62.5 cm; CW (VD): 58.0 cm.
No others seen. This circuit took about 45 min.
Returned to camp near Nest's 9, 3, 6, 7 etc.
Tortoise # 127 had started prospecting for a nesting site—the following notes were taken by Jan in my absence.
1430—She came out from resting spot under guayavillo tree, passed by Nest # 9 and headed directly toward the area where the fresh digging was found earlier today (presumably done by her yesterday?). She sniffed along the ground here a bit. In this process of moving along she

(Pg 131)
at one point deposited about ½ cup of that thickish yellow fluid which I think is urine (as done by small tortoise at La Fe). This was done in a semi-rocky area covered with small herbs and some dead plant debris and I do not think it was at all connected directly with nesting—she did not stop, dig, etc. in this area; she moved around Nest # 3 and over toward # 7; in the vicinity of Nest # 7 she again began sniffing about, but did not start digging here; during this time I returned and she saw me while sniffing around # 7; she was very wary and watched me intently for about 5 min, even though I remained very still.
I left again and Jan continued watching her; she poked around # 7 some more; one interesting facet of this exploration in addition to the obvious visual inspection of the ground in front of her followed by olfaction in the same area, is that she was clearly orienting mainly toward open areas with exposed red surfaces soil and avoiding spots with rocks and even light herbaceous cover—she was apparently doing this visually before ever beginning to sniff the areas; she occasionally inspected an area with a little herbaceous cover (dead veg litter, a few mallow stalks, etc.), but not often. Finally, about 1600 hrs she gave up

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on the area around # 7 and moved around full circle in between Nests # 9 and 6; at 1623 hrs she began digging in a small cleared area of red soil here; I returned at 1645 and the rest of the notes on digging are mine.
[Marginal Note: Jan took these notes.]
However, in the process of moving from Nest # 7 area to where she began digging she ran directly upon the small unmarked animal who had come out from under the Cordia bush at about 1530. She approached "him" from the rear and immediately became extremely aggressive, and began bumping into the small one very

roughly with the nuchal area of her plastron; she also tried several times to crawl up and onto the carapace of the small one; the small one in turn took off immediately—she followed directly behind it, and they circled the Cordia bush 2 times rather rapidly with attendant bumpings and attempted scalings; then the little one took off past nest # 6 and 3 and headed SE with the large one right behind. She chased it about 20-25

(Pg 133)
m and then stopped; the small one kept going as fast as it could. #127 then returned to aforementioned area and began digging at 1623.
At about 1705 she stopped digging in this area having hit rocks; the depth of the hole at this time was 15 cm and no cloacal fluid had been used.
She then moved over near Nest # 6 and prospected there a bit then to W a bit and around Cordia bush and finally at 1730 returned to very same general area where previously was digging; again began prospecting about by looking and sniffing.
1735: began digging at a spot covered by a bit of dead plant debris and a little mallow. This place is only about 1 ½ m away from just previous digging site and is only about 2 ½ m away from one of sites discovered on arrival today (the one made on clear, open red soil); i.e., she almost seems to have a fixation on this one small area.
1840: dark now; she has just finally stopped digging and moved about 1 m off of the digging site—stretched out and resting. The digging only reached a depth of 11 cm and she had been trying to dislodge a hopelessly large embedded rock for 20-25 min. Used no cloacal fluid. The hole was wedged down in between a lot of small embedded rocks and she was getting virtually

(Pg 134)
nowhere after first 20 min of digging.
From little I saw of foot movements, they were very similar, perhaps exactly alike to # 131's; however was watching only from a distance so as to not disturb her and after dark saw very little except by using flashlight occasionally.
Several notable things:
1) In wild, as with Hood tortoises in corral at CDRS, ♀♀ have to prospect some for sites and then experience some false starts because of rocks and obstructions in the nest; saw this ♀ start and abandon 2 holes and she probably was the animal responsible for the other 2 seen earlier today—probably dug yesterday.
2) Even without using cloacal fluid, this soil allows ♀ to dig a fairly nicely shaped hole with only a small amount of difficulty experienced with loose soil tumbling back into the hole; this is considerably different from conditions in CDRS corrals where red soil fills have been constructed; due in part to the well-packed hard, solid nature of the ground and soil here.

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3) As with Hood ♀♀ at CDRS, if ♀ stops after dark because of difficulty with nest site and digging does not appear to prospect any further till next day.
Weather: it was overcast and rather pleasantly warm all day today, even in Zone 3 n. area; some weak radiation was coming through the clouds and could feel the day warm up as a result; no garúa or other precipitation.
5 Nov 1969—
Arose 0530; overcast;
#127 still in exact position where left last night at 1900; Jan will try to watch her and ♂ # 325 all day for daily activity patterns.
Left 0630 for La Fe to complete this vertical sample run. Set Thommens at Zone 3 n.a. to read 180 feet. Will instrument region rest of way down.
Region 7—this region continues on down past the central part of the Zone 3 n.a., includes Nest # 5, and then runs about ½ - 1 km beyond this. The altitudinal range is from 180-160 feet. After leaving the Zone 3 central n. area the rest of Region 7 consists primarily of a very rocky surfaced area (much as described for the 2 loops

made yesterday out from Zone 3 n.a.). Scattered through these rock-covered areas are occasional open spots and/or low spots where there is a bit of open soil; the soil in these varies from the bright red-brown type of Zone 3 n.a., to a very pale light brownish-gray, to dark brown. None of these areas are large—all have

(Pg 136)
space for a few nests of tortoises at most, but have only found 1 in good condition (#5) and 3 destroyed by pigs. However, there is one area the trail passes through which consists of about 1 1/2 –2 acres of fairly open flat ground with a lot of small bare red soil spots (and it is not covered by many rocks). In this place the goats have made heavy use of these spots for scratching around in the dust. There is definite evidence of 1 old tortoise nest here and a second place which may have been one. On the whole however, most of the soil is very shallow and is underlain after just a few cm by flat plate like lava rocks.
The vegetation through this area is much as in the Zone 3 n.a. Mallow and Plant # 2 in herb layer, and palo santo, matazarno, and Pisonia as main trees; with an occasional guayavillo and caco porotillo also.
Saw no tortoises and virtually no definite sign all through this area.
Region 8—runs from about 160 feet

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down to 120 feet, encompassing an area of some veg change, but stopping where true tree cactus forest becomes dominant; this entire area is very rocky, consisting of great piles and heaps of lava rubble with dips and low places in between which are also almost entirely rock covered.
I saw almost no soil through the entire expanse and nothing suitable for nesting. As proceed S and SE through this region, cacti become more numerous and gradually taller and at its southern end at about 80 feet finally have large tree forms of both Opuntia and Jasminocereus; likewise the dominant tree all the way is Palo santo (Bursera) and it becomes more and more numerous as proceed through the region, whereas the matazarnos become smaller and less numerous; guayavillo virtually disappears quickly and is absent from the region for the most part.
Pisonia is still fairly common and it and matazarno are the secondary tree species to Bursera; also an occasional large caco porotillo. The mallow and Plant # 2 of Region 7 are largely missing; instead herbs are a lot of varied and now mostly dried up things—will attempt to identify them later—anyway the herb layer is much more sparse than in Region 7. One very characteristic aspect of the whole region is abundant Croton of sapling size—8-10 stems per

(Pg 138)
square meter often; this stuff is all about 1-3 m high and is extremely abundant and is everywhere through the region. The region ends just below a small barranco where the cactus forest begins. Saw one tortoise in a very rocky rocky area at 120 feet.
#629 ♂; moving along in Croton shrubbery over large boulders at 0730 hrs. only very, very faint w. g. increments; a little flaking disease; shell not particularly worn. CL: 111.0 cm; CW (CDRS): 127.0 cm; CW (VD): 115.0 cm.
Took a few photos (Roll # 29)
Photos:
#1-2: lower end Region 8
#3: border Regions 8/9
#4-5: Region 9—upper part
#6-7: Region 9—middle part—upper part
In Region 9—
NEW #1172 ♀ prob., but small, hard to tell definitely; at about 70-75 feet alt.; rocky area—Croton, tree cacti; eating a small green herb. Thin white g. increments. CL: 59.1 cm; CW (CDRS): 62.0 cm; CW (VD): 56.0 cm.
At an altitude of approx 75 feet, turn more directly ESE (from SE) and begin to head across to La Fe

(Pg 139)
nesting area, but staying at same altitude all this way—anyway, very little variation. This Region 9 includes a downhill part to the SE of Region 7 and 8 and then a long ESE stretch into La Fe. Actually go down and up, down and up all through this area because virtually all of Region 9 is cactus forest on top of rolling piles of lava interspersed with low lava covered areas;
The dominant vegetation are Opuntia and Jasminocereus trees with Bursera trees scattered throughout in goodly numbers. In almost all the low spots are nice-sized, sometimes huge Pisonias which offer the best and most abundant shade in the area. Still lots of Croton samplings. The understory is mostly dead and drying stuff now, but there are some green herbs like Echinopippon and some others—but the ground food is very scarce I would guess from looking about. Also the whole Region (as in 7 and 8 also, but even more in 9) is crawling with goats in great profusion.
Matazarno now very few and far between; caco porotillo as before.
About ½ way between La Fe and turn—
#1148, ♂ perhaps, but too small to tell: in very rocky area climbing on boulders! Very thick, clean, white g. increments. CL: 49.4 cm; CW (CDRS): 50.4 cm; CW (VD): 46.5 cm.
In part of Region 9 where # 1172 was seen noted a number of low areas with some sparse soil and small fist-sized rocks; the soil is much like that fine dark brown stuff in the

(Pg 140)
corrals (natural soil of the area) at CDRS. Goats are using these heavily for scratching about; interesting question is whether ♀♀ nest in some of these spots; most have rocks right under soil, but some spots look as if nests could be made; saw no nests and no digging signs, but there are 2 large carapaces in this area--about 80-100 cm curved length class; also a number of small tortoises seen in this very same area--#1172 today and #s 1161, 1162 there on Oct 13-14, 1969—from nests in same area? or dispersed from larger nesting areas like La Fe?
About ½ km further toward La Fe from last animal; same alt., upon flat lava "plain".
CL: 74.0 cm; CW (CDRS): 81.2 cm; CW (VD): 73.0 cm.
NEW: #1173 ♀ (prob., almost definitely)
Under an Acacia, partly sunk down into loose dry soil; in shade—1030 hrs; sun out and it's hot! Clearly resting and avoiding sun. Veg and conditions here still same.
[Marginal Note: Compare to those at Caseta!]
Conditions remained as described above for Region 9 all the way over (Editorial Note**:** The following sentence has arrow to 'over' with the following: occasional low spots and flat lava plains have a little open soil but doubt is enough for nesting?) to La Fe. Cannot take the

(Pg 141)
altitude correctly there however because weather is changing—was hot and sunny 1000—arrival (1100)—now at 1200 hrs it is overcast in all directions, a light breeze is up and it is cooling off.
Walked around La Fe n.a. for 30 min—same essentially as on last visit in mid Oct '69---plentiful bare red soil areas, but soil very shallow and lots of surface plate rocks; have not seen any nests yet, nor signs of digging, nor tortoises.
However, it is clear that this is or has been an area frequented by tortoises in the past—there are numerous tortoise bones and pieces of carapace bones scattered here and there through the n.a. and especially find them around the dried up pond.
Also saw a few dried up droppings in open red soil areas.
Other photos taken (Roll # 29)—
#10, 11, 12—small tortoise (#1148) in Region 9 and area surrounding area
#13, 14—dried up pond at La Fe n.area; showing drying and mostly leafless Clerodendrum molle around pond and some old tortoise bones in bed of pond.
#15-27—scenery at lagoons at "La Fe" coast—flamingoes, etc.; red, brown and green m. iguanas

Cut a trail down to coast to SE directly of the big open La Fe n. area; this is only a 30 min walk, i.e.

(Pg 142)
about 1-1 ½ km distance.
Reset altimeter at coast and will record various points all the way back from the coast inland to about 40 feet altitude. There are not the big open expansive "pampas coloradas"; however, the entire trip one comes across little pockets of soil and open areas in the cactus forest with red soil; these are all "goat-scratched" also. Saw tortoise bones here and there all the way to the coast, and in one small open patch of soil at 20 feet alt and only about 150 m in from the lagoons at La Fe saw a very fresh imprint of a tortoise foot in dry soil—must be today or yesterday at most. At 40 feet alt hit first big open area—old dry tortoise droppings and bones in this area—this terrain continues all the way up to where my trail from Zone 3 n.a. comes in from the NW into the really big open pampas coloradas—The main big areas where the trail enters are over a 45-55 foot elevation range for the most part. This is the

(Pg 143)
altitude where the pond is, where the tortoise bones are, where old dry droppings are, and where found one live tortoise, and 2 fairly fresh digging sites on Oct 13, 1969.
*Also—saw one attempted digging today at about 30 feet alt just below first big open area when coming up from lagoons—but hit rocks and not completed.
Goats abound all over these areas and saw many at the lagoons edges.
*In big La Fe n.a.—looking around some more—found #1160, marked on Oct 14, 1969, under exact same Acacia tree as on that date! Remarked as #1360 since there is a #1160 at CDRS already.
NEW #1174 ♀**,** large; shell is not particularly worn or old as in some other large ♀♀ (e.g., 131, 127, etc.). Only very centers of scutes smoothed down. CL: 92.0 cm; CW (CDRS): 105.5 cm; CW (VD): 97.0 cm. Very clear well developed w. growth increments. Just to N of a big open pampa colorada, but still in area where are some small spots of red soil. Appears to be prospecting for a nest site in that in one place she had clearly just attempted scratching surfaces and immediately hit rock and quit; was moving along when seen, toward some fairly dense vegetation in a very rocky area.
Took one photo (#28, roll#29) of open pampa colorada at La Fe.
Returned rapidly, only taking altitude readings on the way these readings are as follows:

(Pg 144)
(1) La Fe n.a.—big open part where trail enters on W side: 50 feet
(2) Region 9—rolling lava covered area, along trail to more NW-SE turn; 60-75 or 80 feet, varies depending on whether in dips or upper regions
(3) Turn—75 feet
(4) Region 9/8 border—160 feet; i.e., Region 8 runs from 160-120 feet. Therefore Region 7 runs from 180-190 feet to 160 feet in altitude.
Will call La Fe n. area central part down to coast Region 10; the area is much like Region 9 in terms of being a cactus forest (Opuntia, Jasminocereus) but has much less Palo santo and is much more open due to abundance of pampas coloradas (see above description of trail down to coast).
Only comment I would add at this time to description of the 10 regions are concerning the density of the undergrowth beneath the tree layer:

(Pg 145)
Region 10—quite open due to abundant bare spots of red soil.
Region 9—varies but often fairly open areas of lava; Croton not very dense here.
Region 8—very dense, almost impenetrable undergrowth of Croton of 1-3 m in hgt.—probably tough going even for tortoise.

Region 7—again more open than Region #8, but not excessively clear—more like Region 9 and part of Region 10 down to coast below the main La Fe n.a. Of course, Zone 3 n.a. part is quite open in places.
Region 6—rather dense undergrowth of mallow, Croton and other 1-3 m high stuff.
Region 5—moderately open again—much Plant # 1
Region 4—moderately open again—much Plant # 1
Both of the last 2 regions have some nice open herb covered areas; especially Plant # 1, but other stuff too, like Plant # 2.
Region 3—fairly dense undergrowth typical of guayavillo forest.
Region 2 and 1—openish again, but mostly thick stands of Plant # 1, best ½-2 m high—variable—but easy for tortoise to plod through (likewise in Regions 3, 4, 5).
Returned to Zone 3 n.a.; Jan had been following 2 animals' activity all day; will record these notes at the end of today's comments.
At 1330 hrs the evaporimeter read 4.9 ml at Zone 3 n.a.; Taylor max-min today gave low last night of 68°F; high today of 81°F. Was cloudy almost all day with

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some intermittent sunshine.
#127 ♀ tried to nest again today; she had been resting virtually all day and at 1400 hrs moved out from under tree resting spot near Nest #9 and headed up trail toward Nest # 1; she poked around in this area sniffing and looking till 1530 hrs. She actually scratched the surface in one place, but did not start actually digging anywhere.
At 1530 she turned directly around and came back down by same route, passed Nest # 9 and in same area where dug twice before (in between Nests 9 and 6) she stopped and scratched and tested the surface; she gave this up virtually immediately and moved off to her left a bit to open area between rain gauge and evaporimeter; she looked at them sniffed around this area (covered with a bit of dead veg and small herbs) and began digging at about 1545. Dug here for about 30 min and began hitting rocks at about (estimated) 10-12 cm depth. She gave this up at 1615 and moved to W past Nests #3 and 6 toward Nests 15 and 7; went to area near Nest # 7 where she

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had dug last night. By 1630 she had begun digging again—this time only 1 m from Nest #7 wall and only about 1 dm to side of a previous dig discovered at same time as found Nest #15 (Therefore not made by #127 to my knowledge); this spot is only about 2 m from where #127 tried digging last night. Again it was in a clear patch of red soil. She dug here till about 1815, but again hit rocks—this time at a depth of 14 cm—quit and moved about 3 m away from digging site and sacked out—dark by time she quit.
In sum—
She seems to have a real fixation on this red soil covered area and particularly the areas between Nests 7 and 15 and that between Nests 9 and 6; of course she did move over near the weather instruments for one attempt and did try to find a nest site up near Nest # 1. But the fixation she has brings up the question of orientation mechanisms used to find nesting areas and how such a fixation comes about (learned from area where hatched? or after just stumbling onto one when sexually mature?)
This makes two definite nights of attempted digging and of definite attempted holes; in addition she almost certainly tried to dig the night before we got to Zone 3 (November 3, 1969) and made one hole on this night. Each hole so far seems to be a failure in that she hit inhibiting rocks just a short distance below the surface.

(Pg 148)
Jan's observations on # 127 ♀ and # 325 ♂ for today—with comments on weather conditions.
0630--#127, awake and sitting in spot where last stopped moving last night and # 325 awake and looking around in place where last checked last night at 1630 hrs. Cloudy, cool; 70°F air temp at 1 m.
0700—ditto above for both animals

0752—Sun out—clouds breaking, warming
0800—clearing still; 76°F.
#127—turned, becoming active—in sun.
#325—in sun, moving about actively.
Both became active between 0755 and 0805; ♂ much more active, ♀ sitting for long periods.
0825--#1227 stationary now after brief activity; # 325 still moving about. Clearing was temporary—sun out occasionally now, but mostly heavy overcast.
0835--♀ now moving about in vegetation; sun out—getting warm.
0900—78°F. Sunny with intermittent thin clouds. ♀ moving around on rocks at entrance to the area—mostly stationary with short bursts of movement in between.
#325 has

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moved quite a ways, about 100 m over rocks and down onto a relatively flat, open area. In moving is walking along deliberately and not grazing when seen.
1000—80°F; sun out full, light breeze. # 127 sitting stationary under guayavillo tree in shade (no activity for last 50 min). #325 has moved another 50 m N onto a lava pile and is sitting under a tree.
1020—clouding up some, off and on; # 127 moving on lava at entrance to nesting area; then stopped in shade under a tree.
1100--clouded over now; 78°F. #127 in shade under same tree as at 1020. # 325 active in same area as before—in and out of sun; grazing a little.
1125--78°F—clouds moving in heavily from SE—noticeable cooling-light breeze.
1200--#127—ditto as at 1100—76°F. #325 ditto as at 1100.
1222--a few minutes of light rain
1300--76°F; clouds, but weak radiation coming through. # 127 still same—hasn't moved for 2 hours. # 325—under tree, same area; sitting and doing nothing.
1320—heavy overcast again moved in –light sprinkle again.

(Pg 150)
1400—73°F. #127 starts movements described in notes above; will not repeat here. #325 moving to N more again; grazing a bit, moving along. Getting too far away to follow and will leave alone at this time.
1530—72°F
1700—70°F
6 Nov 1969
Arose 0530; #127 exactly where stopped last night—not burrowed in, just in open near where quit digging at 1815 hrs.
Left at 0630—Evap.—6.8. ml; refilled full. Rain—0.0 mm. Min. temp. last night—66.5°F.
Stopped and checked weather instruments in Region 4—0730 hrs. Evap.—6.0. ml; refilled full. Rainfall—0.005 inches (=0.13 mm)
Did not sample on return, but did note a few animals which encountered. These are as follows:

(Pg 151)
#1074; about 60 m further S in Region 5, just below 4/5 border area, from where saw on Oct 30, 1969. Saw still burrowed down into soil a bit and sitting there at 0720 hrs.
#437♂, just 25 m above (distance) Region 4 open area (weather instruments); medium-sized; moving around a bit beside trail; 0745 hrs.
#242♂; about 75 m above (in distance) Reg. 4 open area; still burrowed into soft soil a bit—0755 hrs.
#891 ♀ (prob.)—moving upward in a very deliberate manner, in Region 3, strong ascent part; alt is about 390-400 feet; could detect a bit of a path along trail side too about 75 m before found her; at 0830 hrs.

#933, in Reg. 3, but lower down than on Nov 4, '69, when sighted; at about 450 feet, in guayavillo forest, eating herbs; at about 0845 hrs.
#117—moving down along trail ½ way between Caseta and Caseta Pond # 1.
#376—at Caseta, feeding on grass in open virtually all day long.
Checked weather at 0900 on return for temperatures for last few days—
Max. (4th/or 5th)—81°F. Min. (night of 3rd, 4th, 5th)—67°F
1900 hrs—Weather at Caseta--Max—82.5°F. Min.--?. Rainfall—2.9 mm; Evap.—6.7 ml (reading 10.7)
Note: Rainfall and Evap. bracketed to: 1900 Nov 3 to 1900 Nov 6 (today)

(Pg 152)
Sample of Region 4 of Caseta—La Fe trail taken on Oct 31; Caseta upper ponds on Nov 1, and Caseta Pond 1 and general area below 28 Oct 1969. These can be added to above transect for Nov 4-5, 1969 to complete the sample; areas carefully examined (2-3 hrs. each) are Caseta Pond # 1 and vicinity Region 4, Zone 3 n.a. (R.#7) and La Fe n.a. (Reg.#10)
7 November 1969
Beginning sample from El Chato to Cerro Gallina.
Left Caseta 0745; set altimeter to 670 feet.
Arrived Chato 0915; alt reads 710-20 feet. Damned wet—pouring it out of boots and ringing [sic] out socks—disgusting.
Saw the following animals in between Caseta trail and Reserve border intersection and El Chato turn off along Reserve border:
#450 ♀-- at Caseta trail—R. border intersection just below C. upper ponds; active, 0745
#277 ♂--in woods just before enter mora along R. border; active, 0750
#627 ♂--1/2 way between # 277's location and top of first hill – active -- 0800
#106 ♂--just on other side of first hill – active -- 0805
#103 ♀, just before right angle turn; active -- 0815;
CL: 96.3; CW (CDRS): 107.3; CW (VD): 99

(Pg 153)
#278 ♂, near right turn—very close to it—also active—0820
#97 ♂ and #98 ♂: 2 m apart in camote patch just past right turn—active and eating camote leaves—0825
#621 ♂--about 150 m E of El Chato turn-off (same place was on Nov 2) active—0900
#775 ♂--near El Chato turn-off, but about 50 m E of it on Reserve border; has flaking disease very badly.
During all this time it was continually drizzling and with a mild breeze, but warm and overcast.
Beginning of real sample—around El Chato and its vicinity:
#16 ♂--in guayavillo forest (just after entering it on way down)
#154 ♀--in guayavillo forest—about ½ way down to base of El Chato. Carapace worn somewhat in central areas of scutes but not excessively; large deep, cracks between scutes not present yet, but somewhat deeper and more spread than normal. No flaking disease. CL: 95.5; CW (CDRS): 107.0; CW (VD): 98.0
#1102 ♂; no flaking disease; in guayavillo forest just a short distance before come to Pond # 1.
CL: 88.5; CW (CDRS): 94.5; CW (VD): 87
#296 ♂; just to side of Pond # 1 in open grassy area—grazing. CW (CDRS): 151.0; CW (VD): 138.0. Has at least 3 different lichen species and 1 algal species growing on rear portions of carapace. Lichens restricted to 4th vertebral and edges of last 2 costals on each side; however algae over dorsal

(Pg 154)
surface of whole back half of carapace. Has been in red mud wallow recently.
#61 ♂; same area as # 296; also with algae growing on same parts, but no lichens detectable. These are both huge males. CW (CDRS): 142.0; CW (VD): 129.0

All the following animals were grazing on the floor off and immediately around Pond # 1 in fairly open grassy areas. The little bit of H_2O in the low rocky area which was still here on Nov 2, 1969 is now only a thick, goopy mud.
[Marginal Note: some are sleeping stretched out—in open.]
318 ♂
#540 ♀; not worn very much on carapace scutes at all—only very small central areas; CL: 78.8; CW (CDRS): 79.5; CW (VD): 85.3
#207 ♂; flaking disease prominent; white g. increments visible but thin. CL: 102.3; CW (CDRS): 108.0; CW (VD): 99.0
#79 ♂ (prob.; tail smashed somewhat!) Flaking disease all over—severe. CL: 102.2; CW (CDRS): 111.5; CW (VD): 101.0
NEW #1175 ♂ (prob.) faint fine w. g. increments; no flaking disease. CL: 77.2; CW (CDRS): 78.0; CW (VD): 72.0
NEW #1178 ♀; only very faint w. g. increments and has a very good case of flaking disease, especially in rear areas. CL: 84.3; CW (CDRS): 88.5; CW (VD): 81.5

(Pg 155)
Only central parts of scutes worn smooth, but can see that is somewhat worn down all over—
#212 ♂; very large; as with #s 61, 296, carapace scutes worn completely smooth and no growth rings visible; grooves between scutes becoming wide and deep, especially around last costals and supracaudal and adjacent rear marginals. A little flaking disease; w. g. increments only very faint.
CL: 132.8; CW (CDRS): 150.0; CW (VD): 135.0
#155 ♂. CW (CDRS): 145.0; CW (VD): 133.0 Very large, smooth shell; some flaking disease; a little algae on shell, but no lichens; grooves between scutes as in #212.
#141 ♂ CL: 145.0; CW (CDRS): 157.0; CW (VD): 141.5. Large, smooth scutes (worn down), large grooves between rear scutes; only a little flaking disease; no lichens but a few spots of visible green algae on 4th vertebral scute.

#171 CW (VD): 137.0; CW (CDRS): 149.0
#10 CW (VD): 136.5; CW (CDRS): 151.5
These 2 together in trail about 100 m on around and S from Pond # 1. Head of one facing side of the other—Both have bad flaking disease, but especially bad on #10; both smooth scutes all over, no lichens, no algae and grooves, widening between carapace scutes—certainly very old.
NEW #1176 ♀ (prob.) -- CL: 82.7; CW (CDRS): 89.3; CW (VD): 82.0
Has the worst case of flaking disease have yet seen and yet is quite smallish in size. She was right near #s 10 and 171. White growth increments there, but only very thin

(Pg 156)
and fine; carapace scutes are worn, but smooth only at very centers. Flaking disease largely restricted to rear 1/3 of shell and front marginals—why not in between? Quite flared rear marginals.—Photos taken.
#298 ♂; another 75 m on to S—about ½ way between Ponds # 1 and # 2. Some flaking, some alga; no obvious lichens; grooving getting wider between rear scutes. CL: 133.0; CW (CDRS): 145.5; CW (VD): 134.0
#8!! ♂ CL: 110.2; CW (CDRS): 121.7 CW (VD): 111.5
#632 ♂ CL: 115.3; CW (CDRS): 123.8; CW (VD): 113.0
Were face to face in open grassy area, just 50 m before Pond # 2. Both about same size; one (#8) eating grass; both have rather bad cases of flaking disease all over rear ends and on front marginals; in fact #632 has it all over.
#321 ♂, very large; just a few m beyond the last 2; in what was a small pond of red mud on Oct 18, 1969—now dry! Has flaking disease rather badly on most of rear scutes and front marginals and first vertebra. No lichens or alga visible. CL: 129.8; CW (CDRS): 146.7; CW (VD): 137.0
Has clear, fairly thick w. g. increments

(Pg 157)
Following animals grazing and resting in open grassy areas around Pond # 2:
#612 ♀; has some flaking disease on fore and rear marginals and spots in other and various scutes; thin w. g. increments. Only centers of scutes worn smooth. CL: 87.4; CW (CDRS): 93.0; CW (VD): 85.5
#439 ♂; flaking disease on marginals front and rear; clear thin w. g. increments between carapace scutes. CL: 94.0; CW (CDRS): 99.0; CW (VD): 92.0
#567 ♂; very large, but only a little flaking disease

#537 ♂; has been in pond—old dried mud on carapace;
#132 (or 136)—old, worn smooth scutes; a little flaking disease; scutes still have a few visible growth rings at very outer borders
#57 ♀; very old; scutes of carapace entirely worn smooth; deep grooves between scutes of rear marginals, supracaudal and 5th vertebral; a little flaking disease; some alga on front-part of 4th vertebral. CL: 93.5; CW (CDRS): 103.6; CW (VD): 96.0
Very dome-shaped and oval shaped; classic dome-shaped concept!—took photos
#82 ♂; very large; also has a jagged cut (or break) in 2 position of 10's, but 1 and 7 marks and clean and nice. Scutes all worn smooth; deep grooving of rear scutes (in between) not well developed; fairly oval and dome-shaped. Has recently been in mud. Very little flaking disease. CL: 137.0; CW (CDRS): 154.0; CW (VD): 145.5
#168 ♂; very large and old. Scutes all worn smooth; a good amount of flaking disease on rear parts and front marginals; w.g.i.'s very fine and not well developed at all; CL: 128.0; CW (CDRS): 145.0; CW (VD): 134.0

(Pg 158)
#192 ♂; central parts of scutes (i.e. ½ of surface area of them) worm smooth—other growth rings still visible; bad flaking disease all over rear and on front marginal—1st vertebral border. White g. i.'s thin and clear and better developed than on really large animals. CL: 122.2; CW (CDRS): 137.3; CW (VD): 124.0
#339 ♂; scutes worn completely smooth; whole rear half of carapace has bad deep flaking disease; also some on front marginals and 2nd vertebral. No lichens or algae. Very oval shaped, but not excessively domed. CL: 132.6; CW (CDRS): 152.0; CW (VD): 138.0
#1177 ♂ (prob.)—flaking disease scattered all over scutes, but mostly in rear 1/3 of carapace and front marginals. Very thick w. g. increments, but clear and well developed. CL: 80.4; CW (CDRS): 84.6; CW (VD): 80.5
Photos for today listed on next 2 pages.
Samples cont. in Volume 5
Weather at El Chato:
11-7-69 at 1:30 PM: Rain Gauge--.055 inches (=1.4 mm); Evaporation—10.4

(Pg 159)
Roll 31 cont.—
#4 -- C.MacF. and tortoises—open grassy areas near Pond # 2, El Chato—
#5-6 -- Photo of very dome-shaped, oval-shaped ♀ (old one)--#57
#7-8 -- Sleeping posture at Chato
#9-11-- #613 algae on costals right side and rear
#12-13-- #11 side and angle view
#14-15-- #507 large male (Zone 5) may be dying (will keep track of him). Bad flaking disease; been in exact spot for one month. Much organic debris.
#16-17--#1882—large old female (Zone 5)
#18-21 -- Cerrito; 1967-68 hatchling found in dense forest; amazing. See notes Nov 8 (Isla Santa Cruz Notebook #5) Shots of animal and general area where found.
#22-23—Cerrito Nesting Area

#24—Camp in Zone 5—Vegetation typical.

(Pg 160)
Photos—Nov 7
Roll 29: # 30—end—drying out (?) at El Chato

Roll 30--HSE
Chato
#1-6: locomotion of #207 ♂ at El Chato
#7: Photo of typical S. Cruz shape--#1175 ♂
#8-9: Photos of flaking disease--#1178
#10-11: #155 ♂ shell shape front and back—very large male; without oval shape—gets wider all way from front to back
#12: Galapagos Dove
#13-15: #212 ♂ (very large)—shows his shape—perhaps conceptions of typical S. Cruz (G. e. porteri)—compare to those of #155 ♂
#16-21: #296 huge ♂ showing lichens, alga, and land snail on his back.
#22-25: fooling around with 2 grandes who met in trail
#26-28: #10 almost necrotic areas on scutes and traumatic destruction of marginals
#29-31: #1176—good example of flaking disease—closeup, area of concentration on whole body; back of shell
#32-35: 2 galapagos meeting in trail; one grande

Role 31—HSE
#1: flaking disease all over shell of # 632 ♂
#2: # 439 ♂-- plastral concavity of small male
#3: #612 ♀-- plastral concavity of female of similar size to #429

End of Notebook

Isla Santa Cruz Volume #5.
Field Notebook of Craig MacFarland
Nov. 1969 - Dec. 1969

Pg. 1.
7 November 1969 –
Sampling at El Chato continued.
Continuing through open grassy area between Ponds #2 and #3.
2 big males – front of one up against rear of the other –
#771 ; flaking disease bad on rear 1/3 of carapace and front marginal and spotty elsewhere. Central 1/3 of surface area of carapace scutes is worn smooth. White growth intervals visible and thin but well developed. CL 109.6; CW (CDRS) 121.4; CW (VD) 112.0.
#600 ♂ - Carapace white growth intervals etc very similar to #771, but no flaking disease whatsoever! CL 115.0; CW (CDRS) 127.s5; CW (VD) 117.0.
#142 ♂ - in little bit of mud left in a small pond; mostly very dry and that left is very sticky. Very bad flaking disease and sloughing off area here and there all over rear ½ of carapace. CW (CDRS) 148.2; CW (VD) 137.5.
#198 ♂ - near last one but in grassy area eating CL 139.0; CW (CDRS) 148.0; CW (VD) 140.0. Looks much like Chatham tortoises at CDRS.
In grassy area near pond "#3 and #4 –
281 ♂ - out in open grassy area near Pond #3; very large yet has very clear white growth intervals – well developed; also about 1 –1.5 inches of growth rings visible around outer margins of carapace scutes – i.e. no all worn smooth yet. Scattered flaking disease; especially in areas which still have growth rings – very little or none in smooth area! CW (CDRS) 138.0; CW (VD) 126.5.
685 ♂ - burrowed up under vegetation and can't measure; but very large, about like #281; very extensive flaking disease, all over – white in huge areas as in some of smaller animals; very clear white growth intervals and shell about same degree

Pg. 2.
of wearing as in #281.
#151 ♀ -
#613 ♂ - (may be 683, but doubtful); scutes all worn smooth – lots of flaking disease scattered all over; green algae in spots and areas all over carapace dorsal surface and sides. CL 144.0; CW (CDRS) 151.0; CW (VD) 139.00
#14 ♂ - S side of El Chato just where turn toward Zone 5 – still Chato Region. Shell about same condition exactly as #281, but has 2 deeply eaten out areas (in centers of 3rd and 4th vertebral scutes; flaking disease it appears). No other flaking disease; thin but clear white growth increments. Very typical oval and dome-shaped animal. CL 12.4; CW (CDRS) 137.3; CW (VD) 129.5.
#11 ♂ - just 25 m S of #14; scutes mostly smooth all over; scattered flaking disease – especially along scutes border where some signs of growth rings still visible. Green algae scattered; especially noticeable on back ½ of 4th vertebral. Very oblong, low build animal; like Chatham tortoise at CDRS. CL 149 ; CW (CDRS) 156.5; CW (VD) 141.5. Very clear white growth increments.

Pg. 3.
#229 ♂ - same area as #11; scutes all smooth; scattered but minor flaking disease; some green algae across rear of carapace; very oblong and similar in shape to #11; thin, but clear white growth increments; CL 151.4; CW (CDRS) 152.0; CW (VD) 144.5.
Bit further S – 75 m, but same altitude – open grassy area – lots of small dry ponds all around – following beasties:
#1035 – (♀ probably) – clear thin white growth increments; CL 73.3; CW (CDRS) 76.5; CW (VD)71.5.
#653 ♂ - (probably difficult to tell) – White growth increments are thin and intermittent. Quite small for altitude. CL 59.1; CW (CDRS) 61.3; CW (VD) 56.5.
New #1179 ♀ - (probably) –well developed white growth increments; CL 68.3; CW (CDRS) 72.8; CW (VD) 67.0.
One animal plowing through heavy brush (♂ probably).

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starting down through guayavillo forest toward Zone 5 – obvious mowed tortoise path paralleling a small stream bed – mowed grass and lots of plant #1 in small open areas a few m out on either side of trail –
Saw 1 tortoise – large male – burrowed in and inaccessible.
#109 ♂ - large – scarred up border to marginals; growth rings still visible in all of central 1/5 of carapace scutes; scattered flaking disease all over – especially bad on rear 1/3 of carapace. CL 127.0; CW (CDRS) 138.0; CW (VD) 127.0

Pg. 4.
Had to quit after only about 200 –300 m because of heavy rain and they are starting to burrow. Will sample later on the trip so – walked down to Zone 5 where it is not raining to set up camp. Right near Pone #1 area in Zone 5 saw the following tortoises – all in about space of 1/3 –1/2 acre!.
#704 ♀ - (definitely, I think – but a bit intermediate tail length) – thin intermittent white growth increments in between scutes; good case of flaking disease on fore marginals and all over posterior 1/3 of carapace. Worn smooth only in very center of carapace scutes. CL 98.4; CW (CDRS) 107.5; CW (VD) 98.5.
New # 1180 ♂ - (probably, but hard to tell because so small) – Clear white growth increments; no flaking disease at all. CL 64.0; CW (CDRS) 67.8; CW (VD) 61.0.
New #1181 ♂ - huge; very flat carapace, but high on sides; smooth all over all scutes; very little flaking disease on fore and rear marginals; no lichens, but a bit of algae on rear of carapace. CL 135.7; CW (CDRS) 145.0; CW (VD) 134.0.
#777 ♀ - large, dome –shaped; all scutes worn completely smooth and has typical wide and deep grooves forming between scutes particularly at rear of carapace . CL 93.4; CW (CDRS) 106.5; CW L(VD) 100.0.

Pg. 5.

#507 ♂ (or 107) - in Pond #1 bed in exactly the same location as on Oct. 16, 1969. He is not in very good condition from the looks of his carapace - deeply etched and flaking off in places due to the flaking disease which he has all over in splotches - Will sample Zone 5 more thoroughly tomorrow or Sunday morning.

A few comments to add to the day's observations.
1) Saw no standing H20 in any ponds at El Chato - #1 had a little in a small 1 x 1 m hole in amongst some large rocks when last viewed on Nov. 2, 1969. Now this is just thick mud which the tortoises are walking around in. Pond #2 is dry and has been since first saw in late Aug. 1969.
Pond #3 is now just thick mud - very sticky - tortoises still using it for wallow - on Oct. 16-18, 1969 it was still soupy mud and had some standing H20 on surface in places.
Pond #4 - very dry now - still had a few soupy wallows and a little standing H20 on Oct. 16, 1969 but now dry. May be a few manzanillo shaded ponds on S side of Chato with water, but did check a few today and all were dry; the majority completely so; a few had some stiff mud in bottom.
2. There are obviously a huge number of tortoises around El Chato now - are certainly concentrating in that region over past 1 - 1.5 months or so - because of this and to approximate equivalent areas, will confine my sampling to include from Pond #1 on NNE side to turn off to Zone 5 and Cerrito on S. side - simply can not

Pg. 6 . . .
cover more than this adequately alone.
8 Nov. 1969 - Beginning sample on down to Cerrito, etc. Just before leaving Zone 5 saw following tortoise:
#704 ♀, large. CL 98.2 cm; CW (CDRS) 107; CW (VD)98.5; Scutes worn smooth only in central ¼ part; very extensive flaking disease on back 1/3 of carapace and all over front marginal and adjacent scute border to them. Actively moving around at 0700.
New #1182 ♀; large. CL 92.3; CW (CDRS) 108.5; CW (VD) 98.5; completely worn smooth scutes all over carapace; no flaking disease; deep and wide grooves between scutes on rear marginals, supracaudal, front marginals. Very nicely dome-shaped. Only very faint white growth increment.
Passed through entire region from Zone 5 to W flank of Cerrito without seeing any tortoises - this is the region which is rather equivalent to Region 5 of Zone 3 - Caseta - La Fe Trail. Quite some sign here however - rather

Pg. 7 . . . . semi-green area, lots of plant #1 and some plant #2, the former smashed down a lot. Old dried dropping also and an occasional burrow in dry soil - in general however no animals and they are probably rather sparse in here. Trail all this way rather open (tortoises and pigs/donkeys I think) and it follows a drainage bed most of the way.
Next region - W flank of Cerrito and down a ways. On W flank of Cerrito in dense forest an amazing discovery - a small tortoise moving along at 0815 hours in dense herb layer, under dense shrubs, vines, trees of this area - very green and fairly moist area - but extremely shady, lots of soil and not at all like the rocky zones around the nesting areas at La Fe, Zone 3 , and Cerrito.
The animal must be of the 1967/68 hatching period judging from its size. CL 19.3 cm; CW (CDRS) 19.5; CW (VD) 18.0; SL 15.2; SW 12.8; (all done with Lufkin tape and eyeball); seems to be very healthy. The main question is where he came from since the nearest known nesting area (Cerrito) is about 1.5 km away and in a very different vegetation - terrain type - the "forest" here is not high - mostly guayavillo, Pisonia and

matasarno of 20-30 feet, but the shrub layer is very thick and about 2.5- 4 m high everywhere; lots of lianas and vines also. Very green and lush in fact. Of course the W

Pg. 8 . . . slope of Cerrito may drop rapidly over a short distance to suitable rocky nesting areas?
Took some photos (Roll #31; # 18-22) of the tortoise and the general habitat along the trail. Too small to mark scutes, so put a single vertical slash on lower half of 4th vertebral scute. When released he abruptly turned away from the open lighted area of the trail and moved off rather rapidly into the dense undergrowth of the forest.
Continued down around W flank of Cerrito still in dense vegetation saw no tortoises but plenty of deep churned up soil (pigs and goats probably) and some matted down trails off into veg which could have been tortoise - however, no droppings and only 2 spots which could have been burrows. Then commences a long flat, slightly (climbing?) stretch to Cerrito nesting area; this is virtually entirely rocks with a heavy growth of small Pisonias and the rocks are covered rather densely with plant #2; plenty of goats through this area, but saw no tortoises and

Pg. 9 . . no definite tortoise sign. There are probably very scattered individuals through this region. Saw almost no soil spots at all throughout this portion in either high or low parts and really doubt that many if any nests are made here - This region because it is dry and open in places, would seem to me to be the nearest zone which is climatically suitable for nesting to the area where we just saw number "1" - the small tortoise on the W base of Cerrito.
Have just arrived at nesting area south of Cerrito; a few further digging attempts have occurred around nest #16, but could not find any new nests in immediate vicinity of .5 acre.
Took altitudes on the way down and the differences between pts agree closely with those of Oct 16, 1969 - however the actual readings are in doubt and will be recorded later.
Also have decided on Regions for El Chato - Cerro Gallina trail to this point. They are listed below and will be described more thoroughly later with correct altitudes.
Region 1 - guayavillo - Scalesia forest from mora along reserve border to base of El Chato at Pond 1.
Region 2 - all around base of El Chato, wide-open grassy areas with many ponds; are sampled will be 170 -180 degrees arc from N to south side.
Region 3 - guayavillo forest from south side of El Chato down to Zone 5 - well used narrow trail with small open areas on either side.

Pg. 10
Region 4 - Zone 5
Region 5 - from S end of Zone 5 down to N-W flank of Cerrito where veg. Becomes very dense. 60-65 ft altitudinal change inclusive.
Region 6 - around W flank of El Chato, through dense veg down to beginning of dry, very rocky area. 120-130 ft alt. Change inclusive.
Region 7 - dry, rocky area from Region 6 down to nesting area south of Cerrito. 100 ft alt. Change inclusive.

Region 8 - Cerrito nesting area and made a 3 hr. "abortive" trip from Cerrito N. Area toward Cerro Gallina. Went about 1.5 - 2 km WSW of the nesting area's NW corner and stopped when directly N (more or less) of Cerro Gallina - on whole trip certainly did not go down in altitude more than 25-35 feet. The entire way, except as noted below was dense Pisonia and rocks with a lot of plant #2 and mallow on the rocks. Very hard walking. No definite sign of tortoises in any

Pg. 11 . . . of this rocky area. Essentially the entire trip was like the rocky area with predominates and surrounds the small open soil areas at the Cerrito N.A.
Certainly very few tortoises in the area and must be scattered widely. However did find a rather large (1.5 -2 acres I saw today), maybe more) flat open area with few rocks and fairly sparse vegetation; had a lot of open patches of darkish brown soil (like nest #1 in Zone 3 NA) and much evidence of goats using these - appeared suitable for nesting and maybe some occurs here - saw no definite digging signs.
This is the only area seen on the trip where there were smashed down trails in the vegetation which looked like tortoise activity - but, so no droppings or burrows.
Returned to Cerrito N. area (Region 8 of trail) and searched there for 1 hr. (Jan also looked around for 1 hour independent of me). Some tortoise sign - smashed veg. Trails (however some of it goats no doubt) and dry droppings of unknown age. But not much ! Area mostly fairly dense veg, very rocky, lots of plant #2 and mallow. Very analogous to areas around central part of Zone 3 N area. - Here and there are small spots of 10-50 sq meters with a bit of open soil (sometime dark brown type, sometimes red) which goats use heavily; these show some evidence of tortoise attempting to nest, but

Pg. 12 . . . so far only 3 nest - #10, 11, 16. The area is mostly rocky with only intermittent soil spots, the latter mostly in low area - more like area just S of Zone 3 NA central part. Did find the following tortoise:
New #1183 CL 43.2; CW (CDRS) 43.8; CW (VD) 41.5; Up under prone branch of a large Pisonia resting in shade - well hidden! At 1430 hrs., sun out and hot. Very fine thin, incomplete w. g. increments between carapace scutes. ♂ maybe, but too small to sex. Clearly does not like sun and being in open - went immediately to heavy shade when released.
Also some very fresh - 2-3 days - droppings near nest #16 - also some new and fresh looking diggings there -
Returned to Zone 5 and am going to sample there some before supper - now clear and sunny - has been since late morning - (i.e. 1030-1100 hrs). Searched all around pond #1 in Zone 5 - no animals seen in addition to the 6 seen yesterday and this morning.

Pg. 13
9 Nov. 1969.
Sampled all around pond #2 in Zone 5, saw no tortoises, but some trails, droppings which are mostly dry, and a few burrows. Also passed through much of Zone 5 along trail - conditions similar a few trails, some dry droppings. In general, this area is very like that of Region 4 of Caseta - La Fe trail, but not nearly as many tortoises present and not nearly as much sign as in that location. Difference probably is lack of H20 in ponds in Zone 5 and its presence in Region 4.

Then sampled between Zone 5 and El Chato - Region 3 of El Chato - Cerro Gallina trail - Also took some more latitudes along this trail - these must all be corrected below to Caseta altitudes as a base. Will do later. Zone 5 altitude used as base - reading 520 feet when left - probably not correct, but rest of altitudes will be given as differences and can correct by using an official altitude for El Chato trail - reserve border intersect.
At 40 feet altitude above Zone 5 begin seeing first open grassy areas along trail where tortoises keep it mowed down - not very much - 1-2 m on either side of trail - some tortoise trails off to sides into guayavillo forest through plant #1; some drying droppings also.
At 90 ft alt. Above Zone 5 more open grassy spots along trail; more tortoise trails off into forest and some fresh droppings.
At 100 feet alt above - first big open grassy area - near El Chato now - open for 0 m. on either side of trail; first trails, droppings and a few burrows.
1 tortoise - maybe the one seen here on Nov. 7; #1046 ♂, large male; CL 128.4; CW (CDRS) 147.5; CW (VD) 136.5 - . . .

Pg 14
. . . has scattered flaking disease all over carapace, the latter being completely worn smooth. Has a few scattered faint splotches of green algae on dorsal parts of carapace. Also has a species of lichen on the lower ½ of the 4th vertebral, on the last 2 costals (last one on each side) and on the supracaudal scutes. Also this same lichen and one other one on 3 foremost marginals (one on each side).
Continued on up -
#57 ♀, large, now about ½ km south of El Chato in region 3 upper end - she has thus moved rather directly about 1 - 1.5 km from pond #2 (less than 48 hrs) area at base of Chato on ESE side around and down trail toward Region 5 a bit. Was grazing on grass when seen.
*Altitudes: above Zone 5 - beginning of region 2 of trail : 135 feet
1. Pond #2 - 185 feet
2. Pond #1 - 220 feet
3. Highest point of trail in guayavillo - Scalesia forest along tail (Reg. 1) - 310 feet.
4. El Chato turn - off - 280 feet
Took weather at El Chato - 0930 hrs. Rainfall 0.14 inches (=3.56 mm); Evap reading 12.8 ml, difference of 2.4 ml since Nov. 7 (1330 hrs).

Pg. 15
Refilled evaporimeter full.
On return to Caseta saw about one dozen animals in between Camote patch and Caseta turn - off along reserve borer l- spot checked some numbers; almost all were those recorded in this region before - i.e. #'s 97, 98, 103, 106, 627, 277, 73. But 2 numbers checked have not seen up here before -
#376 ♂ - he has been around Caseta at least since early Oct. (4th) , and saw on Nov. 2, '69 above Caseta at reserve border, with carapace showing signs of having been in pond. When we left Caseta on Nov. 7. he was still right out in the grassy lawn there, having returned from the ponds above recently. Today was on reserve border, .25 mi. W of

Caseta trail - reserve border intersection - almost to top of first hill - so has moved up there onto mora area in about 48 hours time!
#104 ♂ - at Caseta trail, reserve border intersect. CL 91.5 cm; CW (CDRS) 103.0; CW (VD) 95.5.
Also saw #450 ♀ again, same place as on Nov. 7: CL 87.2; CW (CDRS) 95.2; CW (VD) 87.0
Caseta weather - was overcast, cool, and occasionally drizzly all day long - (and probably was the last 3 days also) Max 79.5 F; Min 66.5 F; First since Nov. 6, (0900 hrs); Evap - reading 14.3 ml, 3.6 since Nov. 6. Rainfall - 6.6 mm (since Nov. 6).

Pg 16
10 Nov. 1969
Going to Devine's - up his Western cut from the reserve border - tortoises have now moved into the cut from 2 more points - 1. directly up from Reserve border through a small patch of mora about 5 m thick and 2. from Caseta upper pond area through another small bit of mora near the reserve border. Just about 15 m up the cut saw #236 ♂ in the edge of the mora eating herbs - but not any of pangola or other introduced plants.
About where group of animals was on Nov. 2, 1969 - both these face to face - #695 ♂ and #101 or 501♂ (501 is circled and checked suggesting this to be final assessment), not sure of marking of latter l- 1 of units marked clearly - other 2 marks in hundred very, very poor and hard to determine definitely. The latter's measurements - CL 113.3; CW (CDRS) 123.5; CW (VD) 113.0; very fine intermittent w. g. increments; not well developed; only central 1/5 of scutes worn smooth.
A lot of abundant trails, partly dried and very fresh droppings all over this area - much pangola

Pg 17
smashed down but only a few eaten places - most of activity and trails is on either side of central pangola strip in 2 side strips covered with a 1 m high herb with dark black - bluish berries - eating all the low herbs in these areas which came in after mora cut. Much sign of traffic out toward Caseta upper ponds - trails and general smashed down vegetation.
Up another 75 m - #692 ♂ - eating off to side of pangola strip. About 1/5 of way up cut toward first hill - #368 (♀ maybe - looks like it but tail intermediate tending). Has bad flaking disease all over back 1/3 of shell but only central 1/5 - ¼ of scutes are worn smooth - rather large for female. Eating Commelina nudiflora off to side of pangola trip Altitude is 830 ft.
About ¼ of way to top of first hill (or ½ of cut length) #305 grazing on Commelina nudiflora. This is the highest animal seen 1840 feet) and no paths or droppings seen above it - so have gone about 2- 3 x as far as 1 week ago but not really very high yet. Thommens reads 1330 ft at top of hill.
Caseta weather - 1900 hrs; Max 83.5 F; Mind 68 F; Rainfall - 1.8 mm; Evap 2.9 ml (reading 17.2)

Pg. 18
11 Nov 1969

Did nothing all day but relax and obtained a little fresh food from closest Guerrero's. On way to latter's found that tortoise sign (trails) did not indicate that they have moved up any further than 1 week and 2 days ago (Nov. 2). Altitude of highest sign is about 760-770 feet.
#712 and 31 ♂♂ and #3 ♀ were around the Caseta feeding on grass and other herbs. Nothing of great note except the following:
1. When sun cam out strong at about 1200, #31 ♂ and #3 ♀ moved into mostly shaded areas under trees and began feeding there rather than in the open where the sun was heating things up; #712 ♂ not visible at this time.
2. In mid - afternoon #'s 3 and 31 came to within about 3 meters of each other in their foraging wanderings; they sat facing each other for about 2-3 minutes, then #3 moved forward a few steps toward #31; then sat again too about 1 minute. The #31 stretched neck out for but parallel to ground and headed straight for the female. She immediately took off sideways so that as he came on his

Pg. 19
head came up near her rear and as she was retreating - he appeared to attempt to smell her cloacal region, but she moved away so fast that he was unable to do so. She continued moving off quickly, and the ♂ simply collapsed onto the ground with a great "woof" and that was all - she moved off 10 m and they both began grazing again.- After the first charge and lunge he made no attempt to follow her.
1900 - Weather - Overcast and cool till 1200- cleared off completely then and has been clear till now - Max 84.5 F; Min 68.0 F; Rainfall 0.1 mm; Evap - 3.6 ml (reading 20.8).
12 Nov 1969 -
Going to Zone 3 and Region 4 to check weather instruments. Will take notes on animals encountered just to add to movements data.
#31 ♂ - just below Caseta - still hanging around since)ct 1, 1969 sighting
#205 ♂ - ½ way down to Caseta pond #1
#408 ♂ - 2/3 way down to pond #1.
#785 (♂ maybe - small) - right near pond #1 on trail - recently in mud.
#274 (♀ probably) - right up trail a few meters from pond 31; very recently in mud wallow.
3 animals in pond #1; grazing on low grassy areas which are above water and mud line.
#114 ♂ moving very deliberately through shady manzanillos groves E of Caseta pond #1. Mud and fresh Azolla on lower part of carapace.

Pg. 20
In lower part of Region 3 - moving up and Northward very deliberately through the brush about 15 m off of the trail not eating , walking steadily.
New # 1184 ♀ maybe, but small and hard to determine; CL 65.9; CW (CDRS) 66.8; CW(VD) 61.0. Shell not worn smooth at all except very tiny central areas o scutes; No disease or plants on shell; only faintly visible intermittent w. g. increments.
In Region 4, a few hundred meters distance above the pond area - just after leave Reg 3/4 border area - sleeping in shad in forest

New #1185, ♀ probably; CL 73.3; CW (CDRS) 76.2; CW (VD) 69.5; Clear, thin, but complete w. g. increments.; no real wearing smooth on shell yet at all; no sign of heaving been in pond recently.
Region 4 - under shade of manzanillos and guayavillos right near weather instruments are a number of tortoises.
#626 ♀; w. g. increments barely visible and not complete - see next page; CL 85.5; CW (CDRS) 94.3; CW (VD) 86.5.
#223 ♀ probably, but tail a bit intermediate w.g.i.s very clear and large; about same size as #626 and the following animal. CL 81.3; CW (CDRS) 87.5; CW (VD) 79.5;

Pg. 21
dried mud and Azolla on carapace - recently in pond.
#1074 ♂ - CL 78.0; CW (CDRS) 80.7; CW (VD) 74.0; Also dried mud on lower carapace. Also very nice clear white growth increments - very thick and well developed. These last 2 animals were eating dry dead manzanillos leaves under the trees when I found them ! #626 just resting
#626 has clear evidence of red soil all around and on front and rear marginals - therefore must have been down lower fairly recently - not mud, just faint color now where mud has worn off and only some sign of it remains; scutes worn smooth only in very central parts.
Zone 3 nesting area - 1300 hrs - Rainfall 0.0 inches; Evap - 35 ml, refilled full; Max Tem 86 F; Min 66 F, since Nov. 6, 1969.
Region 4 weather - 1200 hrs - Rainfall 0.005 inches; Evap - 30.3 ml.
#127 (apparently her and probably so) has really dug up the area around nests 3, 6, 7 etc where there is open red soil. Can not find a completed nest here, but there are 14 hole which she is probably responsible for - she is certainly responsible for 6 of tem and the other 8 all seem to be new since we left here on Nov. 6, 1969 when she was still present. Took photo of one of these. All stopped by rocks in sides and bottom of hole although several look as if she might have been able to make suitable nesting holes with just a little more effort. All are only about 10-15 cm. at deepest

Pg. 22
. . . parts and she used cloacal fluid for only one of the deepest ones as far as I can detect from looking for mud clods.
Scoured all the obvious possible nesting sites in the nesting area's central part and found no nest and no #127 or any other large ♀♀.
#127 certainly seemed to have a marked fixation on the one open area where red soil was visible and almost all the holes (all but 3 or 4) were attempted on virtually open ground, the other begin tried in areas where there was only a covering of very sparse and low herb like mallow, plant #1 and plant #2.
Did see the following tortoise while looking for nests.
#918, too small to sex - asleep in shade of a large Pisonia trunk at 1345 hours - (air temp is only 78 F, but sun has been out and strong off and on and radiation through the clouds is strong at times) This little one has very clear, well-developed white growth increments.
On return saw a few more animals. Just above Region 4 Central area a very short . . .

Pg. 23
. . . ways (50-75 m) -
#406 ♂; large ; central 2/3 of scutes worn smooth, very thick, nicely develop w.g.i.s only a small bit flaking disease.
#128 ♂; very large - like biggest at El Chato. Also very nice w.g.i's a bit more of flaking disease but not much - scattered here and there on fore and rear marginals in small splotches. All but very outer thin border of scutes worn smooth. When saw him he was waling along up on all 4 legs straight at #406; had been eating some kind of large dead very dry leafy plant - parts of it hanging from mouth; has been in pond recently because has freshly drying mud and Azolla on carapace. CL 132.2; CW (CDRS) 143.4; CW (VD) 132.5.
Caseta weather - 1900 hrs. Clear and sunny off and on form sunrise to noon - most sun from 1000 - 1200; after that overcast and only weak radiation coming through. Max 85.0 F; Min 61 F; Rainfall - 0.0 mm; Evap. 3.3 ml. (reading 24.1 ml)
3 tortoises around tent at 1600 hrs - #31, 712, 508 - all large males.
13 Nov. 1969 Going to El Chato and Naranjo - On way to El Chato following tortoises
#236 ♂ - ½ of the way from reserve border Caseta trail intersect to top of first hill;
627 ♂ and 103 ♀ top of first hill

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376 ♂ - ½ way between first hill and rt. turn of reserve border
354 ♂ - 150 m from turn - E of it; CL 105.5; CW 113.3; 103.0
106 ♂ and 104 ♂ - 100 m from turn - E of it; #104 off of border about 50 m. in passion flower.
873 ♂ and 73 ♂ both off into open areas of Passiflora and Commelina just about at turn;
278 ♂ at turn, on border. In this area near the turn the animals are obviously beginning to move to the N of the border a little out into the big patches of acres of Passiflora punctata and Commelina nudiflora. These patches are widespread and lush up to the grove of trees which lies about .2 km N of the reserve border l- so far the furthest trails and sign I could find only go about 75 -100 m N of the border and the furthest N animal seen #73 ♂ appears to have made these trails.
97 ♂ and 98 ♂ - Camote patch just after turn
720 ♂ l- 75 m. beyond Camote patch to W - on trail furthest W animal see from the Caseta area.

Pg. 25.
Near dry pond at El Chato trail - reserve border intersection -
981 ♂ (probably, but tail intermediate); CL 73.7; CW (CDRS) 83.5; CW (VD) 75.0.
319 ♂ CL 111.4; CW (CDRS) 118.8; CW (VD) 111.5; very high dome in rear.
Went away from this pond for about +,- l hr and when returned these 2 animals had moved away into slightly wooded area around it. But two more there now.
#144 ♂ and #164 ♀ (prob.)
Also decided to explore the area N of the reserve border at the El Chato turn off - the area has several little peninsula of woods and island of forest trees (guayavillo, Xanthoxylum, others) scattered here and there but most of it is very lush open areas just covered with ankle to knee deep Passiflora punctata, Echiropipporn, and Commelina nudiflora, The

first being the most common - there is scattered mora here and there but I went up about 350 - 400 meters in distance and about 30-40 ft in altitude above the pond and there is almost none - most importantly there are abundant tortoises and tortoise sign as far as I went - most of it is fresh trails, droppings of various ages from fresh to mostly dry and "fluffy", fresh burrows and eaten down areas of the herbs of from a few to 10 -15 square meters. I think most of this sign is at most 2-3 weeks old - so, I feel that the

Pg. 26.
. . . tortoises are moving directly up N of El Chato into this lush area - there are also abundant trails, burrows, droppings and eaten areas lower down around the dry pond on the reserve border and these sign are older - 3 weeks - 1 month or so probably - it appears that the animals are funneling out of the El Chato area through the guayavillo forest above it, down past the pond and then up to the N through the lush herb covered areas - there is abundant sign in the little islands of trees also but most of the activity appears to be around and in the open spots - the majority of the area is open - the animals are definitely coming by and checking this pond - have seen 2 here today, 2 more came in last hour and 1 more is now coming into it. Lots of trail from the reserve border lead to it rather directly and there are trails and burrows in high

Pg. 27.
density all around it - all this even though it has had no standing water since sometime between late July and late August.
Saw a few animals up in open herb areas discussed above - will return there shortly for more exploration.
485 ♂ CL 113.4; CW (CDRS) 121.2; CW (VD) 110.5; Only central ¼ - 1/3 of scutes smooth; flaking disease scattered all over rear 1/3 of carapace, front marginals and here and there elsewhere. About 25 m N of reserve border
621 ♂ CL 107.4; CW (CDRS) 113.0; CS (VD) 103.0; 100 m N of reserve border in an open Passiflora area feeding. Only very centers of scutes worn smooth. Has almost no flaking disease but 2 deep patches of it in very smooth centers of 2nd and 3rd vertebral scutes.
154 ♀ - about 350 m N of reserve border and about 30 -40 feet higher in altitude In open Passiflora area feeding.
On returning:
#172 ♂ on reserve border near pond CL xxx; CW 147.5; 135.0; abundant flaking disease all over rear 1/3 of carapace; only ½ -2/3 of each scute worn smooth; flaking disease as noted many times before is concentrated most heavily in non-smooth areas where thee are still growth rings.
Finches and tortoises: As I am sitting here writing there are 2 finches (I think small ground finch in specific) eating these small seeds which are all over the front end of #144 ♂. They are hopping about on the forward border of his carapace and all over his

Pg. 28.
foreleg picking the seeds up from between the scutes and in between the scales on the leg where they have collected. [Marginal note: "note the seeds are of a grass species"]. Occasionally one of the birds will be a bit aggressive and try to run the other off but this

never lasts more than a few seconds and hey both feed side by side most of the time. The yare working very diligently and have been on this one tortoise for about an hour. The tortoise is hardly moving at all because of my presence. He has made no sign to cooperate with the finches cleaning in any way but on the other hand is not bothered by their presence - once when one finch jumped from a carapace marginal down onto this leg he retracted a bit and hissed and the finch flew off for a few seconds and then returned. This reaction appear to be virtual reflex and may in part be due to the animal being tense in my presence.
#30 ♂ (may have been 430); CL 125.3; CW (CDRS) 137.7; CW (VD): 125.5. Heading toward pond directly with a deliberate pace - near reserve border at El Chato turn off.

Pg. 29.
Shell has color of ed mud around bottom of carapace - shows from El Chato pond area - **Many of tortoise seen up N of reserve border here and around this little dry pond show exactly the same indications!
Went up onto hill covered with guayavillo forest just N of and above El Chato to look for possible routes N to Scalesia from pond area discussed above. Looks as if could go up between Los Hermanos and Mirador and on up to S. Rosa trail. Then cut my way over top of this hill and E to trail leading from reserve border to base of El Chato. Lots of tortoise trails and sign but only saw one in forest - #316, a large ♂. As on our Oct 19 sample the tortoises have been using this guayavillo forest heavily and it now appears are probably moving through it and to the N across the reserve border -
Going up N toward Mirador and los Hermanos - In open Passiflora areas - by 1330 hrs (2.5 hrs since last here) #319 ♂ and #485 ♂ have moved up N into exact area where #621 ♂ was and still is now; i.e. about 100 m N ! #30 ♂also has moved about 20 m N of pond are where saw him 1.5 hrs. ago.
Back up in area where #154 ♀ seen this a.m. Alt is 50 feet higher than pond by reserve border (i.e. El Chato turn -off area)

Pg. 30.
More tortoises here in a big open Passiflora covered area
#101 ♂ (maybe 301, but chipped badly) CL 113.0; CW (CDRS) 128.0; 128.0 (VD); Spotty flaking disease on rear of shell and front marginals; scutes only worn in central areas (1/5 -1/4 or so); signs of red mud all over lower 1/3 of carapace - therefore from El Chato!
#82 ♂; can see old dried mud on carapace from El Chato or some fairly recent pond area. Up about .5 km from reserve border - alt is about 50-60 ft above that of El C. turn off area.
#209 ♂ - same area as above 2 animals; CL 111.0; CW (CDRS)116.5; CW (VD) 111.5; very clear, well -developed white g. increments. Central 1/5- ¼ of scutes worn smooth; Extensive flaking disease only on rear ¼ of carapace, otherwise splotches of it here and there all over. One large splotch right in middle of worn smooth area of 3rd vertebral scute; but most patches of it are where there are visible growth rings.
Went on up above theses 3 - tried following passion flower areas but immediately above the are where these 3 are all open areas become quite solid mora.

Pg 31.
. . . and impassable. So then tried following this little islands and peninsulas of few trees left in the area (all are being slowly smothered by Passiflora , Echinoppion, and mora). First headed for Mirador- followed tortoise trails till they ended about 250 m or so south of the base of the hill. - ended in mora and turned around it looks like - had been in rather heavy mora for a couple hundred meters when stopped. There is not much above this point but a few tree covered areas but these appear isolated and there is thick mora all around them and all over the south slope of the hill and far away to the W also.
The tortoise sign (above the 3 animals below) in this direction is all at least 1 week old, but probably less than 3-4 weeks old - the trails are still visible even in only passion flower areas and these can not be too old since this plant seems to spring back rather soon after being pressed down. The droppings are all dry but this does not mean much since we have had some sunny afternoons recently. The burrows are dry at the surface and not extremely recent (>than a few days old). [Marginal note: highest alt. Where saw sign is 100 ft above El C. turn-off.]
Then headed for Los Hermanos using same method of following trees - again lots of trails and sign both into mora areas and in open Passion flower spots and through and under trees in woods; dry droppings too. At an alt. of about 110 ft above the El Chato turn off came out of a small

Pg. 32.
. . . patch of trees and found an open grass and passion flower covered area; fresh droppings and burrows and trails here. Then found following tortoise here, but burrowed in so can't measure -
#205 ♂ - traces of red soil at base of carapace shows from pond areas below.
Grass here is very luxuriant and about .75 m high; can see he has been eating it a lot. Just above him the area is honeycombed into the mora with trails and there are droppings of all stages from very fresh to those that look like a handful of straw - obviously some animal's very active here - found him.
#92 ? (both 4 and 7 marked in units category); very nice clear, well developed w.g.i's only a few spots of flaking disease on front marginals and her and there on rear of carapace. CL 96.0; CW (CDRS) 107.0; CW (VD) 98.0
From here could not detect any more sign to N where thick mora becomes dominant - however are some tree extending out to E and N toward Los Hermanos. Went E

Pg. 33.
and found more sign, but 1-2 weeks old and only a few scattered trails - not heavy use - probably only one animal. Then found a trail and followed it up past Los Hermanos to an alt. Of 270 -280 feet above El Chato turn -off - Last tortoise sign was seen at 200 feet above E. C. turn-off near the trail - 2 burrows and an eaten down area of Passiflora and Commellina - turd dry and spread out like straw - probably about 2-3 weeks old, but not older certainly. Only looks like one animal. From area where saw #205 and 92? There is not much sign of any concentration of activity and animals - so general limit for now is 110-120 feet above El Chato turn-off area. - with a few animals straying higher. To W

side off and above Los Hermanos are some lush open areas of tall passion flower and other herbs - but no sign of tortoises there or having used trail at all since 80 feet lower down - even there did not use trail much - just used it and burrowed next to it once. Certainly if there were many animals in this area they would use the trail and these open, verdant areas of vegetation.
Followed human trail back down - comes out right beside pond near El Chato turn off! Except for bit of sign at about 180 -200 feet mentioned above, no more tortoise sign till about 120 feet above pond - from

Pg. 34.
then on more and more sign till the last 200 -300 meters of the trail is rather solidly used by tortoises and fresh trails, burrows and droppings are on all sides of the trail. Most of the sign and activity is from about ½ km to 50-60 ft altitude above the pond to the pond. I would guess that the highest sign seen (180-200 feet) is about 1.5 -2 km above the pond in distance.
Saw only 1 animal on return #165 ♂, medium sized; near the pond; not surprising because was moving very fast and it is after 1600 - they are beginning to burrow in now. On return all but one animal I passed along Reserve Border between 1630 and 1700 were burrowed in. The one was grazing (saw about 10 in all). Jan reports that at 1615 she walked by about 6 and all were burrowed in or doing so at that time. Just above Caseta on border was one animal still grazing at 1715.
Caseta weather - 1900 hrs. Overcast all day except for about 10 min. Max 82.0; Min 68.0; Rainfall 0.3 mm; Evap 2.7 ml (26.8 ml reading).

Pg. 35.
14 Nov. 1969 - To Naranjo for real!
Along reserve border and Caseta trail to just W of the right turn and Camote patch I saw 9 animals this a.m. - 8 were out of their burrows and active - the other was awake and just beginning to leave his. This was all between 0745 and 0805. None of the animals was more than a few to a few dozen meters from their easily detectable burrows. Yesterday between 0820 - 0845 all animals seen were also active. This plus other days convinces me that arousal now occurs from 0700-0830 with the vast majority between 0730 -0800; retirement 1530 - 1730, majority 100 -1630.
#165 ♂ at pond at El Chato turn off- CL 99.2; CW (CDRS) 109.0; CW (VD) 101.5
Altitude at El Chato turn off on reserve border - the official one I will use - 820 feet; set at 670 before leaving Caseta 45 minutes ago and weather has not changed.
On toward Naranjo - just over first hill, still in mora and Passiflora covered open area before enter woods.
#548 (♀ prob., but hard to tell, tail int. tending) CL 77.3; CW (CDRS) 87.0; CW (VD) 83.0; Flaking disease abundant on rear ¼ of carapace; also on front marginals; scutes not worn smooth much at all.
Another 400-500 m W - in Guayavillo - Scalesia forest, but on reserve border in open eating mumuyu (Commelina). Can see where came on border from south up through forest.

New (1361 ♂; CL 72.7; CW (CDRS) 75.0; CW (VD) 68.0. Very little flaking disease - only on front and rear marginals in splotches; scutes worn smooth only in centers of a few - lg. Vertebrals; w.g.i's only extremely faint and not complete -

Pg. 36.
For about another ½ km. Saw 8-10 places where tortoises crossed border, and used border some - not a great lot of disturbance in total; just simple paths across the reserve border or use of the border for 15-20 meters; a few drying but fresh (1 week or less) droppings. Saw no tortoises but this activity was not here in this much abundance on Oct 8, 1969 trip; on the other hand this is not much of an increase in tortoise activity - very minor in comparison to around El Chato, Caseta and in between. Most of his activity is probably due to animals coming up around El Chato and then continuing around El Chato and then continuing N - all the trails but 2 which crossed the border seemed to be going N.
From here to about ¾ - 1 km E of Naranjo area only saw sign of 4 animals - these were widely separated tracks crossing border - one going south and 3 N it appeared - fairly fresh also.
The last 750-1000 meters as approached Naranjo big open central area proper, began to see more and more tortoise trails and droppings.
Pg. 37.
. . . until about last 150 meters was very noticeable - paths all over the place going in all directions through the herb covered semi-open areas (Plant #1 and Passiflora). The use here is not as heavy as that in Region 4 of Caseta-La Fe trail - more like Zone 5 below El Chato, or perhaps a bit more dense than the latter zone.

Activity in Naranjo open area is certainly more extensive than on Oct 8 visit, but saw only a few tortoises. However, in general it appears that Naranjo zone and areas in between El Chato and Naranjo support the notion that animals are tending to move upwards and that the routes taken generally run by way of openish areas with pond (dry or otherwise seems unimportant except that concentrations are more dense and remain longer around ponds with water and or mud).
Also noticed that most not all but most activity signs of tortoises between El Chato and Naranjo were associated with semi-open to open well lit areas of guayavillo - Scalesia forest and not darker, denser more heavily canopied areas as much.
At Naranjo set up rain gauge. (Tru-Check) and Piche evaporimeter in Standard fashion and began them operating at 1100 hrs. Also implanted meter stick in (dry now) pond in central open area; will have to add 25 cm to all readings here because couldn't drive in any deeper than that.
Pg. 38.
Tortoises:
#901 ♂; in plant no. 1 open area a few meters from pond. CL 95.0; CW (CDRS) 103.0; CW(VD) 94.5; bad flaking disease all over rear 1/3 and front 1/6 of carapace. Sleeping when I found him - in drizzling rain.
#660 ♂ - in open cleared off area of dirt in passion flower covered floor of very open guayavillo stand. CL 144.0; CW (CDRS) 158.5; CW(VD)148.0; has very lovely, bright green (almost chartreuse) alga all over carapace in places which are rubbed the least in moving - especially heavy on following areas - lower half and part of sides of 4th

vertebral, all over 5th vertebral, very rear border of 3rd vertebral; all over last caudal (must mean marginal) on each side and on supracaudal; scattered on front and rear marginals; in cracks, dips and indentations in general all over rest of carapace. Has very little flaking disease, just spots here and there, except 3rd costal on right side is severely scarred and deeply eaten away by a patch of the . . . .

Pg. 39.
. . . disease.
When arrived at Naranjo Thommens read 730 ft. - probably partly due to gradual (but very small) temp rise- got here at 0930.
From Naranjo took a human trail at about 75 degrees E on compass- this immediately enters semi-open guayavillo - Scalesia forest, but denser than open area around Naranjo. About ½ - ¾ km above Naranjo and at an altitude 70-80 feet above it hit a very open area - (2-3 acres) covered by plant #1 and with a dry rocky - bedded pond very similar to that at Naranjo. Between Naranjo and here lots of tortoise trails and old drying and dry droppings - hard to estimate age but probably none of it more than 3-4 weeks old - at this open area plant #1 crunched down about to same extent as at Naranjo but being a small area could be due to only 1-2 tortoises.
One tortoise beside pond, grazing on plant #1 and other herbs - #663 ♀; CL 90.2; CW (CDRS) 9l6.0; CW(VD) 89.0.
Continued on up - tortoise trails and sign continue- none older than that below and most more recent - some very fresh turds - only a few days to a week old - also fresh trails all through the guayavillo - Scalesia forest am passing through. At an altitude of about 130 feet above Naranjo and probably 2-3 km from it there is a big semi-open lush area thick with lianas, vines, shrubs, ½ - 2m high shrubs and herbs, all under

Pg. 40.
guayavillo and Scalesia. Wet and rainy today and appears to be extremely succulent and fresh vegetation. Lots of very fresh tortoise trails, turds, and burrows - an area of 2-3 acres here is well used.
3 tortoises seen:
#887 ♂ CL 103.5; CW (CDRS) 112.2; CW (VD) 106.5; extensive flaking disease all over rear and front of carapace and scattered here and there all over.
#662 ♀ (prob. But tail intermediate); CL 84.8; CW (CDRS) 97.9; CW (VD) 89.0; flaking disease on rear ¼ of carapace and front marginals.
#973 ♂ (prob.) CL 86.6; CW (CDRS) 93.8; CW (VD) 89.0; mild flaking disease on front and rear marginals.
Continued on and in just 200-300 meters or so hit National Park border which runs 330 degrees NW at this point. It come up from tortoise reserve boundary not too far W of El Chato area; altitude here is 160 ft above Naranjo. Some very clear tortoise sign where the trail hits the NP border- not much sign that it goes further up at this point however- some drying droppings and old burrows - sign not as fresh as area below where 3 animals are - this I would guess is 2-3 weeks old.
Pg. 41.
perhaps.

Working back down the trail (NP border) toward its juncture with tortoise Reserve boundary. - Just a short distance from where began at human trail - NP border intersect: #860 ♂; widespread and moderate flaking disease on rear ¼ of carapace and front marginals and adjacent scutes - in middle of NP border in open eating herbs; CL 94.9; CW(CDRS) 103.0; CW(VD) 94.5. Note: Can hear another tortoise just to my south somewhere.
Just a bit more and came into a very large open area; mostly herbs, shrubs, and mora - a few trees and tall shrubs but all being smothered by mora, Echinopippon and Passiflora. One tortoise penetrating about 30 m into this open area - this is about 110 feet above Naranjo in altitude.
#1045 ♂ CL 112.4; CW (CDRS) 125.0; CW(VD) 116.0; moved on toward reserve borer - about 350-400 meters before it found another tortoise.
#278 ♀; CL 91.2; CW(CDRS) 100.0; CW (VD) 93.5.
From area where 3 tortoises found near NP border and human trail intersect to reserve border there is spotty sign (fresh) here and there o f tortoises- trails and droppings; but no heavy concentrations. The are certainly moving up N through this forested area toward Lechoso, Salasaca and the general Santa Rosa area- of course its possible have been some in this area all along the past few months, but doubt more than a handful -

Pg. 42.
Caseta weather 1900 - Rained all day, drizzling almost constantly - overcast completely; looks as if drizzling all way to coast and out at sea also. Max 74.0 F; Min 69 F; Rain 5.5 mm; Evap. 0.0 (reading 26.2)
15 Nov. 1969
Going to Chato with guests.
Saw #505 moving back down to Reserve Border from Caseta upper ponds - has been at ponds since 1 Nov. 1969. In woods above Chato, just where enter - #316 ♂; #384 ♂; Half way down #59 ♂ large.
Just 50 m from pond - still in guayavillo forest in open well -matted down area.
New - #1186 ♂ (prob): bad flaking disease on front and rear marginal - scutes hardly worn smooth at all. CL 82.8; CW (CDRS) 89.5; CW (VD) 82.0
At pond #1
#151 ♀; #1046 ♂; #171 ♂; #139 ♂; 296 ♂.
Between pond 1 and 2 - half way
#204 ♂; CL 128.5; CW (CDRS) 137.0; CW (VD) 127.5; #172 ♂; #1176 ♀
Near Pond #2
#613 ♂; #281 ♂; #79 (♀ maybe - tail int. and smashed a bit at tip)
(Pg. 43)
#338 ♂; central 1/3 of scutes smooth, bad flaking disease on rear 1/3 of shell and front marginals CL 109.4; CW (CDRS) 123.0; CW (VD) 110.5
#168 ♂; #309 ♂ large;
Weather at El Chato - 1300; rain 0.20 inches (=5.08 cm); evaporation 12.4 ml; refilled full.
Caseta weather - 1900 hrs; very nice day - clear and sunny from about 1100 till sunset; Max 81.5; Min 67.5; Rainfall 0.2 mm; Evap 2.8 ml (reading 29.0 ml).

***Note: thermoregulation** - When arrived at El Chato at 1200 sun had been out full and strong for about 45 - 60 minutes. Almost all tortoise seen (about 10L) were out feeding and moving in open. But by 1300 all tortoises seen had moved into shade under vegetation - most were sleeping stretched out - a few eating grass under trees. On return through mora notes that al animals were in shade, resting - this was between 1330 - 1430. On trip over before sun was out and just after it was out (1030-1200) they were all active and in open.
16 Nov. 1969
1900 hrs. - Caseta weather; Max 75.0; min 68.0; Rainfall 0.1 mm.; Evap 1.2 ml. (Reading 30.2 ml); refilled evaporimeter full.
Went to Devine's earlier today - on return came down his cut which passes just W of Caseta upper ponds - (Called W cut before; actually middle one now because he has put in a brand new one a bit further W). Found that tortoises had progressed to within about 70 -80 meters of first fence, I.e. just about to top of this cut.

Pg. 44.
In other words the tortoises in less than 1 week have moved from about ½ way up this cut to the top of it - about ½ km - they are now about 1 km above Caseta upper ponds in distance; alt is about 860-880 ft.
All rest of way down saw abundant tortoise sign in Pangola grass, nightshade, and Commelina nudiflora.
Counted 4 tortoises in burrow (1730 - 1800 hrs) but are certainly a few more than this here. - W by Juan Guerrero's and N to (bellow?) trail - no tortoise sign.
17 Nov. 1969
Devine has just completed expanding his Eastern cut from a strip only 2 m wide to one 10 m. wide - he left trees, but cut all mora, herbs, shrubs, etc. down. Went up today and checked this cut upwards for about ½ km - no tortoise signs along it or beside it except in guayavillo - Scalesia forest immediately adjacent to Caseta upper ponds; therefore appears that tortoise not using this as a pathway to higher elevations, at least not yet - may be due in part to lack of any abundance of green herbs and grass in narrow cut before, and of course this just completed.

Pg. 45.
expansion has not been there long enough (just 3-4 days) to allow time for the animals to utilize this larger, more opened up areas. Also poked around Caseta upper ponds and open area just below them and above the reserve border - pond #3 now (about 2 sq m surface area and a few cm deep) due to rain last few days - but pond #2 not noticeably changed.
Saw following tortoises-
At pond #2: #123; #134 ♂, #252 ♂.
In mora on paths leading up to Devine's central cut from pond #2 - only 20 m from pond feeding in the smashed down trails in the mora: #258 ♂; #1067 ♂; CL 77.9; CW 83.0; 76.5; #909 ♀ CL 91.5; CW 97.0; 89.5.
In pangola grass and nightshade of cut just where trails enter cut from pond 2 area): #782 ♀; #827 ♀ - both medium -sized; #508 ♂
In open area just below ponds #598; #852.

*Nothing of great note today - but did see #598 using its forefoot to aid in smashing down the slightly woody stem of a small shrubby herb which it was attempting to E - the foot was used to rush the plant down low enough and hold it in place so the animals could tear the stem and leaves with its beak - first time I've actually seen a tortoise do this while feeding.

Pg. 46.
Caseta weather: 1900 hrs - Cool and rainy and overcast virtually all day - garua heavy at times, but mostly a constant light mist. Finally quit misting at 1500 or so and has not started again yet, but still overcast. Max 75.5 F; Min 68.0 F; Rainfall 8.2 mm; Evap -0.0 ml (reading 0.0)
18 Nov. 1969 - To Salasaca and areas near there - Went to Santa Rosa - Bellavista trail by way of Segundo Barrera's new cut which came to within about 25 m of Reserve border just W of Camote patch by about 100 meters. Absolutely no sign of tortoise anywhere on his land or all along trail to its end just E of Salasaca southern ponds.
At Salasaca ponds - altitude reads 1370 feet on Thommens (read 670 when left Caseta) but bit warmer (few degrees I(would guess) so may be off a little - weather same - overcast, occasional drizzle.
#143 ♂ - still in exact same open grass -covered, dry pond bed where was on Oct. trip here (1 month ago). All 3 ponds in about same condition – Vegetation in dry ones perhaps bit more dried out but not greatly so.

Pg. 47.
Can also see a little tortoise sign around pond with abundant H20 - a few trails and dried droppings - but very little and could all be due to #143. Looked around all 3 ponds and went down woodcutters trail to NW for about 300 -400 meters - no further tortoise sign.
Ten came down trail to W to NP border - upon reaching it (prob. 1.5 - 2 km.) Thommens read 1350 feet, conditions same - no tortoise sign al the way - some animals trails here and there which might have been tortoise but no droppings or burrows of tortoises at all - only occasional cow and pig dung - therefore can't definitely exclude tortoises being here but if so very sparse - and I doubt many if any at all!
Then along NP border to SE to my trail to Naranjo (i.e. am just W of Lechoso where it joins NP border - "Thommens reads 1150 feet. Again, nothing but a few trails along way and only some fresh cow dung - conclusions same as in above paragraph!!
Continued on NP border to SE making one slight direction change more to E. Went up and over Lechoso. Continuing as above - no real sign. Even searched several semi-open areas under guayavillos - no tortoise sign. Then at about 1020 -30 feet hit a small area of a number of hectares which is semi-open forest - mostly Scalesia and Xanthoxylum, some Pisidium. But abundant lush herb layer to ½ -1 meter - also lots of carpets of Passiflora - first real tortoise sign - obvious smashed down, unmistakable trails, droppings (fresh) and burrows.

Pg. 48.
Tortoise:

#675 ♂ (maybe 695, but think its only a chipped place). CL 126.3; CW(CDRS) 140.5; CW(VD) 129.0; faint, but clear, incomplete w.g.i.'s; flaking disease all over rear 1/3 and front marginals.
Above him on slight grade going up - more sign, droppings, trails - all fresh - very thin almost totally Xanthoxylum forest - lots of Commelina and Passiflora on ground.
#168 ♂ prob. But tail tending to intermediate. CL 105.0; CW(CDRS) 119.5; CW (VD) 109.5 [marginal note: "not same as seen at El Chato]
New #1187 ♂; very clear, well- developed w.g.i.'s ; flaking disease on back 1/3 and front marginal scute area; CL 117.0; CW (CDRS) 128.8; CW (VD)116.5.
New #1188 ♂; very clear, thick w.g.i.'s; only small bits of flaking disease on front and rear marginals CL 101.8; CW(CDRS) 110.6; CW (VD) 1005.
Went up from NP border a total of about 25 ft in alt. - still semi-open forest - mostly Xanthoxylum and Scalesia; much tortoise sign - looks fresh but see some drying turds hard to estimate age; direction is 45 degrees NE of

Pg. 49.
. . . NP border - can see up ahead only a bit but still much tortoise and burro sign.
All this is near post #M33 of IERAC surveying crew; tortoises certainly go up even higher here! Also the area may run to several hundred hectares or more when fully examined. Continuing along NP border to SE.
About 150-200 m further.
#763 ♂; CL 88.3; CW(CDRS) 95.8; CW(VD) 88.5; very clear, large w.g.i.'s; flaking disease on front and near marginals. This animal is near another semi-open area of lush herbs under a thin forest canopy- mostly looks like activity has centered to south of the NP border - mora dense canopy and has trails to N near IERAC post #M28.
Another 400-500 m on and came to area where trail comes in from Naranjo which I (explored) Nov 14, 1969 (see notes).
#877 ♂ is now up on NP border from about 100 - 150 m below, where was on Nov. 14. This area where tortoises are clearly moving up from probably Naranjo or Chato and onto NP border and probably across it is near IERAC #M24. Thommens is reading 950 feet here. Just beyond here to SE about 50 m heard some noise off to left in fairly dense forest and saw a fresh trail and turd. Entered and found 2 males -

Pg. 50.
#673 ♂ chasing #378 ♂ - about 5 m apart.
#673 ♂ no flaking disease; w.g.i.'s thin an incomplete; CL 02.4; CW 106.3; 99.5.
#378 ♂ (prob). Bad flaking disease all over rear half of carapace and front ¼ also; w.g.i.'s very thick and clear; CL 87.6; CW (CDRS) 97.2; CW(VD) 90.0. Could be a ♀ because tail int. in length. Scutes, however, smooth only at very centers, rest of growth rings obvious.
This area is just above open mora area where saw #1045 ♂ on Nov. 14, 1969. Not too far from El Chato - probably about 1.5 to 2 km.
On return to Caseta Thommens read 750-760 feet, so will have to correct above readings in some way - those from Salasaca to my trail from Naranjo - NP border intersect are probably internally consistent so that at least differences can be used; due to weather similarity.

1900 hrs. Caseta weather - overcast almost all day - sun from 1430 - 1530 only; almost no rain - just in early morning a few times , 0530-0800; Max 80.5; Min 69 F; Rainfall 1.8 mm; Evap - 1.7 ml. (reading 1.7 ml).

Pg. 51.
19 November 1969 -
To Zone 6 to check weather instruments. Went by way of actual reserve border starting just above Caseta and following it till it first strike- the Caseta Trail - i.e. covered all of it but a small corner to the S and E.
Only saw definite tortoise sign immediately after beginning and for maybe 150-200 meters along the boundary - i.e. could interpret all of this as movement in relation to Caseta upper ponds (#'s 2 and 3) and Caseta pond #4.
The area immediately above and around the intersection of the Caseta trail and the N-S running reserve border is quite openish forest, the trees almost entirely being 10-20 feet tall, very thin stemmed Scalesia; lush herbs on forest floor here and canopy much less dense than all along border to this point yet, although there is pig and burro sign, nothing there gives definite evidence of tortoises in the area.
Then proceeded eastward along reserve border toward Zone 1 turn off - conditions largely as above, no definite tortoise sign anywhere except 2 feeble trails and an associated dried dropping in center of reserve border - this was just after starting E. Also no sign of use of border itself. These forests along border are mostly fairly dense, but there are occasional expansive semi-open areas on either side with abundant herbs and plenty of light coming through.
Then about what I estimate to be ½ - ¾ km E of Zone #1 turn off, come to a small openish area of shrubs (e.g. Clerodendron molle

Pg. 52.
. . . plant #1, vines and a few manzanillos on either side of the trail; this is the area where we have seen tortoises on all trips to Zones 1 and 6 and CDRS since coming to Caseta from the latter on Oct. 1, 1969. Lots of trails here leading off into vegetation. On either side of the trail. Went along these to south and dropped gradually to southeast - mostly open areas of a few to a few dozen sq. meters surrounded and inter-digitated with area of Clerodendron and other shrub and sapling sized stuff; scattered manzanillos groves; open areas covered with herbs, the dominant being plant #1, all reminds me a lot of Zones 1 and 6. Tortoise trails continue markedly down though this weaving along the easiest paths - the animals are or were clearly using this area to come up from SE to NW - one very obvious well used trail into rocky area especially makes the repeated use noticeable. Only went down 200 -300 m but looks as if continues on this way - perhaps runs to Zone 1 - seems very reasonable from appearance and directionality. Then returned and went N on

Pg. 53.
other side of reserve border - again many trails. Immediately, after 50 m hit a large 20 x 30 m oval - shaped, very open pond. Has drying Azolla all over it and is dry to muddy all over except for one little 1 x 1 m spot of a few cm of standing H20 in center. Much pig and donkey sign all around. Tortoises do not appear to have been using it for wallowing

at all as it dried out. Azolla carpet, through drying is intact all over except for footprints of animals.
There are scattered tortoise trails all around the pond, with a few burrows and a few droppings of indeterminate age. Not a great deal of activity but some. Clearly tortoise seen in the areas since Oct 1 were crossing R.B (reserve boundary) on way to this pond.
All around and above pond have fairly dense forest with some tortoise trails scattered here and there but not much sign of activity - can't tell if moving further N, but if so not a great horde of them by any means.
General appearance is low density of tortoises in area most activity being around immediate pond area and off to the south through an open area.
Two tortoises around edge of pond - in shady areas feeding -
#419 ♂; medium sized.
#268 (or 228, hard to tell if cut intentional or not); ♀; CL 80.5; CW (CDRS) 87.5; CW (VD) 81.5; very thick distinct w.g.i.'s; scutes smooth only in very center - carapace has very bright unworn look; no flaking disease at all.

Pg. 54.
In Region 6 - tortoise sign about same as around first of November - scattered trails and droppings, but animals here.
Near Pond #1 -
#1037 ♂; no f. disease at all ! w.g.i.'s clear and well-developed but not entirely complete between all scutes CL 113.5; CW (CDRS) 126.4; CW (VD) 117.5
Near Ponds #3 and 4
#136 ♂ (prob. - tail intermediate); under manzanillos grove eating plant #1. [Marginal note: has been in mud very recently.; CL 91.0; CW (CDRS) 101.0; CW(VD) 103.0.
1 tortoise (small - about 60 cm CL) in pond #2 wallowing. Can't read #.
All 4 ponds checked in early November still have abundant water and Azolla coverings - very little drying noticeable if any.
Tortoises have clearly been wallowing in all of them, in particular in NO. 2 (where the meter stick is implanted) where there are signs of 5 or 6 separate wallowings. Around this latter pond the activity in the plant #1 covered open areas seems to be greater than it was in early November, maybe about 2 X as much.

Pg. 55.
Weather data - 1400: Rainfall 0.70 inches (=17.8 mm); Evap 31.3 ml (refilled full at this time); meters tick reads 8 cm depth for H20.
On leaving -
#847 ♂ progressing though plant "#1 toward pond #2.
#1037 ♂ drinking at pond #1 on edge.
Interesting note on #847 - he is very large yet all growth rings visible - scutes smoothed only in very small part of centers - shell is worn but not smooth! - and he has almost no flaking disease, this being present only on a few front and rear marginal scutes.
On leaving Z #6 saw #455, medium large ♂, along rail a few hundred meters NW of pond 1-2 area - no f. disease at all and clear well - developed w.g.i.'s
On return

#32 ♂, very large, along border just 25 m E of open area where pond is - discussed above in today's notes.
#220 ♂, still near Caseta pond #4.
#722 ♂ half way between Caseta pond #4 and Caseta.
Around Caseta - #1006 ♀ - all day yesterday and today; came up trail from C. pond #1 area yesterday.
#3 ♀ - was around Caseta yesterday and day before - came up from pond 1 direction; left in same direction yesterday afternoon.
#31 ♂ has moved N somewhere - saw his starting up trail toward reserve border from Caseta's "backyard" on 15 Nov. 1969.

Pg. 56.
1900 hrs - Caseta weather; Max 82.5 F; Min 63.0; Rain 0.0 mm; Evap. 3.2 (reading 4.9 ml); overcast and sun alternated off and on all day.
20 Nov. 1969 - To Caseta pond #1 to mark animals with paint for hourly surveys.
Went down at 0800, almost all animals on way and at pond active.
#1006 ♀ at Caseta still burrowed in at 0800.
#31 ♂ - Linblad toilets - active
#205 ♂ - drinking at small pond off to W a bit of trail, half way between Caseta and pond #1.
#862 ♀ - 100 m above pond #1, moving down trail; just came out of burrow.
0815 when arr9ived at pond # 216 ♂ and #445 ♀ (prob) were active and feeding - #'s 647 ♂ and 274 ♀ (prob) were still in mud wallows. These two came out of wallow positions at about 0845-0900.

Pg. 57.
Checked following animals around pond between 0815 and 0930 - all were active (or just becoming so in case of #'s 647, 274, and 701 at 0900). Painted #'s on them in white latex base paint on all 4 sides of upper part of carapace, for distance identification.
#445 ♀ (prob) (tail intermediate) ; in pond White # given #1
#274 ♀ (prob); in pond ------#2
#102 ♀; fresh mud on carapace -----#3; on NE side coming into pond
New #1189 ♀ maybe, but small and hard to tell; -----#4; fresh mud on carapace; coming toward pond on NE side CL 65.0; CW (CDRS) 68.2; CW (VD) 62.0.
#862 ♀ - 75-100 m above pond on trail ------ #5
#647 ♂ - in pond -----#6
#216 ♂ in pond -------#7
#701 ♀ (prob) - 35 m W of pond in open area; feeding CL 76.1; CW(CDRS) 83.2; CW(VD) 74.5 ------#8
#754 ♀ - 25 m E of pond in an open area eating grass CL 83.2; CW (CDRS) 92.7; CW (VD) 84.5;
Was able to watch 1, 2, 3, 4, 6, and 7 all morning (till 1200) - mostly grazing and walking about slowly - activities in detail as follows:

#1 – active in pond from arrival at 0815 (active when arrived) till 0930 – then chased out of pond area by #2; active in semi-open area just N of pond till about 1130 when returned to pond and began grazing on grass there. Still grazing in open when left at 1200.
#2 – left mud wallow at about 0815 – 0830 and simply grazed in open on grass till we left at 1200 – only break was when chased #1 briefly.

Pg. 58.
#3 – first saw coming toward pond at 0840 on NE side; grazed there in shady semi-open area till 1030 when entered pond and grazed on grass in open there till just before 1200; when left at 1200 had just partly submerged in a pool of H20 and was drinking.
#4 – first saw at 0840 in same area as #3; grazed and rested in this area till about 1030 also and then entered pond where was still grazing in open on grass when left at 1200.
#6 – first saw at 0815 – in mud wallow, came out of wallow at about 0900; spent about ½ of next 3 hours in water of deeper part of pond – walking about slowly and drinking; rest of time was on bank of pond in open eating grass and herbs. At about 1150 – 1200 left pond and went into forest to W of the pond – rather shady area.
#7 – first saw at 0815 on arrival – sitting at edge of pond in open mostly resting – occasionally grazing but not much. About 1030 struck out across pond and made a big circuit, eating a bit of vegetation along bank

Pg. 59.
Enroute, but mostly just walked along an drank some H20. Finally left pond on E side about 1130 and was moving around in semi-open areas here as we left at 1200.

Weather: Temperature gradually rose all morning but sun never came out – could , however feel the air heat up and feel the rather noticeable weak radiation coming through the overcast clouds all morning.
Air temperatures in shade, in open , at one meter –
0800 – 22.2 ºC
1000 – 25.0 ºC
1200 – 27.0 ºC
1400 – 27.7 ºC
1500 – 25.0 ºC
1600 – 23.8 ºC
1700 – 22.5 ºC

Took h20 temperature at 2 cm depth where #3 and #2 are burrowed into mud and water in pond - at 1715 hrs – 27.2 ºC
Likewise took soupy mud temperature just behind #3 and at about depth of plastron – 27.0 ºC – also at 1715 hrs.
Remained overcast all day – only weak radiation coming through clouds; most marked cooling was noticeable in air temperature from 1600 on – could noticeably “feel” it.

Pg. 60.
Aggression between #2 and #1 (i.e. #’s 274 and 445, both ♀♀ probably): both had been grazing near each other for about 1.5 hours; rather suddenly #274 headed straight for the side of #445 and with head out crashed into the side of the latter with her gular

projection; #445 swiveled rapidly to a position such that her rear was pointed at #274's face. She then retracted her head and legs about ½ way in and remained rather still; #274 was also quiescent now but had head out and neck rather extended and was sort of "looking around" the back end of #445.
This interlude lasted for about 3 minutes; then again suddenly #274 stretched out and angled upwards at about 45º and charged into the rear of #445 again slamming hard using the gular projection. #445 took off rapidly passing under the corner of a Clerodendron noble shrub and headed out of the pond by a path with stopping. #274 gave up following #445 after taking only 3-4 steps after bumping into her.

Pg. 61.
Returned to Pond at 1500 –
#3 still in mud wallow – covering over all lower parts (i.e. marginals) and with a mud rest on which partly extended head is resting – asleep.
#2 – still grazing on grass – same area
#4 – grazing on herbs – S edge of pond
#1 – grazing on herbs – N edge of pond.
Plus 3 new animals –
#1070 ♀ (prob.) – in area where #2 is – went to a low spot, drank for 15-20 minutes then into same hole wallowed in mud for 5 minutes. Then left pond to SE. CL: 71.0; CW 77.4; 70.0; very clear nice w.g.i.'s; marked with paint as #10.
#444 ♂ - nice clear thick w.g.i.'s; CL 101.0; CW 110.0; 101.5.; was on edge of pond on W where #6 was this a.m. Enteredh20, drank a bit and then headed directly for #1 across pond and chased the latter out of the pond - #1went somewhere such that I lost here.
#444 now out of pond and 10 m E grazing on plant #1 (1530 hrs).
#933 ♀ - on SW edge of pond at 1500; entered H20 at 1530 and drank a lot – for 15-20 minutes; then in marking her as #12, I scared her out of H20; now moving about on SW edge of pond (1600 hrs.)
At about 1525 – 1530 #2 went into mud and wallowed; is now there, in similar fashion to #3; resting and sleeping, head on a big slush of soupy mud.

Pg. 62.
At 1600 hrs.
Found #9 burrowed into plant #1, asleep; 10 m SE of pond
#2, #3 – in mud wallows, asleep
#12 – grazing on SW side.
1630 hrs. –
#12 – still grazing in same place
#10 – grazing in forest 45 m E of pond.
#6 – found already burrowed in, about 30 m W of pond – near area where #8 was this morning.
1645 hrs. –
#11 – about 25 m N of pond in semi-open area eating plant #1
#12 – burrowing in under Clerodendron shrubs where has been grazing.
1700 hrs. –

#10 and #11 burrowed in now – when leaving at 1715 noticed #3 "squirmishing from side to side and then getting down further into soupy mud.
1900 – Caseta weather –
Overcast all day. Max 82 º F; Min 67 ºF; Rainfall – 0.0 mm; Evap 2.7 ml (reading 7.6)

Pg. 63.
21 Nov. 1969 - #1006 active along trail at 0725 hrs.
To pond to further study activity rhythms.
Weather and related notes:
Air temperatures at 1 m in shad
0700 – 21.1 ºC
0730 – 22.5 ºC
0800 – 23.4 ºC
0900 – 26.5 ºC
1000 – 26.8 ºC - High in here at 29.4 ºC somewhere, probably around 1100-1130.
1200 – 28.6 ºC – High for the day 29.4 ºC –

Water temperature near #3 at 2 cm depth – 0745 hrs. – 22.4 º C.; Mud at plastral depth - 0750 hrs. – 22.5 º C. Sun out off and on, mostly not from 0730 – 0800 hrs. Out almost all the time 0800 –0900 hrs. Out only occasionally from 0900 – 10000 when I am leaving – looks as if will be cloudy for at least the next hour.
Sun out about 1030 hrs. Sun remained out till sunset; cloudy soon after.

Pg. 64.
0730 hrs.– Arrived at pond – all animals possible to check still in burrows - #'s 2, 3, 11, 12, 9, 10, 6.
0750 hrs. - #9 has backed up a few cm. From burrow and has head out- just becoming active.
0755 - #10 has moved about 1 m. forward through herbs from where was burrowed – just becoming active; head out.
0800 - #12 has back out of burrow turned toward pond and is stretched out and basking in sun.
0803 - #6 – turned 180º out of burrow and is lying basking in sun.
0805 - #11 – same as #6.
0807 – returned to pond - #3 still in wallow resting; #2 has moved out of wallow and up onto flat grassy places where is lying with head, neck and all limbs out stretched, basking in rapidly warming sun. Moved a total of about 2.5 m from mud wallow. This occurred between 0750 – 0805 sometime.
0844 - #2 just quit basking, moved forward on grass and immediately began grazing; was full sunny all but about 5 minutes of the 37 minutes she was basking – this is a very accurate basking time; She was stretched out (with head and legs in sun also) whole time. Temperature rose from about 23.5 ºC to 26.0 ºC in air at 1 m

Pg. 65.
(shaded) in open during this period.
At 0900 - #3 yawning and looking around, sighing, etc. but still in mud wallow.

At this time noticed #12 feeding on herbs in open on opposite bank and #1 on N bank feeding on grass when they became active is unknown, but probably between 0830 – 0900. #1 must have been burrowed near N bank where #11 chased her out yesterday, but couldn't locate last evening.
0905 - #9 has moved in a semicircular path of about 10 m and come to rest under a manzanillo where is grazing on herbs. Dropped 3 turds enroute which already have slight drying crust on outside – this looks as if active between 0830 and now – whether basked much or not don't know – burrow and droppings in an open area.
0910 - #10 has moved up into open area where was feeding just before burrowing last night – lying there asleep and basking.
0915 - #11 active and feeding on plant #1 – how long active is unknown.
0925 - #3 moving just lightly in wallow so can eat a few spears of grass which are growing on a pile of mud near her wallow; still fully in mud and water. Then almost right away went back to simply resting with head on mud pile
#6 – did not recheck – too far away.
0950 - #3 finally left wallow and is now up on green lawn of higher area in pond eating grass.
1000 – leaving ; #'s 1, 3, 12 grazing on grass and herbs in open in various parts of pond. #2 heading across pond, N – S, and in doing so crossing some H20 – perhaps going to feed on opposite bank. Other animals feeding at various distances away from pond - #6, 9,10,11.
1015 – finally leaving; #2 drank for 6-8 minutes then went across to S edge where is . . .

Pg. 66.
. . . now feeding in open on grass. After drinking raised head and neck up fully outstretched, and arched upward at 60 – 70 degree angle – held thus for about 1 minute – then lowered and walked off – probably aids in swallowing and getting all H20 down into stomach.
Will not be able to watch rest o day because need to go to Devine's.
Discovered tortoises are all way up cut, past the fence and about ½ the way up on other side of fence parallel to banana patch (i.e. ½ patch distance up); altitude here is about 950 –1000 feet; will have to check it more clearly. Highest animal up – at the point mentioned above is #305 ♀. Lower down just below fence where cut begins found #508 and #695. No. 508 was down by Caseta upper ponds (at least ½ km below) on Nov. 17, 1969. Was one more animal in same area with #508 and #695, but burrowed in and couldn't get #. From this area to reserve border evidences of abundant tortoise activity at all points and all along the cut – trails all over in pangola grass, nightshade and here and there into mora as well. Saw 4 more animals, all burrowed . . .

Pg. 67.
. . . in (walking back 1730 –1808). Probably more than this because we walked a straight path down and could not see more than 0.5 – 2 m on either side of us.
One interesting aspect of activity – on way up between 1230 – 1400 saw 7 tortoises between Caseta and Devine's - sun had been out full since about 1030 – all were in full shade under low herb-shrub vegetation – about ½ of them were simply resting as if burrowed; other ½ were grazing a bit on herbs there were under.

1900 hrs. – Caseta weather
Max 85.0; Min 65.0; rain 0.0; Evap 3.9 (reading 11.5).

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22 November 1969.
To Caseta Pond #1 to study activities.
0655 – 0700 – on way down to pond – a large male already active beside trail
0700 - #3 and #31 in mud wallows at E end of pond - #3 almost exactly where was last night burrowed in (20-21 Nov.)
A new large male at edge of pond active and drinking – can't paint or get # because in water somewhat.
0715 - #9 and #10 – both still burrowed exactly where were night of 20-21 Nov.
0730 - #12 burrowed in same exact site as night of 20-21 Nov on SW edge of pond; has turned outward slightly but asleep and stretched out – no sun yet.
0732 - #6 also burrowed in same exact site as on 20-21 Nov.; also turned outward from burrow just 180 º into open – stretched out and sleeping.
**Note: very interesting that 5 out of 6 animals which followed for both last night and previous night burrowed in same locations both nights. Could not find #11 or #2, so they did not burrow in same locations. Therefore nearly 5 of 8 burrowed in same place.

Pg. 68.
Weather at pond.
Air temperatures at 1 m – shaded in open.
0700 – 21.6 ºC
0800 – 23.8 ºC
0900 - 25.6 ºC
1000 – 26.0 ºC
1100 – 25.5 ºC
1200 – 27.0 ºC
1300 – 26.5 ºC
1400 – 25.2 ºC
1600 – 24.2 ºC
1700 – 24.3 ºC
1800 – 22.5 ºC
1900 – 21.6 ºC

0600 –0700 - overcast completely
0700 –0800 - overcast completely – some slight weak radiation coming through
0800 – 0900 - still overcast; weak radiation and light breeze.
0900 – 1000 – same as past hour
1000 – 1100 – same as past hour
1115 – clouds still heavy but parting; radiation seems to increase periodically; no sun
1135 – occasional soft shadows; still overcast
1145 – sun now out partially; some blue sky; clearing on W
1200 – mostly sunny with partial clouding ; warming
1225 – clouds becoming denser; mostly shady now.
1245 – now cloudy; no sun; occasional faint shadow
1300 – ditto 1245

1400 – still cloudy; cooling; brisk breeze off and on.
1500 – 1600 – ditto on weather last hour.
1600 –1630 – weather much the same but clouds thinner and weak radiation can be easily felt.
1630 – sun out full
1705 – sun obscured again now by clouds; breeze still holding (has been all days almost)
1800 – sun out off and on for last hour till sunset; mostly out.

Pg. 69.
0800 - #3 and #1 in same locations in mud; #1 swiveled 90 º but again at rest. New large male in pond, just sitting and drinking occasionally.
0805 - #6 has moved a few meters from burrow and is now moving through the plant #1 and brush.
Heard another animal yawn and groan in this area – found it – unmarked, also W of pond about 30 – 35 m. Moving along under manzanillo grove; only about 3m from burrow so probably just recently active – in shade.
0815 - #12 moved out into open on pond edge- now resting and sleeping and basking there.
0820 - #9 – moved 1 m from burrow; in open in plant #1 basking and eating herbs
#10 – moved back up into same open grassy area where first moved yesterday after emergence. Lying there and basking in weak radiation – asleep.
0900 - #'s 1,3, 12 and new large male all basking in same positions –
#9 – feeding on plant #1 in open – same place
#10 – basking and asleep, same exact place.
0910 - #6 – active in same area – feeding and moving.
New (#13) – New One (#1190 ♂) – marked #13; in g. forest eating herbs. CL 91.6; CW 100.2; 91.0.
0915 k- New large ♂ finally moving - moved to edge of pond and now sitting there. Then moved off to N and I lost him. - # is either 633 or 233 but could not determine exactly.
0930 - #351 ♀ grazing just a bit W of area where #6 and #13 are. Marked #14.
CL 78.3; CW (CDRS) 86.7; CW (VD) 79.0. Very nice clear w.g.i.'s; Feeding on grass and other herbs in manzanillo grove near a small pool of water in rocky area.
0959 - #1006 came into pond at NE corner near #'s 1 and 3. Marked as #15

Pg. 70.
1000 – all the same almost -- #1, #3 in pond resting in mud and occasionally looking about
#12 basking in sleeping and basking in same place.
#6 – moved on out of sight and lost
#9 – feeding in open in same area (therefore inadvertently ? basking)
#'s 13 and 14 – feeding in same areas where first found, both in shaded areas under trees.
#15 – in pond edge of water; probably will go into H20 soon.
Large male (#233 or 633) has moved off beyond where can see him – can hear moving N in brush but can't get to him.
#10 – still sleeping in open area.

1010 - #1 moved a bit - 1 m or so – and then plopped back into mud after drinking a little; now sitting there in mud resting again.
1020-1030 - #15 drinking an poking about in the mud.
1030 - #15 wallowing into mud deeply! Swivelling from side to side in about 15-20 º arc to get down in well.
1035 – Found #2 active at side of trail on E side of pond – appears to have come out of forest just a bit further to E. Eating plant #1 and grass.
1040 - #9 moving toward pond
#10 still sleeping and stretched out – same area.
#4 eating in semi-open under manzanillo 20 m SE of pond.

Pg. 71.
1045 - #15 moved from mud onto grassy area and began eating.
1100 - #15 eating in grassy area by pond
#3 in mud same place as past hour ; basking
#1 in mud same as last observed; basking.
#12 same as past hour; head out and looking around occasionally.
#2 eating in open on trail; same place as before.
#9 eating in open E of pond; 30 m from #2
#10 in same area; eating in open where sleeping before
1110 - #15 back into mud (not deep) yawning; looking; drinking.
1125 - #12 sitting in same place but now eating.
1130 #3 moved from wallow, eating
1135#12 moving around; actively eating.
1137 - #4 moved to edge of pond from vegetation on S side; eating.
#1 still sitting in mud; basking.
All animals around pond are eating and #15 has moved from mud (exception #1).
1155 - #12 moved to pond and began drinking.
1200 - #12 partially in pond; drinking; looking around.
#4 eating on S (side of) pond
#15 eating on SE corner of pond
#3 eating on Eastern edge of pond
#1 in mud ; unchanged.
#2 and #9 eating and moving in open in same are.
#10 left of trail in shade chewing on old carapace part. 30 m E of pond by entrance; has moved considerable distance since 1100.
All animals (except #1) active and eating at close of survey..
1210 - #1 finally moved from wallow and began eating very “pig like” appearance! Love.
1215 – All visible animals (#’s 3,15,2,4,12) eating around pond edge.
1220 - #1 drinking then resumed meal of Azolla while standing in water.
1230 - #15 scratching neck with both front legs – neck far outstretched; comical activities indeed!! Using first one leg then the other to scratch entire neck surface.

Pg. 72.
1230 - #’s 4, 15, 3,1,12 all eating on pond edges.
1240 - #12 moved from pond SW corner – no longer visible.

1245 - #15 moving from pond edge SE corner.
1300 - #'s 3, 1, 4 moving in pond area, eating and quite active in open.
#'s 2 and 9 engaged in "combat" 20 m E of pond in dense vegetation. #2 found butting side of #9 again and again till #9 moved away. Going on when I arrived and proceeded about 5 minutes.
#10 now in open and eating; identical area to location of #2 at first sighting today.
#15 35-40 m S of pond on Zone 3 trail, eating in open.
1315 – visible #3,1, 4 all moving, eating in open.
1335 - #2 arrives at pond causing #4 to move from its position of last hour on edge;
1335 - #9 arrives at pond at E/S edge. Shortly after entering the pond #2 proceeded directly up behind #4 who was drinking - #5 not aware of #2 at all; sat there for about 1-2 minutes stretching around and looking over rear end of #4; then #2 lunged forward and smashed into #4 with gular process; then immediately after one smash started climbing up onto rear of carapace of #4 – but 4 was by; this time very alarmed and moving off very rapidly – it was all very comical –they were both muddy all over their lower halves and thus slippery and as #2 was trying to climb up on #4 the mud was flying and . . .

Pg. 73.
. . . she was slipping and sliding all over #4's back 1/3 of her carapace.
Question however is whether #2 was really trying to mount #4 or just smashing into the smaller one and thus as was lunging at her was unavoidably scooting up over her rear. #4 left pond due to this attack.
1400 - #'s 1, 3, 9 all grazing in open at pond
#2 drinking in open at pond
#15 grazing in same area as last hour.
#12 in dense brush and semi-shade about 1.4 m from pond's edge where left awhile back – eating herbs.
#10 moving into fairly shady forest E of trail near pond – feeding on herbs.
#4 moving out of pond through dense Clerodendron noble after being attacked by #2.
1440 - #2 has been drinking off and on for about 45 minutes; timed him for 2 drinking periods – one 6 minutes long , the other 2 (minutes). After each drinking period raises head and neck to about a 30 º angle upwards, then holds it this way for 10 – 20 seconds up to a minute then begins drinking again or retracts head and just "looks" around.
1445 - #2 into mud – typical swiveling to get down into mud and water.
1500 - #2 now in mud
#'s 1, 3, 9, 10, 12, 15 all same as last hour.
** Note: Can't find #4 (Jan saw at 1530 hrs about 100 m up trail toward Caseta).
1510 - #3 into mud wallow about 1.5 m away from #2 and with side to the latter.
1515 - #1 starting into wallow also very near (1.5 – 2 m) from #2 and #3. Suddenly #2 came out of burrow position, mud caked and sloping along and charged directly toward front end of #3 from the side. Opened mouth and made definite quick biting down . . .

Pg. 74.
. . .motion toward #3's head; then kept moving forward and crashed into #3 at front side with gular projection and nuchal area, retracting head just before impact. #3 pulled in head when #2 bit down and after first plunge turned tail to him and took off out of mud.

#2 followed only a meter or 2 and then stopped - #3 went away 3-4 m, stopped and started eating grass.
#2 then returned toward wallow area and became aware of #1 who was swiveling into mud with here back to #2. 32 progressed directly toward #1's rear and smashed into her immediately; #1 moved a few cm forward in response and stopped. #2 then sat at immediate rear of #1 sniffing a lot and craning neck and head above rear of carapace of #1 and out to side apparently trying to look at #1's front end. #1 remained in frozen position ½ way out of wallow. #2 butted #1 once more, then sat for another 5 minutes, #1 doing nothing all this time. Finally #2 turned away and went back into wallow herself.
Then stupid #3 came right back toward wallow toward #2's front end. Just as started into wallow, #2 raised head up and . . .

Pg. 75.
. . .stuck neck out. Then came up and out of mud quite fast and charged right at #3 who remained motionless. Again tried to bite down at head of #3 and then crashed into her, front end to front end; #3 now turned rapidly and took off quickly – went 15 m away and into a much less muddy area of Azolla covered water.
#2 went back into mud wallow and settled in again. About this time #1 had turned back to wallow and was settling in = #2 stuck head out and looked #1's activity over "carefully" – then did nothing. Both now in mud wallow 1.5m apart or so.
#9 just kept grazing through all of this. All action over by 1535.
1600 - #'s 1, 2 in mud wallow; sitting.
#3 - in water – sitting.
#9 – just left pond on NE side.
#10 – found burrowed in about 30 m. into forest.
#15 – eating plant #1; same general area.
#12 – burrowed in – same place last seen.

1615 - #9 found burrowed under dense shrubs on N side of pond – very recent! Returned at this time to find that persistent #3 had returned to wallow where #'s 1 and 2 are burrowed in = all 3 these in a bunch - #2 with head out and about ½ out of mud – clearly alert – the other 2 frozen stiff – looks like the king #2 has been butting one or both of the others; finally #3 didn't budge – sitting with back to #2; #2 then back into wallow. #1 still in wallow.
1630 - #3 now wallowing in; #2 and #1 are butt to butt only a few cm apart in wallow. #3 is about 8 dm – 1 m away from them in wallow also.

Pg. 76.
1630 – Found #15, just burrowed in; but not burrowed in well; only head and forelegs and plastron covered by vegetation and or soil. All of carapace open to air. (The same is true of #12, whereas #10 has fore 1/3 – ½ of carapace also covered, and #9 is completely surrounded by shrubs and herbs).
1645 – New animal moving into pond edge on W side in shaded area. – grazing on edge of pond on herbs.
1700 – New animal into water – then into mud wallow – finished and at rest by 1707.

Some comments about submergence:

1. very obviously seem to prefer soupy mud to water if have choice; of 2 animals last night and 4 tonight all burrow into very wet, soupy mud instead of H20 and had choice of both in pond. Also#3 even after driven off rather fiercely by #2 today, and submerging in a water and Azolla covered area, quickly returned to mud wallow in preference to water (where #2 was in mud, again a potential aggressive threat).
2. watched #'s 1, 2, 3, all in mud wallows for about 45 minutes tonight. All resting and sleeping with eyes closed. Attempted to determine if rest with nostrils under or above mud. Found that when first go into wallow and are swiveling to get well down into mud, often stick head and neck completely under mud or slosh mud over these areas. Results in . . .

Pg. 77.
. . . these parts being covered with a nick thick coat of soupy, sloppy mud. However, saw no cases of holding head under mud for any length of time at all. Instead, by swiveling get mud piled up all around front end of carapace, up to level of head (as if were holding head parallel to ground and straight out) – then rest with head about 2/3 – ¾'s of way into shell – head and neck just lie on top of big pile of mucky mud.

3. when fully into wallow, have mud covering up above marginals – plastral sutures –usually up about ½ - ¾ way on marginals. Thus all lower parts under mud – most of forelegs except very upper parts are covered, usually all of rear legs are covered, and due to slopping around all of rest of skin on neck, head and up under carapace have a coating of mud also. For ticks?? Or mosquitoes ??

ran down to Zone 3 N area and region 4 to check weather instrument between 1100 and 1330 while Jan watched animals at pond –
Weather – Region 4 – 1130 hrs. – rainfall 0.34 inches (= mm); Evaporation 30.7 ml; refilled full.
Zone 3 NA – 1230 hrs. – rainfall 0.24 inches (= mm); Evaporation dry (therefore35.8ml plus); refilled full. Max temperature 84.5 ºF; Min temperature 60.5 ºF. Did not actually sample at all because walked rapidly on trip – however did record #'s of animals seen. Very interesting because there was an obvious heavy concentration of animals around Region 4 area – in short distance of few hundred meter along trail through this region saw numerous animals without hunting for them at all, yet saw very few on all rest of trip – therefore I think could argue that they really are concentrating in around this area due to pond and continuing drying trend of this period – further confirming . . .

Pg. 78.
. . . observations of last 1.5 – 2 months.
Animals seen as follows:
Region 3: #585, middle of region, probably about 400 feet altitude, in shade moving upward it seems from trail making beside our trail.

Region 4: #635 ♂, very large; #128 ♂, very large; #919 ♀, medium; #713 ♂ (prob., tail intermediate), medium-small; #709 ♀, large and completely smooth shell; #1103 ♂(prob, tail intermediate), small-medium; #1185; all the above resting in shade, mostly inactive, 2 of them feeding a bit. #437, medium, moving in open; #223 ♀, medium, feeding in open; one unidentified, medium—sized if male, moving in toward pond through dense shrubs from W out of guayavillo forest.
Region 5/4 border: #423, moving along in semi-open, partial shade.
Region 5: smallish unmarked one (about 55-60 CL), in shade resting.
Region 6: near nest #13, resting in shade of dead tree, #133 (or #33, hard to tell). Shell all smooth, large. CL 95.8; CW 109.5; 100.5; no flaking disease.
Region 7: #1144 under Cordia in dense shade resting near Nest 3, 6, 7, etc.

Pg. 79.
Interesting thing about this – of 15 animals seen, all but 2 were in shade and of these 13, 10 were definitely resting and largely inactive in shade; other 3 were moving along. Only 2 animals were out in open where radiation coming through clouds could hit them. Was warmer in these regions than around Caseta and Caseta pond #1 – could obviously feel it; was completely overcast on trip down and until middle of return trip about 1300. All these animals were seen before sun came out full; was probably overcast all day up till this time; however clouds thinner down here and radiation coming through felt obviously a good deal stronger, air was drier and warmer felling and in general a hotter climate. When I returned Jan reported that no animals around Caseta pond obviously sought shade during entire time I was gone – in fact 3 or 4 of them were out in open on grassy areas of pond feeding this entire time. This may indicate a real difference in activity periods at this time of year for Region 4 and below as compared to Regions 3, 2, 1 and above, even when sky is overcast.
1900 hrs. Caseta weather: Max 83.0 ºF; Min 65.0 ºF; Rain 0.0 mm. Evaporation 2.5 ml. (reading 14.0 ml).

Pg. 80.
23 Nov. 1969.
Weather –
Air temperatures at 1m – shaded.
0700 – 21.6 ºC
0800 – 21.8 ºC
0900 – 22.0 ºC
1000 – 22.4 ºC
1100 – 22.2 ºC
1200 – 22.5 ºC
1300 – 23.9 ºC
1400 – 23.9 ºC
1500 – 23.8 ºC
1600 – 23.8 ºC
1700 – 22.5 ºC

0600 – 0730 – raining, fairly hard at times for garua.

0730 – 0800 – very light drizzle and mist.
0800 – 1100 – rain (light) almost constantly; a few periods of 5 – 10 minutes when only an almost imperceptible drizzle; also, a few periods with very weak but warming radiation and no rain. Also only 5 minutes long or so.
1100 – sunset – no more rain; slight weak radiation and air warming just a little all afternoon. Never really sunny at all. Also have had almost a constant light breeze all day , even during rain.
Animals' activity:
0715 – saw #5, about 100 m above pond on side of trail; just turned 180º out of furrow and sitting there.
0730 - #9, #10 – burrowed in still where last saw last night.

Pg. 81.
#15 back up a few cm. From bush where burrowed; sitting there partly stretched out.
#12 – turned around in burrow site 180º but resting in it in similar fashion to #15.
#'s 1, 2, 3 – burrowed in mud at pond, sleeping; looking around occasionally but mostly resting.
#699 ♂ (new one from last night) – now marked #16; also burrowed into mud at pond. Interesting that #16 had moved about 15m from where last saw last evening burrowed into mud wallow - and trail evidently indicates that went directly over a stretch of mud and grass and re-burrowed – why?
#2 had done same, moving from one soupy pool near #'s 1 and 3 to another about 2-3m further away – why?
0800 - #'s 1, 2, 3, 16 still in mud wallows
#'s 12, 15, same.
#'s 9, 10 – each backed out of burrows a small bit; resting and sitting still; both in dense shrubbery.
0845 - #16 moving out of mud and up onto drier area at Wern side of pond; then drinking at pool edge.
0850 - #15 starting to move in woods.
#9 moving through brush and herbs toward pond.
0900 - #'s 1, 2, 3, same – in mud.
#16 same – drinking.
#'s 9, 15 – same – moving.
#12 – same – resting in burrow.
#10 – has moved about 5 m from burrow into an open place; resting, sleeping and trying to bask.
0915 - #16 moving along a bit, then stopping and drinking again.
0920 - #9 enters pond and right after entering on grassy area proceeds to footprints and other small puddle of H20 and begins drinking.

Pg. 82.
0925 - #2 leaving mud wallow and by 0930 began drinking from small footprints and pockets of water.
0940 - #2 begins grazing on grass; drank for 10 minutes off and on.
0945 - #9 still drinking.

0950 - #9 starts grazing; drank off and on for 30 minutes.
1000 - #16 – same, drinking at pond.
#2 – grazing, in pond, grassy area.
#10 – same.
#9 – grazing in pond grassy area.
#15 – grazing in same area as late yesterday afternoon.
#'s 1, 3 – in mud wallows – same.
#12 – same.

Took measures of a few of marked animals.
#1006 ♀ (#15) – CL 86.5; CW 93.2, 87.0
#699 ♂ (#16) – CL 93.5; CW (CDRS) 99.0
Interesting that smaller animals such as #10, #12 seem to be getting active much later today than larger ones such as #9, #15 (this statement applies to those burrowed in on land). To add to this impression, at 1045 saw another small one in similar position to #'s 10, 12 -
#1069 (1,000 mark indistinct), ♀ maybe; . . .

Pg. 83.
. . . CL 65.3; CW (CDRS) 65.8; CW (VD) 61.0.
And at 1050 saw a larger one (like #'s 9, 15) moving in woods W of pond (near where #1069 basking and inactive in open) #13. Makes one wonder if smaller ones cool down more overnight and thus have to wait longer to get up to activity temperatures.??
Of those burrowed into mud in pond can't say much - #'s 16, 2, seem a bit larger than #'s 1, 3, but only slightly so – could be same type of reasoning however.
1100 - #'s 1, 3 – same in mud wallows.
#2 – same – grazing in open area of pond.
#16 – same – grazing in open area of pond.
#15 – same – grazing in open area of pond.
#12 – same – sleeping and attempting to bask at burrow site.
#10 – just now moving from basking position near burrow site, to open area near trail.
#9 – crossing corner of pond to other side – NE to S side.
1125 - #1 leaving mud wallow; out by 1130. Immediately starts drinking from small packets of water at water's edge.
1130 - #3 looking around, yawning, moving slightly in wallow.
1134 - #3 leaving wallow;
**The above emergences occurred right after a 20-minutue period of thinner clouds than usual and thus more weak radiation getting through.
1138 - #2 out and starts drinking from small holes right away. The after only a few minutes starts grazing on grass.
1200 - #'s 1, 2, 3, 9 – grazing in open at pond;
#16 – leaving pond – grazing on way out ; W side.

Pg. 84.
#10 – heading toward pond; grazing in open area on E side of pond.
#15 – grazing in open on trail, same areas as all morning.

#12 – moving to S a bit, grazing, semi-open, but shaded area.
Saw #4 and #5 about 20 m apart about 100 m above pond on trail. Also saw #1067 about 200 m above pond walking very deliberately down trail toward pond.
Returned to pond just before 1600.
Did not see #'s 4, 5, on trail.
1600 - #'s10, 2 grazing in pond open area on grass.
#3 in center of pond in water and mud; submerged and quiescent although alert.
#1067 as expected at pond by E entrance, drinking.
#9 burrowed in under plant #1, on SW side of pond; about 1/3 –1/2 covered by vegetation. Near where #12 was last night.
#12 – burrowed in same area last night about 4 m distance away; quite exposed as last night – vegetation covers only sides of carapace.
#15 – burrowed about 2 m from where was last night; also quite exposed; sitting in dense plant #1, near where has been active all day.

Pg. 85.
1620 - #10 into mud wallow and burrowed rather completely – mud completely up over rear of carapace and rear legs, and in front up to within 1 cm of lower edge of most anterior marginals – solid mud; thus only a very tiny gap available for air. Approached the animal closely and look into hole – could not see much but could hear breathing so nostrils free of mud and must be drawing in air through this small opening. I disturbed her a bit and she hissed; but I left right away and she did nothing.
1630 – 1635 - #2 into mud wallow, same area as past 2 night exactly!
#1067 going out of pond to N after looking over mud along N side; appeared to try to burrow in about 2 places but was very shallow. So turned and left pond in NW corner.
**Earlier (1605-1610) had been attacked and chased away from wallow area near E end of pond by #2. #1067 had been drinking and about 15 m away from #2; the latter was grazing and did not seem to be concerned at all with #1067 even when the latter moved a bit from place to place. Only after #1067 moved across the grass toward #2 and within about 4- 5 m of the latter did she look up and start toward #1067. #2 once started toward #1057, never stopped, just walked right at her trying to butt her with the front of her carapace and plastron. However, before #2 made contact, #1067 took off to the W across the grassy area with #2 about .5 m behind. Very rapidly, #1067 outdistanced #2; after only 3 – 4 m #2 gave up the chase, dropped down onto plastron and literally instantly started grazing on grass, not even watching #1067 anymore. The latter became less concerned just as soon as #2 gave up and then spent the next ½ hour gradually wandering Westward across grass and water, occasionally grazing and looking about.

Pg. 86.
1645 – can't find #1067 where left – can hear thumping and grinding in vegetation, but in an area which I can't get into – probably burrowing in now.
#10 – for some reason between 1635 and 1645 left mud burrow and went directly across pool. Then stopped for nearly 10 minutes on opposite bank up against a rock – mud underneath, but rather hard and thus unable to wallow into it at all.
1655 - #10 leaving this last spot and into woods on S side of pond. Wandered slowly through here to the SE finally heading rather directly and determinedly to trail and then

down trail (toward Caseta actually) for about 4 m then left trail and went into woods to E, first passing through an open area previously used by #9 as a burrow site. Finally burrowed in at 1715.
**Description of location of burrowing site by #10 and how burrow is constructed:
How selected burrow: This is rather difficult to determine because went through about 35 m total of vegetation with many sites which looked as if could serve as burrowing places. Was moving rather steadily through most . . .

Pg. 87.
. . . of this and not grazing at all. Did not really look around much at all until reach open are of plant #1 covered ground where #9 was burrowed in the other night (20-21 Nov. 1969); then began to stop and rest on plastron occasionally and literally turn head from side to side and look at vegetation. Went up to #9's burrow site and then sniffed this area 3 or 4 times; after only 20-30 seconds moved on from it and went on through area another 2 m, then burrowed up under some plant #1 and overhanging vines and shrubbery. Can't really say much about selection process at this time.
In constructing burrow most noticeable thing was that as begin to go into and under vegetation keep front end low by not stretching legs out fully; keeps head pulled in about ¾ of way; rear legs are out in normal walking position (i.e. out rather fully) and does most of pushing with these. In this manner pushes body up and under most of the vegetation except the lowest growing herbs instead of crushing it down as does when normal walking through and over vegetation – due to keeping plastron low when burrowing at front end.
Will describe other burrowings observed later. This instance did not involve more than pushing under vegetation – no grinding up of and into soil in this case.
1900 hrs. - Caseta weather –
Max 76.5; Min 67.0; rainfall 5.1; evaporation 0.2 (reading 14.2). Overcast virtually all day; rain during early morning.

Pg. 88.
24 November 1969 – Weather at pond.
0730 – 21.5 ºC
0800 - 21.5
0900 – 21.6
1000 – 22.9
1100 – 23.5
1200 – 25.0
1300 – 23.3
1400 – 23.0
1500 – 23.0
1600 – 22.4
1700 – 21.5
1800 – 20.8
1900 – 20.5
Temperatures at 1 m, shaded, in open.
0600 – 0730 – overcast, feels warm, no breeze.

0730 – 0840 – light garua.
0840 – 0900 – light breeze; weak radiation; no rain.
0900 – 1000 – no rain; weak radiation and no breeze, warming up.
1000 –1100 – same; light breeze again.
1100 –1200 – same; warming even more as cloud getting thinner.
1200 –1300 – clouds heavier again; les weak radiation; cooling.
1300 – 1500 – still cooling; light breeze and only very weak radiation.
1500 –1700 – same, but rain starting lightly at 1645.
1700 – 1800 – raining off and on till sunset; a light breeze; cooling even more.

Pg. 89.
0730 - #2 in mud wallow.
#3 - in mud water wallow; interesting that has moved a few meters from where saw in mostly water last night at 1700 just before left; has moved about 1-2 m from wallow site and is partly out of mud now – probably did so very recently; head and neck out on mud, sleeping and resting.
#9 – 30 m from burrow in open; eating plant #1; probably active since 0700 at least.
#15 – has made a 60 m circle from burrow, dropped a fresh turd; eating nuisance plant; probably active since at least 0700 I would judge; in semi-open.
#10 – about 15 m from burrow site – can't tell when moved; probably moved last night from look of trail behind the animal; anyway, stretched out, head and neck on ground, legs out! Fairly well coved by vegetation and thus not receiving much radiation.
0800 – same for all.
0900 – same for all, but #9 not grazing; instead stretched out resting on ground and basking in open – has probably been doing so for last hour and most of time since 0730.
#15 in full open now, grazing, same area.
1000 - #2 still in mud resting; alert and looking about off and on – nothing more.
#3 – just not active after looking about off and on and resting for last ½ hour; out of wallow and then immediately drank for a few minutes and then started grazing.
#12 – moving toward pond; almost there; has moved 25-30 m and thus probably active for last 15-30 minutes.
#15 – moving directly toward pond on S side.

Pg. 90.
#10 – moving just now from burrow area toward trail (and or pond?).
#9 – has turned a bit, but still lying in same area; alert and perhaps grazing some, but mostly still basking and resting in open.
1005 - #15 enters pond – into mud wallow
#12 – stops drinking and leaves pond out into semi-open area to S of pond – same area from which entered. Did not actually see (cove?[word not clear] so could have been aggressed by either 3 or 15, both of which were near the animal.
1037 - #2 leaving wallow after 2 big yawns and looking all about; immediately out onto grassy area and begins grazing by 1040.
1043 - #15 out of mud wallow; then drinking out of small pockets and finally pond itself by 1050.
1100 - #2 grazing on grass, open area in pond.

#3, #15 – grazing on Azolla in pond in open.
#12 – SE of pond on trail; in open grazing on herbs.
#9 – in open; has finally moved about 15 m from burrow site and is grazing on plant #1 and nuisance plant; don't know when became active, but was within past 45 minutes.

Pg. 91.
#10 – has moved into open area near where first burrowed last night (not in pond) Now lying there in crushed down plant #1, inactive, stretched out and basking (has probably been so since about 1015 hrs.).
1200 - #2, 3, 15 – all grazing in pond on grass and herbs.
#1 now entering pond on N side about 10 m away from #2; apparently spent night in woods near here.
#9 – up on trail to S – grazing on plant #1 in open.
#12 – beyond trail, grazing on plant #1 – in open, but slowly heading toward more dense vegetation of manzanillo grove.
#10 – moving down trail toward Caseta, E side of pond; may enter pond soon; probably active last 20-30 minutes.
#4 – just saw 40 m NE of pond grazing on grass in open.
1430 – just returned –
#3 – in mud burrow on W side of pond – perhaps already in for the night.
#2 on NE side, 30 m from pond, near trail grazing, heading into woods.
#1 – on NE side, 20 m from pond in open, stretched out resting and basking.
#12 – same area as at noon; also stretched out and basking.
#9 – moving S; about 50 m from pond; grazing some, mostly walking slowly.
#10 – at pond drinking.
#4 – on SE side of pond on trail; eating in open.
#15 – leaving pond, heading N .
1500 – all same.

Pg. 92.
1510 - #10 into water and mud in pond; burrowed in deeply – nostrils barely out and only small space of 1-2 cm between anterior marginals and mud; now stationary.
1525 to 1530 – Checked #'s 1, 2, 15 - all grazing, same areas ; #1 has moved 10 and probably only basked a short while after saw at 1500.
1600 - #'s 10, 3 – as before, burrowed in.
#9 – burrowed in very near to place where last seen – not much vegetation for grazing in between where now burrowed and where last seen moving S (about 8 m apart) and straight path indicates probably burrowed soon after 1500.
#1 – burrowed in on edge of woods – open area border, just # of pond and trail; thus burrowed sometime between 1530 – 1600.
#2 – grazing same area.
#15 – grazing same area.
#12 – sitting in same position as found at 1430; I guess this is its burrow – has drawn head and legs in now part way.
#5 – can not locate – moved a lot and rapidly.

Pg. 93.
1615 - #2 – going into burrow –same area as #1.
1700 – all same ; all now burrowed but #15.
1730 – watched #15 finally burrow in after grazing in light garua for last 45 minutes.
** Notes – about structure of burrows:
Have noticed something strange about burrows constructed by this group of animals around Caseta pond #1; this is that few of the burrows are deeply if at all gouged out down into the soil; i.e. by grinding plastron down into soil and this displacing vegetation from the floor of the burrow. Of all the burrows have seen constructed in soil covered areas around the pond the majority y have not been the type in which the soil was gouged into; most burrows are such that the animals get well up under vegetation and are covered most often over 1/3 to ½ of top and sides of carapace (obviously front part since go in head first); this leaves only rear ½ - 2/3's of carapace and part of rear legs exposed. However, this is variable, and it varies all the way from getting well into and under complete vegetation cover all over carapace or with just very small part of rear exposed to cases in which the animal ends up lying almost fully exposed with vegetation covering only side of carapace a bit up to level of costals (1/2 way up these) – thus not a real "burrow".
There does not seem to be any consistency according to individual animal's type of burrows they construct.- e.g. #15 lay out virtually in open for 2 nights (22-23; 23-24 Nov.) and then . . .

Pg. 94.
. . . burrowed in rather completely on following night – virtually covered completely by vegetation. #9, however, made fairly deep burrows into soil also, for 2 nights, but 1/3's of carapace was exposed even though did so – another night was completely under vegetative cover, and tonight was about ½ covered but made no exposed area in soil. #12 burrowed hardly at all for past 3 nights (including tonight, virtually lying in open in dense plant #1, whereas on previous 2 nights was burrowed well up under dense vegetation in SW corner of pond.
Secondly, have rarely seen an animal march along looking about for a burrow, then pick one out and walk to it (the area) and make burrow very deliberately. Mostly seems to be that they are grazing along and late in afternoon simply stop grazing wherever they happen to be and burrow in very near to this point in damn near whatever is available. This latter fact may have a lot to do with how well the animal ends up covered by vegetation . . .

Pg. 95.
. . . and how much it grinds into soil - could be that don't grind into soil except in areas where is soft and easy to get into. However, could be something which depends on climatic regime at the time and it has been rather warm and overcast all through the nights during this observation period – maybe are different and cause deeper burrowing when more clear nights an
d cooler weather. (e.g. see my notes on burrowing during August 1969 (is this 1968?) just above Caseta; in these cases almost all burrows were rather deep and into soil and well made).

One interesting observation: one night #31 ♂, very large, had been grazing in front of Caseta and at about 1745 was still doing so – as neared dark, he simply quit grazing on grass in open, gave a great sigh, retracted head and legs part way and went to sleep – did not burrow at all – seemed to have been caught in open by sunset and just didn't even try to burrow – Have seen him burrow on countless other nights near Caseta but usually between 1600 and 1700. His burrows vary from very slight cover to well made ones and they don't appear to correlate well with clear or overcast nights and general low temperature regimes.
Burrows along reserve border in mora and along Devine's central . . .

Pg. 96.
. . . cut are clearly virtually all well made and deep under vegetation and deep into soil. May be due to abundant deep soil and high (1-2m) herbaceous vegetation in these two areas more than anything else.
Also saw a number of old friends around Caseta today and near the small water hole about 120 – 150 m to the SW of our camp - #'s 3, 31, 712, 205, 117.

Caseta weather – 1900 hrs. – Max – 77.0; Min 69.0; Rain – 2.6 mm; Evaporation 0.0 (reading 14.2). Very overcast, cool, and rainy day.

25 November 1969 –
Weather at pond – temperatures at 1m, shaded in open.
0700 – 21.6
0800 – 21.7
0900 – 22.8
1000 – 22.8
1100 – 25.5
1200 – 26.4
1300 – 26.7
1400 –29.5
1500 –29.0
1600 – 25.5
1700 – 25.0
1800 – 21.6
1900 – 21.5
0600 – 0730 – raining rather hard; overcast all night and raining off and on.
0730 – 0800 – a little rain – mostly not
0800 – 0900 – no rain, clouds thinning a lot and weak radiation really warming things up.

Pg. 97.
0900 – 1000 – clouds mostly denser than previous hour; strong breeze; raining off and on for whole hour – no warming felt.
1000 – 1100 – clouds thinning again by 1030 – warming up again – sun out for a few periods of 10 – 30 seconds.
1100 – 1200 - clearing – only cumulus clouds now – sun out off and on whole hour; mostly cloudy but sharply warming up.

1200 –1400 – continuing same; sun out off and on and perhaps out ½ of time, maybe even 2/3's.
1400 –1500 – sun out off and on; cumulus clouds; sunny ½ - ¾ of the time and hot; marked effect on tortoises.
1500 – 1600 – largely cloudy with very brief episodes of full sun; breezy, cooling, pleasant
1615 – very briefly and barely perceptible rain; sun pleasant and warming when out.
1600 – 1700 – mostly cloudy, very little sun.
1700 – 1800 – mostly cloudy, very little sun.

0830 – arrived rather late; but all animals basking; watched #31 in burrow at Caseta and he backed out of burrow and started basking at 0730. This plus weather suggests that these animals have probably all been doing the same since 0730 or thereabouts.
#1, 2 – moved out of burrows a few meters; stretched out in open in plant #1 basking.
#9 – 90 º turn out of burrow into open – basking, stretched out.
#12 – same as #1 & 2, only slightly back up and basking.
#15 – out into open beside burrow – 90 º turn as with #9.
#3 - slightly out of mud – basking at edge of pond, stretched out.

Pg. 98.
#10 turned 180 º - in H20 sitting and basking, but alert.
0845 - #3 just now moving and active; by 0850 grazing at W end on herbs.
0900 - #9 same.
#12 – just now moving and grazing on herbs.
#'s 1, 2, 15 – same.
#3 – same – grazing.
#10 – just beginning to move along in H20 – drinking and appears to be eating Azolla some.
0910 – #3 – leaving pond by W entrance.
0930 - #1, 2 – still basking.
#15 – has moved about 15 - 20 m and is grazing in an open spot of plant #1 - made this move in last 30 minutes sometime.
1000 - #1, 2, 9 same.
#10 – same – grazing now on grass and herbs at E end of pond in open.
#12 – same – grazing in open, same area.
#3 – has gone abut 100 m plus in last 50 minutes to SW along a well worn, partly muddy trail to an open area of plant #1 (this a well used tortoise path); now there grazing.
315 – same, grazing.

Pg. 99.
1015 - #9 – just starting to move – yawned 3 big times, looked about for a few seconds and moved ahead a few feet and began grazing on herbs in an open area; also heading toward same general open area to SW where 33 now is located – along pond drainage.
1020 – Saw #4 moving in exact same direction as #'s 3 and 9 in same general area. Can only retrace path part way so do not know when became active and from whence started.

1030 - #1069 basking and stretched out into open area, exactly where was 2 mornings ago.
1034 – discovered large male (#526, CL 139.8; CW 159.2; 146.0) heading along trail into pond from W – another well used tortoise path. Moving very steadily and deliberately, walking at a steady pace. He is clearly using and following the tortoise path rather than going across other low vegetation in the area – would not cause him any passage problems, but he is picking out the open trail clearly and can see pond below him I'm sure.
Took him about 7-8 minutes to go 135 feet to pond – now –stop walking.
Some spots flaking disease here and there all over rear, front, and top of shell (carapace) – some deep ones. The worst one covers virtually the entire 3rd left costal; almost the whole scute is necrotic and flaking badly and deeply. Also some green plant (algae?) in interscute cracks here and there all over. W.g.i.'s incomplete and poor.
At least 2 lichen species on rear . . .

Pg. 100.
. . . .end also – on last 2 costals, lower half of 4th vertebral, and 5th vertebral.
1100 - #10 – same, grazing.
#'s 3, 4 9 – same areas – grazing.
#15 – same – grazing.
#1 – has looped up into forest and back down to trail just E of pond – active, grazing in shade.
32 – has moved down to trail - near pond – stretched out basking in sun.
#12 – same area – grazing = but has moved W under some manzanillos in shady area.

1110 - #2 heading into pond, E entrance.
#5 – coming into E entrance from side trail – a bit ahead of #2.
1120 - #5 enters pond and proceeds to first small wallow edge and starts drinking; about 2 minutes later #2 entered behind #5 , came right up behind #5 and crunched into the latter. #5 at first drew in, then simply got up, moved about 0.5 m and started drinking again. #2, nonplussed, repeated this sequence about 3 more times. – each time #5 just moved a bit and started drinking again – once #5 moved about 3-4 m away and started d drinking at another. . . .

Pg. 101.
. . . hole. #2 watched a minute or so and then walked up behind and crashed into #5 again. #5 looked up, pulled in legs, then just returned to drinking. #2 just sat about 1 dm behind 5, looking about and otherwise resting on plastron. Finally 5 quit drinking, got up and walked about 3 m to pond edge and began drinking more; #2 did not follow – instead went to a hole and drank for a few minutes, walked past hole and began grazing - all this by 1135.
Note that not once did the animals face each other and #5 never once even looked back in #2's direction so could not have seen what was crashing into her – just took the banging and largely ignored.
1150 - #5 drank rather steadily till now, then out onto open grass and began grazing. Also.

During all of this #10 paid little attention to all this activity which was taking place only 10 m away. Went into and out of mud wallow and got covered all over lower third by mud – all in about 3 minutes then back onto grass.
By 1145 – all 3 grazing on grass within about 3 m of each other.
At 1155 after grazing near (2 m) each other for 5 minutes and fully 20 minutes after last aggression, #2 suddenly raised head and looked at #5, raised up on all 4's and walked directly toward #5 – the latter did not see #2 till they were head to head only a few dm apart (because had head down . . .

Pg. 102.
. . . and was drinking). #2 slammed into side of #5 just after #5 withdrew head and legs. #5 wheeled around and took off into H20 of pond. #2 quit, #5 moved 3 m away and immediately began eating Azolla; #2 just turned around and went back out onto grass and started grazing.
#10 continued grazing through all this activity taking place 10-12 m away - never even looked at this.
1200 - #'s 2, 10, 5 - all grazing at pond in open.
#12 – just entering pond and grazing on herbs – SW entrance.
#9 – moving under manzanillo grove toward pond's SW entrance – in shade.
#526 – looping around toward pond's SW entrance – moving in shade under forest trees.
#15 – has moved further N – can't follow trail in brush – lost.
#'s 3, 4 – moving to SW more apparently; lost, can't find.
#1 – in semi-open, but semi-shaded by small guayavillo tree. Near where #12 was burrowed last night – grazing.

Pg. 103.
1230 – all same except #12 – left pond to W into forest – never even drank as far as we could determine.
1345 – Returned –
#'s 2, 4, 10, 9 all in shaded areas at various places around edges of pond- obviously had been grazing in open and (word not clear) during last 1 hr and 15 minutes the sun drove them into the shade – thus apparently respond to it rather sharply.
#1 grazing in same area as at 1230, but in shade of manzanillo trees.
#1165 coming to pond at W entrance and in partial shade.
1353-1400 - #5 came out of shade into full sun, grazed about for exactly 7 minutes and then went rapidly and directly back into, shade under shrubbery at pond's edge – obviously sensitive to heating up.
1415 - #10 moving into open at pond's edge; grazing ; now cloudy.
1420 - #1165 arrived at pond's edge and began drinking (W entrance).
#2 , #5 now also out into open grazing around pond's edges – still cloudy.
1434 - #9 moved from burrow and began grazing about in open area at SW of pond. Still shady.
1437 - #1 enter pond area on S side – grazing in shade (sun now out).
#5 sitting back in shade on S side.
1440 – sun out and hot. #10 in shade at pond's edge, grazing.

Pg. 104.
#2 continuing to graze in open.
#1 drinking and grazing - in shade.
#1165 – walking into H20 of pond
#9 – grazing in partial shade on pond's SW edge.
#5 – leaving pond on S side.
1448 - #2 moved out of sun into shaded area at pond's edge – only 11 minutes in sun.
All animals at pond now in either complete or partial shade except #1165 who is partly submerged in H20 and #10 who is grazing in open in sunlight.
1500 - #1165 moved from H20 into shad of vegetation at edge of pond.
#9 lying in shade at W end of pond.
#1 grazing in shade, edge of pond.
#5 grazing in partial shade at S side of pond – reentered where left – apparently only moved deep under vegetation before and didn't really leave the pond.
#10 - continues grazing in sun, in open.
#2 - grazing in shade still.
1505 – cloudy now; cooling breeze.
1515 – Tortoises appear to respond rather rapidly (10-15 minutes) to clouds, sun and heat. When they decide to move to shade the do so directly and rapidly without ambling along. Response to returning clouds seems to be more variable and . . .

Pg. 105.
. . . individual – i.e. they all seem to respond rapidly to sun and heating up and very often at nearly same time; however, when shade returns and it cools off some move back into open quickly and others do not – move variable and probably due in part o grazing material available ???
1515 – largely cooling and shady last 15 minutes.
#'s 1, 5 – grazing in partly shaded areas.
#'s 10, 2 – grazing in open areas.
#'s 9, 1165 grazing in shaded areas (shaded = what would be shaded if sun were out).
#2 aggressed #10, the later entered H20 and sat there; #2 then followed #10 into H20; #20 just sat tight for 3-4 minutes with #2 behind trying to bump her but having little luck as mud is too thick and squishy to get a firm foothold to push forward strongly.
Then #10 left pond mud; #2 remained in pond in mud wallow- as if burrowed. #10 now back grazing on grass.
#11 entered pond at 1515 on NW side; immediately began drinking.
1517 - #5 aggressed #1 but only chased very short distance; then both returned to eating; no bumping, just a charge and short chase.
1522 - #1 - enters water's edge and sits.
1530 - #2 - remains in wallow.
#10 – grazing in open.
#1 – sitting in water in shade.
#9 k- grazing on SW pond edge.

Pg. 106.
#5 grazing in shade (vegetation edge).

#1165 sitting at W edge of pond (perhaps eating Azolla).
#11 – same area; drinking and looking about.
1535 - #5 leaving pond again, through thick shrubs on S side.
1537 - #1 wading around in shallow mud and water. Walked across grassy area and back into mud wallow at E entrance. Scooting and moving about in mud.
1540 - #11 entered edge and water and began eating Azolla.
1600 - #1 – remains in wallow.
#2 k- remains in wallow.
#10 – grazing in open.
#9 – grazing in vegetation's edge; SW end of pond.
#1165 – grazing up path at W entrance; leaving pond.
#11 – same as at 1540.
#5 – moving S of pond toward trail to SE; grazing in semi-open forest.
1605 - #11 – left H20 and started out w entrance, leaving pond.
General Impression – after cooling set in a great increase in grazing, moving about, and general activity began.

Pg. 107.
1610 - #10 entered H20 and began scooting and wriggling into mud.
1615 - #'s 1, 2, 10 in mud wallow.
#9 moving at SW corner of pond, grazing.
#11 – just left pond by W entrance – following #1165 up same path by about 5 minutes.
Note – 3's 1 and 10 both entered H20 and mud wallow, facing away from sun when settled at first. Just recently each deliberately (or so it seems) turned 180 º so head is directly facing later afternoon sun; any function to this?
#2, however, entered and settled originally lateral to sun; then turned 90 º to face sun just now, then another 90 º to be lateral to it in opposite direction to original position.
1630 - #'s 1, 2, 10 same.
#9 – same.
1639 - #9 leaving pond through thick vegetation.
1646 - #9 burrowed in up against a tree – rather open area and not well-covered by vegetation at all.
1650 – Can't locate either #'s 11 or #1165.
#5 – eating in same area; appears to have attempted to burrow once and the left this site to begin grazing again.
1700 – A new animal (not paint marked) just entered pond and began wading into H20; then dropped down so H20 well up over rear edges and onto sides; looking about and moving around in mud.

Pg. 108.
1710 - #5 same.
1735 – New animal dissatisfied with original wallow site; now wading around, eating Azolla in mud and H20. Left pond now - these 2 animals will certainly burrow soon.
1900 hrs – Caseta weather. See detailed notes, but sun out off and on from short while before noon till sunset; warmest (sun) have yet had while studying activity except 21

Nov. when was unable to watch all day. Max 81.0 ºF; Min 69.0 ºF; Evap – 1.2 ml. (reading 15.4) Rainfall – 2.5 mm.
Marginal Note: Summary on home ranges: very small in general – several acres at most and even then not covering much more than restricted areas within such an overall area- no territoriality or exclusion of each other at all!

29 Nov. 1969. – Was gone from Caseta 26 Nov. 1969 till this evening.
1900 hrs – weather at Caseta: Max 81.0; Min 62.0; Rainfall 1.1. mm ; Evap 7.8 mm (reading 23.2 ml).
30 Nov. 1969. Am going to try and locate a few of my previously painted animals to take their measurements. The #'s below refer to painted numbers (not notched ones).
On Nov. 29. # 7 ♂; near pond #4 (Caseta) – note – this animal was here on 26 Nov. 1969 also; saw as going to CDRS.

Pg. 109.
CL 122.9 cm; CW (CDRS) 133.0 cm; CW (VD) 121.0 cm.
#2 CL 91.5; CW (CDRS) 101.7; CW (VD) 93.0. Just eat of pond along trail grazing. Seems to spend virtually all time either in this area or actually in the pond.
#5 – CL 96.6; CW (CDRS) 101.8; CW(VD) 105.0. Pond – on grassy area, grazing.
#1 – at pond in mud wallow – can't get measures; however is bit smaller than #2; CL about 85-90 I would guess.
#7 was near Caseta pond #4 – on trail between it and Caseta on Nov. 29 at 1715 hrs.
#10 – on trail about 1/3 of way up to Caseta from Caseta pond #1.
#12 – 20 m SSW side of pond ;in a semi-sheltered spot sleeping, stretched out. CL 73.5; CW (CDRS) 79.0; CW (VD) 71.0.
#9 – near pond (5 m) – S side; sleeping in open area.
Found #7 at 1430 hrs., asleep, stretched out basking in open in open area which is 40 m or so SW of Caseta pond #1; had fresh Azolla all over lower 1/3 of carapace – thus must have come all the way from Pond #5 area to Pond #1 in to H20 and then out again and to this area; all done today, probably between 0800-0900 and now; when saw last night was off of trail and about to burrow it appeared.
Saw all the above animals in one simple loop around pond #1 between 1415-1445; Every one of them that was not in the mud (i.e. all but #1) had fresh Azolla (#7) or fresh mud and Azolla on the carapace (all the rest). Thus this group as my days of activity observation showed are really hanging about this pond and using it quite often.

Pg. 110.
The pond is continuing to dry and has dropped about 1 cm since last here on 25 Nov. (Instruments indicate 7.8 ml evaporation and only 1.1 mm rain between 1900 on 25 Nov. and 1900 on 29 Nov.). The wallow area at the E entrance used most heavily of all of the possible entrances and especially by animals # (painted) 1, 2, 3, 5 , 10, 15, and 4. is now isolated completely from the main body of standing H20 in the pond and is drying out rapidly – was at first very soupy mud and some standing H20 (about 20 –23 Nov., 1969) but is now thickened mud and with not standing H20 – animals are clearly still wallowing I it extensively, but will soon have to wallow in other areas, as this one will dry up in early Dec. I am sure.

Note: (I got measurements on #1 on 1 Dec.; animal was just S of the pond CL: 75.3; CW (CDRS) 8l5.0; CW (VD) 78.0.)

Aggression – some comments on observations made at Caseta pond #1 from 20 –25 Nov. 1969. (#'s = painted ones).

(1) of all aggressions seen, #2 (=274 ♀) was responsible for all but one case; the one exception was a short chase of only a few meters. . .

Pg. 111.
. . . involving no butting or other contact, no head biting and no other obvious signs of aggression other than a charge between #5 and #1; #5 "won" and probably would have butted #1 but never was close enough.

(2) #2 at one time or another attacked #'s 1, 3, 4, 5, 9, 10, and notched #1067 Of these are known to be females or probable females except #1067 which is unidentified. Of these #2 is larger than #'s 4 and 10 by some considerable size, slightly larger than ('s 1, 3, and #9 and smaller by a small amount than #5. However size may be only partly important in that #2 was clearly the most aggressive animal in the pond area and initiated all aggression bouts. In addition most bouts or at least ½ of them began with #2 attacking the other animal from the rear – in no case did an animal attacked from the rear turn around or even look back at what was bumping into them – they usually just took off, #2 followed a bit and then the whole thing abruptly ceased. Since #2 initiated all encounters and attacked first (in fact no other animal was even seen to even offer any aggressive signs in return), perhaps this action is important in determining the winner when the animals are of similar size. Note that #5 was attacked from the rear and never even saw #2 – so the function of size here can not be evaluated. Also #5 did not respond much and thus #2 just left the larger animal alone.

Pg. 112.
In the one other case #5 the larger animal initiated and won the brief chase over the smaller animal, #1.

(3) No aggressions ever occurred until the animals were 4-5 meters apart or less – i.e. saw no aggressions in which one animal deliberately picked out another animal from a distance apart greater than 4-5 m and proceeded to attack the other. Also, saw no obvious signs of animals trying to keep themselves spaced out at large distances to avoid contact. They often grazed anywhere from 2-3 m apart, however usually at least 2 m apart when grazing, but did wallow in burrows often just a few dm of each other on occasion. But terrestrial burrows always well isolated from other animals; closeness in mud probably due in part to there being only a limited # of wallow areas- only animal of those I saw near each other in mud (1, 2, 3) which . . . .

Pg. 113.
. . . seemed intolerant of this closeness was #2. (see previous notes).

In sum, it appears that spacing is important in that when one animal gets closer than 4-5 m, another may attack p but not always - #2 was generally consistent in not tolerating another animal closer than this, either when grazing or in mud wallows, or when only walking about on land. At greater distances #2 ignored other animals and grazed right next to them. Other animals seemed more tolerant.

(4) Most of aggression was simply butting using gular projection and sometimes nuchal notch area of carapace, followed by short chases. "Head biting down" postures were rare, but it should be noted that front end to front end attacks were also rare, this perhaps accounting for the absence of this posture. But even in cases of front end or side attack when heads were in reach of each other, animals (#2) rarely used the posture – just butted into the other animal. Will have to examine front to front contacts more for incidents of this posture.
(5) Chases and aggression sequences were always very brief – at most a few minutes, usually less than 1 minute; and, as soon as one animal had gotten a short ways away (2-5 m) from its attacker, they both would very quickly seem to ignore the . . .

Pg. 114.
. . . other and return to previous activities – usually grazing. Note, that in those few cases in which the attacked animal did not move at all or very much (i.e. a few dm), #2 would try butting it 2 or 3 times. And if not chase or movement ensued, #2 would seem to be adequately bluffed for she would simply give up the attack and return to previous activity and leave the animal she had been aggressing alone – and she did not return to attack the animal again after giving up the first time.

1900 – Caseta weather – Overcast, cool most of day ; some rain; sun out a little now and then. Max 82.0 ºF; Min 70.0; Rainfall 4.0 mm; Evaporation 1.2 ml, (reading 24.4 ml).
1 December 1969.
0700 – Caseta weather – Rainfall 0.2 mm; Evaporation 0.1 ml., (reading 24.5 ml).
Went to Zone 3 nesting area and region 4 this morning to get . . .

Pg. 115.
. . . weather data.
0900 – Region 4 – 0.30 inches of rain.; 25.1 ml evaporation; refilled evap. full.
1000 – Zone 3 N Area. – 0.30 inches rain also; 27.4 ml evaporation; refilled evap. full.
Max 84.0 ºF; Min 60 ºF.
Took notes on a few animals and other items while going down and back – did not make a survey and record all animals seen.
#1168 – near weather instruments in Region 4.
#619 ♂ CL 111.5; CW (CDRS) 126.7; CW (VD) 116.5.
near nest #13 in almost exact spot where saw #137 on Nov. 22, 1969. Moving along in brush; extremely round in shape from top view and very domed shaped. Scutes smooth only in very centers; has flaking disease but not extensive and notably absence from rear of carapace where usually, if at all; instead has on front marginals as is often typical, but

then on right rear side of 34d and 4th costals and on marginals just above rear part of plastral bridge.
0945 hrs - #133 ♀ - found again; has moved from Region 6 near nest #13 to Zone 3 NA (Region 7) in 9 days. CL 95.2 cm; CW (CDRS) 109.3; CW (VD) 102.0. Sitting under cactus just S of campsite near nests #3, 6, 7 etc. Eating fallen cactus pads, spines and all; spines all over chin and in mouth.

Pg. 116.
#1144 – same general area; 25 m S of nest 3, 6, 7 etc. area and moving in that direction through brush.
#131 – found again finally; near nest #2, about 10 m W of it moving in that very rocky area to the W; just a short distance beyond will enter an open area where could perhaps nest? Smooth all over carapace; small amounts of flaking disease on supracaudal, rear marginals and in centers of last 2 vertebrals. CW (VD) 92.0.
Tempting to think she just returned here to nest again – but from where? She has certainly not been in immediate central area of nesting zone since laid nest #0 – at least have scouted all these areas on numerous occasions in Oct and Nov. and never saw here while saw many other animals; especially noteworthy is fact that found some resident animals such as #1144 almost every time was here, but not #131.
Just 5 – 6 m from #131 there is a smaller (CL 62.4) unmarked . . .

Pg. 117.
. . . ♀ (prob.); also moving W; is under a large Pisonia; almost no plastral concavity; no flaking disease on upper surface of carapace anywhere, but all over rear marginals and bottom surfaces - Why?
Scouted all over Central Nesting Area (excluded nest #2, 5 in other words and areas near them) looking for more animals and signs of digging. No completed nests or more animals.
Found the following nest excavations:
1 – one hole dug in red soil in a small clear area in a site generally rather heavily covered by herbs (mallow) mostly, and plant #'s 1, 2) – this area is just W of nests #3, 6 7, etc. – only 20 m W of #133's present location and there is what looks to be a trail from the attempted nesting site and this ♀, so she could be responsible for it. Only 10 cm deep, then hit rocks and quit; no cloacal fluid sign.
2 – one small dug out spot about 30-35 m SE of nest #2 in area where was nest last year; This also in red soil in an open spot in an area generally well covered by herbs (mostly mallow) very shallow (8 cm) and hit rocks soon – no cloacal fluid.
3 – a very fresh hole, probably from yesterday afternoon and certainly not more than 2 days old. Right in center of trail, about 30 – 35 m . . .

Pg. 118.
. . . above nest #1, in brownish soil there; 14 cm deep, then quit – hit rocks; soil very wet and muddy foot rest still present, so used cloacal fluid. Nest was clearly beginning to approach flash shapes when stopped – had just started hollowing out semi-circle in front half of nest. Several trails in the area and searched around but could not find any animal or more digging sign. Several places with very fresh turds in trail just above this nest

site. Trails near nest hard to decipher but appears that animal moved off in one of 2 possible directions - SE or SSW – both generally toward central NA below.
Obviously could have been made by either 131 or 133 or any other animal. Note that #133 is closer to it and it is directly inline to where saw her about 9 days ago.
4 – One digging near Nest #13; only 20 cm deep; rocks. [Marginal note: Very near where #133 was on Nov 22, 1969- was not present on that day- only 8 m from where she was.]
Note: all 4 of these nesting attempts add evidence to the general impression that ♀♀ avoid not only rocky areas, but that they visually. . .

Pg. 119.
. . . select exposed soil if available in preference to that covered by herbs such as mallow and plant #1, even though many favorable nesting sties (as evidenced by my inspections and some of previous year's nest) exist which are covered by moderately dense herbs now. These latter areas have in general been almost wholly avoided for nesting in preference for exposed surface – soil type areas.
In afternoon went to El Chato to obtain weather data.
El Chato – 1430 hrs. – Rain 0.62 inches; Evap – 30.4 ml; refilled full.
Noticed quite a bit of tortoise activity all along trail (Reserve border) till just past Camote patch near Right turn in the border. Tortoises have still not progressed W of this point. Their activity seems to be occurring on both sides of Border – especially out into Passiflora covered areas but also quite a lot of trails and loops out into Mora itself for short distances – 30-40 m maximum, usually less.
Then again activity signs begin about ½ km before El Chato turn-off on Reserve Border – they have not moved further E since was last here 2 weeks ago – seem instead to be spending time up N of Reserve Border in this area and S . . .

Pg. 120.
. . . of it just a bit in semi-forest open areas- not much out into open Mora covered areas at all.
Noted #'s of a few animals –
#450 – just above Caseta on Reserve Border.
#'s 277, 627, 104 – between Caseta upper ponds area and top of first hill along Reserve Border.
#'s 416 ♀, 13 ♀, 354 ♂ (maybe 354, but doubt it). 98, 97, 103, 106 – all between top of first hill and 50 m W of Camote patch.
Note #13 ♀ - saw her in August (end of the month) near beginning of woods just above El Chato – in Mora area then. How did she get over to area about ½ way between 1st hill top and Camote patch, when evidence is clear that did not use Reserve Border as a pathway? Seems most likely that worked down into forest which forms the southern border of the Mora covered area and which lies a couple of hundred meters from Reserve Border along most of its length. She could easily have worked into this from where . . .

Pg. 121.
We last saw her by way of guayavillo forest above El Chato which is continuous with this forest and then over a few km to E and then up to Reserve Border from S through

extensive fields of Passiflora which run down toward this forest in the area where she is now – am not sure yet, but appears that Passiflora covered areas may reach almost all or all the way to the forest here.
Caseta weather – 1900 hrs. Overcast and cool all day; rain in very early hours – 0600 – 0800 – off and on; sun hardly out all day.
Max 80.0; Min 70.0; Rain 0.2 mm; Evap. 2.1 (reading 26.6). Refilled evaporimeter full at 1900.
A few comments on pond – more to be added after December sampling.
All pond continuing to dry, as in Oct. , Nov. and at least in part in Sept. (probably in Aug. too!).
Caseta upper ponds (2 and 3) - #3 dry; #2 very little standing H20 – more and more soupy mud each day.-
Caseta pond #4 – dry; small mud holes near it dry now too.
Caseta pond #1 – continuing to dry, more and more mud wallows around edges with each passing week; more and more exposed areas which become covered with grass.
El Chato ponds – all large ones dry; no more wet mud even – only H20 may be (will check) in small ones under Manzanillo groves on S side, but even most of these now dry and even mud dry.

Pg. 122.
Zone 6 ponds – all drying very much; mostly mud now, each with a small amount of standing H20; mostly mud wallows (tortoise activity) and mud covered with Azolla.
Zone 1 ponds – All 3 decreased in volume somewhat but all with plenty of standing H20; tortoises using #'s 1 and 3 especially heavily for mud wallows; these ponds are large and deep and last a long time after full.
Pond along Reserve Border W of Zone 1 – Dry all over; small 1 x 2 m area in center which previously had H20 now just drying thick sticky mud.
Region 4 pond – (Caseta – La Fe trail); Only a bit of soupy mud left around meter stick now; when exactly lost standing H20 is unknown, but probably in 3rd or 4th week of November; whole area continuing to dry. Vegetation is also continuing to dry out in general. This is not as obvious in higher regions such as around El Chato and from about middle of Region 3 to Caseta area and above off Caseta – La Fe Trail, but even in these zones is generally drying out. Most noticeable in lower regions – for example from Region 4 to Zone 3 Na (Region 7) herbaceous layer is clearly drying out rather thoroughly – plant #1 very brown and wilted, more so the lower altitude; plant #2 and mallow also drying out and losing greenness. All this was particularly . . .

Pg. 123.
Noticeable in Regions 6, 7 of Caseta – La Fe Trail today.
2 Oct. 1969 – To CDRS
Region 6 weather – 1030 hrs. – Rain 0.62 inches; Evaporimeter 25.0 ml. Pond meter stick – 4 cm – mostly Azolla lying on mud and mud wallows now; very little standing water; same for other 3 ponds in this area.
11 Dec. 1969. - To Caseta after trip to Duncan 5-7 Dec. and some work at CDRS.
1900 hrs. – Caseta weather – Rainfall 24.1 mm; Evap. 11.2 ml (reading 11.2); Max 85.0 ºF; Min 65.0 ºF

Rained all afternoon and continuing this evening – cool and overcast. Certainly has been rainy and low evaporation for past 10 days while absent from this area.
12 Dec. 1969 – To Region 4 and Zone 3 NA for nest temperatures and beginning of Dec. sampling. On way down stopped in at E end of Caseta pond #1 – saw #1, 2, 10 (painted) , 1 animal unpainted about size of #2, and one huge unpainted ♂ all in mud wallows there. Pond level about same as 10 days ago – also some collected water in old drying wallows – rain of past 10 days seems to have temporarily stopped further drying out. Also saw #'s 5 and 9, painted near pond along trail as was passing.
** Note – saw painted #7 along trail ½ way between Caseta and Caseta pond #4 – i.e. returned again here from Caseta pond #1.

Pg. 124.
Region 4 – 0730 hrs. – Weather – Rain (0.28 inches) = mm. Evap. 33.3, but ¼ of paper disk "chewed" away, probably by birds – probably caused some loss of H20 and also decreased area of evaporation ! Refilled evaporimeter. Also installed a Taylor max – min under radiation shield, just as at the Caseta.
General weather comments for today; Reg. 4
0600 – 1000 – cool, overcast, radiation extremely weak; Occasional light garua.
1000 – 1200 – no more garua; warming a bit as more radiation coming through; but coolish and overcast all the time.
1200 – 1400 – same as 1000 – 1200; looks as if may be clearing in Zone 3 NA about 1300.
1400 – 1600 – Same till about 1530 – then cleared here somewhat – some direct sun on and off, about ¼ of time direct sun, for past ½ hr. Looks as if off and on sun in Zone 3 NA since sometime between 1300 – 1400.
1600-1800 – Sun off and on from 1600 till 1715 – about like since 1530; then overcast till sunset.
1800 –2200 – overcast mostly but some sky clear and starry; no rain.
Next morning – rain in early morning 0400 –0530.
0600 –0800 – overcast almost all time but sun out for a few seconds twice; weak radiation stronger today than early yesterday.

Pg. 125.
Temperatures; probe in soil column – thermocouples
Position #

	0800	0900	1100	1200	1400	1600	1800	2000	2200	0600	0800
1	24.5	25.1	30.0	33.7	32.9	31.9	27.2	25.1	23.8	22.4	25.6
2	24.5	24.6	27.2	28.8	30.0	29.8	27.8	26.0	25.0	23.4	24.8
3	24.1	24.6	27.2	28.8	30.0	29.8	27.8	26.0	25.0	23.3	24.8
4	24.1	24.8	26.4	27.3	29.0	29.0	28.0	26.4	25.4	24.1	24.8
5	25.0	25.1	25.5	25.5	27.0	27.5	27.6	27.1	26.5	25.3	25.3
6	25.4	25.5	25.5	25.3	26.0	26.5	27.0	27.1	26.5	25.9	25.6
7	25.9	26.0	26.0	25.5	26.0	26.0	26.2	26.5	26.3	26.3	26.0
8	26.0	26.2	26.0	25.5	25.9	26.0	26.5	26.5	26.3	26.3	25.9

Pg. 126.

Soil moisture readings in %– N.R = no registration on meter - <15 –20 %
Position # (Note abbreviations – JBR = just barely registering; NR = not registering)

	0800	0900	1100	1200	1400	1600	1800	2000	2200	0600	0800
5 cm	22.5	22.5	23.0	23.0	23.0	22.5	22.5	22.5	22.5	23	23
14 cm	JBR	JBR	JBR	JBR	JBR	JBR	JBR	JBR	JBR	JBR	JBR
20 cm	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

Pg. 127.
Sampling – beginning for Dec. will do Region 4 this afternoon – 1400 – 1600.
#10 ♀; just W of weather instruments between them and trail. CL 90.3; CW (CDRS) 97.0; CW (VD) 89.0. Eating plant #1; has been in this area since 1000 and has moved only 10 –1 m total straight line distance all day. (now 1400 – just before). Almost no flaking disease – a few spots on front marginals and on underside of rear marginals. Shell – carapace – seems old and worn, but scutes only smooth in central parts ¼ -1/2 of their area, no more.
No deep grooves yet developed between carapace scutes. W.g.i.'s present but not clear and complete. No sign of having recently been in pond (headed that way ?) and red soil well ground into carapace; thus has been below in red soil areas recently ?
New #1192 ♀ (prob. Almost sure) – definitely! Just SW of Weather instrument area between it and trail, moving toward trail to NW no mud on carapace. No really smooth scutes and only very few almost "lines" of flaking disease; w.g.i.'s there and complete, but very, very fine. CL 80.8; CW (CDRS) 84.5; CW(VD) 78.0.
#460 ♂ - near pond edge (dry part) on its SW side; down inside a hole with loose soil in it – certainly a wallow when raining good and hard or thereafter for awhile.
New #1191 ♀ - in pond, but dry part with good green herb cover – was dry here in Nov. sample too. Has mud on shell so has been in H20 recently – No flaking disease; scutes worn smooth only at very centers. CL 72.5; CW (CDRS) 76.0; CW (VD) 69.5.

Pg. 128.
451 ♀ - near meter stick area – 10 feet from pond eating dried up leaves in a very rocky area. W.g.i.'s present but incomplete and very fine lines. No flaking disease; scutes smooth only at very centers. CL 85.7; CW (CDRS) 92.0; CW (VD) 84.5.
#890 ♂ - very large; in pond near meter stick, but on dry ground. Bad flaking disease all over front marginals and rear 1/3 of carapace; w.g.i.'s' there but very fine lines only. Scutes all smooth. Has been in mud but not extremely recently. CW 135.4; CW (CDRS) 150.0; CW (VD) 138.0.
#267 ♂ - burrowed in so can't measure – medium sized. Looks about like 100 –110 CL. S of weather instrument area by about 75 m; no flaking disease; no fresh mud on shell; no smooth scutes; red dirt ground into carapace! – quite well developed w.g.i.'s; but some old, dry mud on shell – certainly was at pond in past few weeks.
#693 ♀ - same general area as #267 – big open area S of weather instrument area in between pond and trail; very old dried mud on carapace – very little – walking in direction of ponds!
#404 ♀ - same area as above 2; flaking disease on front and rear marginals and scattered in spots on rear . . .

Pg. 129.
. . . 1/3 of carapace. Nice, clear, thick w.g.i.'s; scutes smooth only in centers. CL 85.6; CW (CDRS) 93.7; CW (VD) 84.5. Only very little old dried mud on carapace as with all others seen today except #1191.
#217 ♀ - very large; scutes very worn but smooth only at very centers! Has spots of flaking disease here and there all around border of carapace, but not heavy anywhere; no deep grooves between scutes at all yet. Must be a female, but really large and not al all with a carapace which looks like #'s 127, 131, 133, for examples. CL 105.7; CW (CDRS) 117.5; CW (VD) 107.5. Plastron not deeply concave either.
#709 ♀ - same area where saw before; like #'s 127, 131, 133 – smooth all over scutes, deep grooves; only small bits of flaking disease now visible l- mostly along marginals edges or actually in grooves.
Red soil on rear of carapace – certainly in pampas coloradas before here. CL 96.8; CW(CDRS) 103.7; CW (VD) 93.0. Dried pond mud on rear of carapace! Plastron considerably more concave than #217's in relative aspects!!
#1033 ♂ - open rocky area of trail just S of Weather instruments; scutes only smooth in center; very few spots of flaking disease on front and rear marginals; red soil clearly worn into carapace around edges; w.g.i.'s clear, but very thin and not all complete; some dried mud on carapace. CL 86.8; CW (CDRS) 93.9; CW (VD) 86.0.

Pg. 130.
#1058 ♀ (maybe intermediate tail length) – burrowed into loose soil in a shallow hole; CL 81.3; CW 86.0; 79.0. No flaking disease; no smooth scutes; bit of dry mud on carapace, but no red soil indications on carapace! Seems as if only larger animals in this area show evidence of having been in lower regions like Zone 3 NA or La Fe etc.
Will quit now till 14 or 15 Dec. – have only about 1 hour of sampling left to do here, but it is 1630 hrs and some animals are burrowing; thus will complete on morning of 15 Dec. See notes there for completion of this sample area and general commentary.
Pond as witnessed on 1 Dec. 1969 is dry, except for a little mud at meter stick area – but even this mud is thick and sticky – no longer useful for wallowing.
Don't really know exactly when all standing H20 dried up, but certainly a good estimate would be somewhere between 15-25 Nov. 1969. Distribution of tortoises reflects this drying I think – see notes at end of sampling for this area.
13 Dec. 1969 – 0730 hrs. – 24 hr. weather for Region 4 – Rain 0.025 inches; Evap. 3.0 ml.

Pg. 131. Min temp last night 70 ºF; high yesterday afternoon 82.5 ºF
To Zone 3 NA to take temperatures and make a sample of the area for December. (0830 hrs).
0930 hrs – Zone 3 NA – Weather – Rain 0.40 inches; Evaporimeter – dry! K- refilled evap full and moved max-min into similar position as ones at Caseta and Region4 Max 85.0 ºF; Min 65 º F – reading when arrived . Will have to estimate evaporation again –

Soil Moisture readings at nest #9.
In Nest – (Readings in %) N.R = no registration on meter - <15 –20 %
Position # (Note abbreviations – JBR = just barely registering; NR = not registering)

	1000	1200	1400	1600	1800	0600	0800	1000 (14 Dec)
5 cm	41	43	41	41	41	35	35	38
14 cm	NR	NR	NR	NR	NR	NR	NR	NR

In Soil Column – (Readings in %) N.R = no registration on meter - <15 –20 %
Position # (Note abbreviations – JBR = just barely registering; NR = not registering)

	1000	1200	1400	1600	1800	0600	0800	1000 (14 Dec)
5 cm	JBR	JBR	JBR	JBR	JBR	JBR	JBR	JBR
14 cm	56	58	55	55	55	45	45	47

Pg. 132.
Weather patterns for the 24 hrs period – general comments.
0600 – 0800 – overcast mostly; weak radiation stronger than yesterday.
0800 – 1000 – was in Region 4 till 0930, but look as if cleared in Zone 3 NA about 0830 – sun out off and on from then on – cumulus clouds; weak radiation quite warming even when sky is overcast.
1000 – 1200 – Is clear all to W and NW; overcast and gray to E and NE. Must be sunny off and on at Region 4 now. Pattern still same here as since 0830; sun out about ¼ of the time full, rest of time obscured by white cumulus clouds l- warm because of weak radiation coming through.
1200 –1400 – Sun out about ½ of the time or more from 1200 to about 1340; then overcasts till 1400 except for a few moments of sun now and again. Certainly overcast in Region 4 most of this time.
1400 – 1600 – Entirely overcast and continued cooling – no sun at all and only very weak radiation – certainly same in Region 4 and even looks as if may be raining up above – at least probably so in Caseta region if not as low as Region 4 – hard to tell.
1600 – 1800 – same as last record
1800 – 2000 – mostly overcast but cleared off about half by 1930 – no moon and stars.
Next morning – 0600 – 0800 – cloudy, solidly, when arose about 0545; continuing mostly same – very cloudy to N in Region 4 and Caseta. Some weak radiation warming things from 0730 – 0800; sun out for a few seconds around 0800.
0800 – 1000 – mostly cloudy till about 0915, but sun out some off and on; since 0915 out about 1/3 of the time – quite like yesterday at this time.

Pg. 133.
Nest #9 – nest thermocouples – probe 1.
Position

	1000	1200	1400	1600	1800	2000	0600	0800	1000
1	34.6	41.7	41.0	33.0	30.3	27.0	24.0	26.2	33.6
2	30.6	36.7	37.6	33.0	30.5	27.7	24.5	26.2	30.7
3	26.3	29.7	32.1	32.0	31.0	28.9	25.7	25.6	27.8
4	25.9	26.0	27.3	28.5	29.5	28.9	27.5	26.9	27.2
5	26.0	26.0	27.0	28.1	29.1	28.5	27.8	27.1	27.2
6	26.0	26.0	26.7	27.3	28.0	27.5	27.8	27.1	27.2
7	25.8	26.0	26.5	27.3	28.0	28.0	27.5	27.0	27.2
8	25.8	26.0	26.4	27.0	27.4	27.1	27.5	27.0	27.0

Nest #9 – soil column thermocouples – probe 2.

Position	1000	1200	1400	1600	1800	2000	0600	0800	1000
1	36.8	43.1	40.0	31.0	28.5	25.6	23.5	26.9	34.5
2	33.2	39.2	38.2	31.5	29.1	26.4	23.9	25.7	32.0
3	30.0	35.1	36.0	31.7	30.0	27.4	24.5	25.7	29.5
4	25.8	33.6	31.3	31.0	30.5	28.5	25.8	25.3	26.7
5	25.5	26.9	28.0	29.0	29.5	28.5	26.5	25.8	26.5
6	25.6	25.5	26.6	27.5	28.2	28.0	26.7	26.2	26.5
7	25.6	25.5	26.1	26.5	27.5	27.1	27.1	26.5	26.5

Pg. 134.

Nest #12 – thermocouples in nest column

Position	1000	1200	1400	1600	1800	0600	0800	1000
1	29.9	44.4	37.0	29.5	27.2	23.0	26.5	33.0
2	27.8	34.9	35.9	30.8	28.7	23.4	25.0	29.1
3	26.5	32.0	34.9	31.0	29.0	23.8	25.0	28.0
4	25.4	28.0	32.0	31.0	29.5	24.7	25.0	26.5
5	25.0	26.1	30.0	30.0	29.4	25.1	25.0	25.7
6	25.0	25.1	28.2	28.5	28.5	25.6	25.3	25.4
7	24.5	24.5	26.5	27.1	27.5	26.1	25.7	25.4

Pg. 135.

Zone 3 NA sample – same areas and approximate searching times as before (Nov. sample)

New #1195 ♀ j. (maybe – too small to tell!) CL 59.8; CW (CDRS) 60.0; CW (VD) 54.0. No flaking disease at all, even on underside. Scutes all fresh and not worn at all – central part (original scutes at hatching) even clear and distinguishable. W.g.i.'s present but very, very fine and thin. Some red soil around lower parts of carapace – are a couple of soft red soil wallows near here and has probably been using – right near nests #9, 4, 15, in shade beneath a tree. [Marginal note – 1300 hrs.]

1330 hrs. - #918 (have measures and sex previously) – under shade of large pega-pega on W edge of open part of Zone 3 NA. Just sitting and resting as was #1192; both about exact same size.

#1051 ♀ - in open area of Zone 3 NA but also resting in dirt wallow under shade of a large Pisonia; same general size class as previous 2 but this one is larger – could she be here to nest? K- will watch. Down in general area of nest #4, 9, 15.

New #1193 – impossible to sex – too small. [Marginal note – 1500 hrs]

CL 30.4; CW (CDRS) 32.4; CW (VD) 29.5. No flaking disease at all; scutes not smoothed or worn and can see abundant growth rings. How old? – about same size as Duncan 65-66 year class at station – but growth rings abundant and impossible to count accurately it seems to me – original scutes in perfect shape and easy to see – from then on a real mess! Has been overcast for almost 1.5 hours (now 1500) and this beastie was still well burrowed in under a prone, large Pisonia [word not clear –set?] of branches – in a

little area of open exposed red soil – literally jammed in between soil and tree and impossible to see . . .

Pg. 136.
. . . unless standing above him and looking straight down or prone on ground – then only can see up under log from one side only – i.e. very well hidden! Should note that just 30 minutes ago #1041 was also still inactive in shaded burrow –
Anyway very interesting in terms of lack of activity, burrow site, and how well hidden this animal was. W.g.i.'s' present and complete but very fine and thin.
Got almost all of sample done between readings from 1200 – 1600. Will finish tomorrow morning.
1530 – Came back by to look for #1193 again and found had wandered abut 100 feet (straight line; thus probably much more in reality) or so in only 21 minutes – now moving along slowly and eating a bit of dried grass and other dried herb stems (leafless whatever it is) now and again. This little guy is really wary of me and if he sees or hears me stops all activity and freezes for 10 minutes or so after, even if I get out of his sight.
Some notes on activity cycles at this altitude – although did not find enough animals soon enough to really do good studies did make some general observations today.

Pg. 137.
First – at 1000 when sun had been out of and on for 1.5 hrs saw #1195 going into shade. It remained here till I marked this animal at about 1200 – this disturbance caused it to wander off under some other trees and I lost it. Then at 1515 I again saw #1195, now active and grazing – the sun had now been obscured solidly for over 1.5 hrs. Then at 1630 saw this animal coming right back to area where first saw this morning active (at 0930) – heading it looks like for a shallow dry red soil burrow which is fresh and has fresh turds (1 day old I guess) around it – am sure going to retire there at this time k- but it saw me and did an about face and took off in direction coming from again – I suspect this beast used this burrow last night and was homing in on it again. The burrow is an exposed open spot.
Also saw #1051 in shade out of sun at 1515 hrs. – remained there till dark and after – never became reactivated all afternoon.
Also saw #918 in shade out of sun at 1330 hrs. – then again spotted moving along 3o m from burrow site at 1600 – thus probably active about past ½ - 1 hr.? Then saw burrow in at 1630 in a typical shallow area filled with loose red soil l- exposed open spot.
Also – certainly I disturbed #1193 but remained active till between 1630 – 1645 – feeding and moving along – I found it burrowed in another typical burrow, but his one less exposed than the 3 above and partly covered over by a prone Pisonia stem. But not nears so well concealed as when first . . .

Pg. 138.
. . . spotted this afternoon. This first site was well shielded from sun or open night sky. The new site is rather exposed to both but does give some protection.
Questions that remain – when in morning do thee animals become active and how dependent on solar radiation is this time of activation? Also when would they emerge for afternoon activity if sun stayed out till sunset and not gone into obscurity at 1400 and

onwards – likewise, when would burrow for night under same conditions. The clearly avoid the sun during the heat of the day 1000 – 1100 on to at least 1500 probably – but need to fix these time with more observations.
Comments on burrows: the smaller animals which have been watching today seem to really selectively pick out areas with loose red soil in the form of shallow pits – only 5-10 cm deep at deepest and more or less saucer –shaped. These areas are chosen over rocky areas for rest in shade, although have seen animals resting in shade under Pisonias or other trees just on rocks or herb or bare flat ground. But most resting animals are found . . .

Pg. 139.
. . . up under trees especially semi-prone Pisonia in these wallows. Also use same kinds of wallows preferentially for night–time resting spots – they clearly seek these areas out and proceed often deliberately to one after they stop grazing and go in for the night. Of course in daytime these spots need to be shaded, but many night-time ones are more or less opens exposed and are not shaded from daytime sun.
These burrows must certainly be partly or completely constructed by tortoises – perhaps old goat scratching areas sometimes serve as a start in making one? Also some are what appears to be low areas where H20 percolation when have heavy rains aids in keeping these shallow holes intact. In fact they are probably made, at least ones in open not in association with Pisonia during heavy rain periods by wallowing tortoises. Many of these spots and especially the shaded ones are in association with prone or semi-prone Pisonia. It appears that when one of these trees falls or partly bends over, the loose soil at the base L(uprooted as the roots come partly out of the ground) then becomes a prime area for tortoise rests – some of soil areas at bases of these tree or prone stems must in addition be due to tortoises scrunching themselves into the ground at night to rest.
What do the larger (i.e. 80 – 90 cm CL plus) tortoises do in this area and altitudes for . . .

Pg. 140.
. . . rests? Most of these wallows are smallish, from 60 –65 cm CL animals or smaller it appears – however are a few larger ones, but none really big enough to take care of the large ♂♂ which have occasionally been seen here. In addition, all large adult tortoises have seen here, ♂ or ♀, have simply rested at night or in daytime on ground, up under trees – no wallows at all! In fact #127 simply spent night out in open on 2 nights when here in early November – she just quit trying to dig and nest and sacked out right where she was. Perhaps all this has to do with comparative cooling rates and thus the little ones get some advantage from bare soil wallows and partial protection they give – heat conservation?? Must get more observations on these matters.
Found a new nest, #7, but will describe and photograph tomorrow. High temperature here today – 84 ºF.

Pg. 141.
14 Dec. 1969. – Low last night of 70 ºF. Checked on 3 animals in known locations for activity: at 0615, just after light #1051 moved out of burrow and started out across open are. At 0630 #918, and small one #1193 still sitting in burrows, the former still asleep apparently, the latter alert and looking about.

#918 became active and started moving at just before 0800 – air temp then about 74 ºF.
#1193 – checked again just before 0800 – not anywhere in immediate area – thus active and I suspect became so around 0700 but don't know.
#918 could have waited till late because was burrowed near my camp and was aware of me.
** also, heard a 4th animal clumping along about 0645 hrs.
** Note: the animals don't bask here soon after activating as around Caseta – don't turn part way out of burrows and the sit there basking for awhile as almost all do in latter location. Once active here seem to stay so. It is obviously and noticeably warmer here at any given hour in the morning than there.
Finished sample except for one small area – will get in a few days on La Fe trip period.
General Comments: certainly not many tortoises here, scattered widely and all saw on this sample were smaller ones. Certainly no large ♂♂ or nesting ♀♀ in the area. Actually density about same or a bit less than in Nov. sample l- main difference seems to be that in Nov. were still some nesting ♀♀ here – of course this could be a quirk since I saw #'s 131 and 133 both here on Dec. 1 and there is a new nest, probably laid by one of these 2. May be that this is the tail end of the nesting season I am witnessing. Anyway density not much less; if at all very little. Drying of vegetation continues – much of plants #1 , 2 drying out. A bit drier than Nov. and much drier than Sept and Oct.

Pg. 142.
Nest # 17 – very typical – looks much like #'s 3, 6, 7, 9, 14, 15, etc. in red soil, open area, No close trees at all. However is in area slightly to W 130 m of nest #3, 6, 9, etc. where there is a denser herb cover than in the latter area. There are ½ - 1m high mallow and other herbs right around the nest and in fact the ♀ had to push some few herb stems aside to make the nest. I am sure this is the same area where last (1968) August it was quite open with bare red soil – saw it then with Castro – apparently rains of this year allowed this luxurious herb growth. But in general as open an area as is around, save that of #'s 3, 6, 7, 9, etc. areas – certainly virtually no shading in this area. The exact nest site is only 3 m from attempted fresh hole I found on Dec. 1 with #133 ♀ only 20 – 25 m away eating cactus. Am almost certain that she is responsible for this nest. But could have been 131 who was in the general area and headed more or less in this direction on Dec. 1 – however everything have seen of ♀ behavior during day prior to laying (e.g. #127 ♀) would make #133 . . .

Pg. 143.
. . . a very likely suspect – feeding in shade near the area, fresh hole from 1 or 2 days before etc. No need to describe nest – typical hard cap, cloacal fluid used, etc.
Will not open nest and perhaps not build a rock wall just to see if pigs destroy it – sort of a controlled experiment to other protected nests.
On Nov. 22 noticed a small hole again into nest #1; had repaired the nest earlier, so decided to check it out this morning in case are some hatched tortoises. Open up and discovered that of the remaining 12 eggs all but 1 are obviously bad; replaced the 1 and refilled and constructed nest. Will take these other 11 to Caseta to examine. For embryos, etc.
Took measurement with vernier calipers:

1 – 63.9 x 62.5	cracked and small 5 mm hole on one side.
2 - 66.8 x 59.9	cracked
3 - 62.4 x 61.2	cracked and large hole of 2 cm on one side.
4 - 61.0 x 60.6	slightly cracked
5 - 62.5 x 61.0	cracked and hole of 1 x 1.5 cm at one side
6 - 60.1 x 61.8	slightly cracked.
7 - 66.4 x 61.0	slightly cracked
8 - 61.6 x 64.7	slightly cracked
9 - 62.4 x 61.0	cracked and 1 cm hole on one side.
10 - 63.0 x 65.0	cracked
11 - 62.0 x 64.0	slightly cracked.

Pg. 144.
Condition of eggs internally:
#1 – infertile.
#2 – infertile
#3 – infertile
#4 – hard to tell – no rotten – probably infertile.
#5 – rotten; either 1st incubation cycle – approaching second ; embryo too rotten to preserve – may be this hard to or simply infertile also – from looks of rest of clutch probably infertile.
#6, 7, 8, 9, 10, 11 – infertile.

All but 1 certainly infertile; one remaining in nest unknown; those 3 (earlier removed from nest impossible to judge because were both cracked open badly and decomposed completely. Why so many cracked -= could be settling of soil on top l-= but seems somewhat unlikely -= hard to say. Perhaps most cracked simply because so rotten that gas caused them to crack to release gas - also hard to say.
One thing in favor of first theory = at least in part – 2 eggs were not too rotten even though cracked – had just begun to putrefy – so cracking unlikely due to gas expansion – again hard to say.

Pg. 145.
On leaving nesting area refilled evaporimeter at 1100 hrs. full. Was reading 4.5 ml. No rain. Temperature 80 ºF already. At 0930 took evaporation to get 24 hour total 4.3 ml; also no rain till then obviously.
Completion of sample in Region 4 – 1130 –1230 hrs.
#713 ♂ - in open rocky area of trail just SW of weather instruments. Eating dried up stems of plant #1 in the shade.
#629 (or 622 – 7 notch no clear) ♂ - medium large size -= burrowed up against Pisonia in shade resting. CL 111.3; CW (CDRS) 123.5; CW (VD) 117.0. Some flaking disease on front marginals and right rear side on costals and marginals above and slightly in front of leg pocket; scutes not worn smooth. W.g.i.'s present but fairly thin. Only very slight bit of old mud on shell. Just W of trail in guayavillo forest.
Comments on this month's sample and conditions:

Can't really argue that tortoise density is any less here in general sense of whole area than in November. But clearly not nearly as many animals concentrated in and closely around the pond. This of course can be most easily explained by the fact that the pond is dry now, was dry on Dec. 1, and probably has been nothing but a bit of mud since 3rd or 4th week of November.
Instead animals seem to be spread out all through whole area, although still find more of them when close to pond as compared to being farther away from the pond in same kind of vegetation and physiognomy. In other . . .

Pg. 146.
. . . words the animals are spread out more now and perhaps a bit lower in density than in November – will check nos. Plants are continuing to dry and especially noticeable in drying out of the plant #1 and other herbs – much tortoise activity for past 2-3 months. Also lots of dry tortoise turds everywhere.
Weather at Region 4 - 1200 hrs. – Rain 0.025 (emptied); Evap. 7.7 ml reading (4.7 ml since 13th. Refilled full. Max 83.5; Min 69.5.
On return to Caseta at 1330 noticed a few animals = some of this can be added to my comments of 12 Dec.
Saw #12 (painted) about 75 m above pond on trail. Also along trail near pond saw #'s 416 and 421.
Then around small pond just below Caseta and near trail saw #205 ♂ (actually on the trail, but has been hanging out around this pond a lot lately.)
Near Caseta itself saw #'s 715, 3 ♀, and 31 ♂ - the latter 2 still in this area after weeks and weeks.
Caseta weather at 1900 – remained overcast with some weak radiation all day here – looks as if was cloudy and sunny alternating below in Zone 3 NA – probably cloudy most of the time in Region 4. Rainfall 2.3 mm; Evap 2.9 ml (reading 14.1); Max 83.0 ºF; Min 69.0 ºF.

Pg. 147.
15 Dec. 1969 – To Zones 1 and 6 for sampling and weather data. Not going after all too damned wet and raining. Will instead do Caseta area sample.
#3 ♀ - near tent.
#31 ♂ - grazing around Caseta.
#835 ♀ - grazing near small pond, below Caseta in between Caseta and Caseta pond #1. Medium-large sized animal; no flaking disease; w.g.i.'s incomplete and then but visible. Fresh mud all over carapace – has been in pond. CL 82.4; CW (CDRS) 89.3; CW (VD) 82.0.
1 animal in this same small pond in mud and water fully -= can't get # - resting and wallowed in well – 1430 hrs.
#134 – grazing on leaves of the tall large sedge so abundant around this pond and Caseta area in general; have this beast from before – can't tell sex because tail intermediate – but probably or better yet maybe a female – if so, then large – scutes smooth only in very centers.
Flaking disease only scattered in patches on rear 1/3 of carapace and a spot or two on front marginals- not extensive.

Continued up through this series of little ponds to N about 100 –150 m to just S of mora forest border. No more tortoises, but area heavily used – littered with semi-fresh and fresh droppings in all stages of decay, burrows and trails all over.

Pg. 148.
Interesting to note that area was heavily used, but not so much as this in November sample; not any of ponds but the one nearest the trail have H20 – true also in November. But in August (late) these other ponds had a bit of H20 or mud in most of them – not much however. The main small pond has had water since first sampled here in late August – just decreasing slowly and steadily ever since. In August this area virtually unused by tortoises – only saw about 2 plus almost no trail then - sort of like change in Caseta upper ponds and open area just below them – clearly as dryness has increased so has use of this are – makes me think tortoises are moving N and not just concentrating around Caseta pond #1 – evidence from this area, around Caseta itself and mora part of Reserve Border over past 3 months supports these notions. Then down toward Caseta pond #1, #204 ♂; was off trail ½ way between . . .

Pg. 149.
. . . Caseta and pond #1.
#421 ♂ just 150 – 200 m N of Pond #1, just off of trail.
#628 ♀, large one, just 75 – 100 m N of Pond #1, just off of trail; grazing on plant #1, looks like she is on a burro or pig trail which heads off toward pond #4 (Caseta) to the E; old female, all scutes worn entirely smooth, deep furrows and grooves between scutes, especially along border of rear marginals. No flaking disease. CL 97.0; CW (CDRS) 110.0; CW (VD) 92.0. Fresh mud all over lower carapace – has been in a pond wallow!
At Pond #1 - #2, #5 (painted #'s) on E side, near trail, grazing.
#10 (painted) - in pond eating Azolla.
#15 - in pond in mud wallow (painted #).
1 unidentifiable animal about same size as #15 in mud wallow also;
#526 – huge ♂ just W of small pond with Azolla and H20 which lies about 40 –50 m W of Caseta pond #1 – followed trail – had been drinking at this pond – also must have been in Caseta Pond #1 recently as has fairly fresh red Azolla all over lower carapace.
Several of these rocky pools just W of . . .

Pg. 150.
. . . Caseta Pond #1, under Manzanillo groves still have H20 and some a little green Azolla.
#1013 ♀ prob., but tail intermediate and small animal; scutes worn smooth only spottily and then in centers of them. No flaking disease; w.g.i.'s visible but very thin and incomplete. Some hint of ground in reddish-brown soil around lower rear portion of carapace – thus from below = but how long ago ? CL 74.8; CW (CDRS) 79.5; CW (VD) 73.0.
From observations today it is certainly clear that tortoises are following natural drainage pattern both from above Caseta Pond #1 down to it and from it out to SW. There are open areas of herb such as plant #1 and the large sedge all along these drainages – and plenty of tortoise activity leading to Pond #1 from both above and below. The small

ponds above Pond #1 and just W and SW of the Caseta are also right in the middle of this drainage and can see tortoise trails honeycombing the open areas all the way from there to Pond #1.
Also explored area between Caseta . . .

Pg. 151.
. . . Ponds #1 and #4 for awhile this afternoon – found a number of small ponds in this area – all about size of pond #4 or even just little pools under manzanillo – all dry now with herbs covering bottom. This area much like that around Caseta in general – many open areas covered by Plant #1, grass, large sedge, shrubs, etc.
Did not see any tortoises in this trek but some trails and other sign – not as heavily used at all as areas around Caseta Pond #1 and trail from Caseta to Pond #1.
Then worked up Northward of Caseta Pond #4 – most of sign around pond #4 itself at least 1-2 weeks old or greater – trails and burrows and droppings not very fresh. As got up N, almost at altitude and just E and S a short ways from Caseta found very fresh trails and droppings certainly from today. At least 3 different sized trail and thus animals. Again open area as is typical of whole Caseta area – could not find actual animals, but probably burrowed because now 1630 hrs.
There is another pond abut size of #4 and just 40 m N of it - will refer to both of them as Pond #5 region of Caseta in future. Also are a number of small pools and potholes under manzanillo groves in this general area which still have standing H20 – like those just W of Caseta Pond #1. Neither of large ponds have H20 now or have had since . . .

Pg. 152.
. . . early September. Only small potholes have H20 for drinking in this area – tortoises' tracks abundant around each of them.
Also, saw #7 (painted) in same area as where saw 11 Oct 1969. Also #456 along trail just above Caseta and also to Reserve Border.

Caseta Weather – 1900 hrs. – Rained lightly off and on all day = overcast and cool; no sun at all. Max 76.0 ºF; Min 70.0 ºF; Rain 1.7 mm; Evap 0.7 ml (reading 14.8 ml).

16 Dec. 1969 – Sampling from Caseta to La Fe begins:
Region 1 - #310 in open beside Caseta.
#715 ♀ near trail just E of small pond area just below Caseta.
#205 ♂ - just SE of same small pond area, near trail.
#933 ♀ - (painted #12) just 100 m above Caseta Pond #1 on trail.
#628 ♀ - 75 m above Caseta pond #1 on trail.

Pg. 153.
#2 (painted #) on trail into Caseta Pond #1 – E side.
Region 2 - #1190 ♂ (painted #13) – upper part – about ½ way between open area of Plant #1 and Region ½ border near Caseta pond #1 on trail.
#416 ♀ - in between 2 open areas of plant #1; altitude about 500 ft – in guayavillo forest just off of trail – has thus moved about ½ -1 km S since saw here near Caseta pond #1 on

14 Dec. – was this far by last night as is by burrow now (1000 hrs) – using trail almost surely. [Marginal note: dried mud on carapace in lower parts.]
In general, no more indication of activity than in Nov sample – in fact no really new signs of trails, burrows or droppings. I think activity in this region even less now than then. Animals just passing through probably.
Region 3 – Not one animal seen all the way down even though looked carefully on both sides of trail all the way; comments on Region 2 apply here also; almost no fresh droppings in trail – only fresh ones were in upper part of the region and on into Region 2 and these very few in number. Also stopped and looked around in some of the openish areas just above and including Region 3-4 border – were a # of animals here in Nov. – none now and no fresh sign at all l- all trails and burrows old and droppings very dry and broken apart.
Region 4 – upper part – no animals – comments of mine on lower parts of Region 3 and 3-4 border apply to these openish areas also.

Pg. 154.
In vicinity of weather instrument open area – i.e. where trail passes through open just W of the now dry pond – many more animals and activity obvious – fresh trails and droppings.
#10 ♀ - only 20 m from where saw her on Dec 12 and 13.
New # 1194 ♀ maybe, but small animal and hard to say; no worn scutes, except some a bit smooth in very centers; No flaking disease, but all scutes very whitish all over -= another fungus, or drying – can't tell – does not look like other disease I am familiar with. W.g.i.'s almost non-existent – where present are interrupted and very, very thin.
CL 67.6; CW (CDRS) 69.6; CW (VD) 63.5.
#1058 – exactly where was on 12 Dec. 1969.
#1192 – near #1058 – moving w – just off of trail near weather instrument area.
#1074 ♂ - ditto to #1192.
Checked weather instruments 1130 hrs. – Rain 0.08 inches; emptied. Evaporation – reading 4.6 ml; Max 83.5 ºF; Min 65.5 ºF reset.
Continuing with animals in this area.
#217 ♀ - open rocky area of trail
#1195 – open rocky area of trail – just off of trail 10 m.

Pg. 155.
Photographs
Roll #32, Nov. 12, 1969
#'s 1-3 – pond and tortoises – Caseta Pond #1.
#'s 4-7 – semi-open guayavillo- Scalesia forest – Region 2 of Caseta – La Fe trail – middle and lower parts.
#8 – 12 – mostly closed guayavillo forest l- Region 3, Caseta – La Fe trail; #8-11 about ½ way down – 425 feet or so; #12 in lower part, about 335-345 feet.
#'s 13-14 – very lower part of Region 3 about 310 feet or so altitude when it blends into Region 4.
#'s 15-20 – Region 4.
#'s 21-22 – big boulder area – Region 5-6 border.

#'s 24-27 – Region 6
#'s 28-29 – Region 7 – (Zone 3 nesting area)
#'30 – 31 – attempted nesting of #127 ♀.
#'s 32-33 – fungi.
#34 – large ♂ #128.
#35 – open portion – upper end of Region 2.
36 – Caseta Pond #1 and tortoises in mud.

Pg. 156.
Region 5 – upper part just below Region 4-5 border
#713 – in open rocky area of forest – grazing.
#206 – about in middle of region = moving S right along trail.
Region 5-5 border –
#892 ♀ - in "big boulder" area, resting under some R. del Caballo shrubbery.
CL 91.8; CW (CDRS) 105.2; CW (VD) 97.0. Entirely smooth all over carapace – like so many large ♀♀ are; deep grooves between scutes, especially marginals – marginals and marginal – other scutes borders; no flaking disease. Can't tell if has been in mud – however, does have some dried crud on lower rear carapace but looks as if could be a lichen ? w.g.i.'s –can't detect any , even with scraping.
Wandered about in big boulder area some – not part of sample – nothing but very old dried dropping an a few old burrows. There is a large rocky area here covered by Clerodendron noble shrub of large size – will certainly be full of H20 (but shallow) if get some heavy rain. One tortoise - #1104, hard to sex, too small – about 60.0 CL range; very bright, wide, well – developed w.g.i.'s.

Pg. 157.
Also #907 ♂ - also has fairly clear medium thick, nicely developed w.g.i.'s. Sleeping in an open spot. This animal also not part of the sample CL 97.3; CW (CDRS) 100.2; CW (VD) 91.0. No flaking disease.
In general Region 5 appears about as it did in November 1969 in terms of tortoise activity.
Region 6 – central – lower part, near Nest #13
New #1196 ♀ prob. – but small and thus hard to tell. CL 63.3; CW (CDRS) 67.9; CW (VD) 62.5. No flaking disease no smooth scutes, but for size looks worn some –probably due to banging around on rocks in this area. W.g.i.'s present and clear and complete, but rather thin.
This region also appears in general as did in November 1969 in terms of tortoise activity.

Zone 3 Nesting Area weather data – 1330 hrs. – rainfall 0.0 inches; Evaporation 7.5 ml (reading this). Max 84 ºF; Min 64 ºF. (This high not from today because very cool so far and only 78 ºF now).
Poking around in Nesting Area for nest and ♀♀.
New – Found #1197 ♂ prob. – but too small to sex accurately; near nest #12, sleeping in shade of some herbs. No flaking disease, no smoothed scutes; w.g.i.'s' thick clear and complete. CL 55.1; CW (CDRS) 57.0; CW (VD) 52.0.

#1193, small one in another typical well-hidden burrow in a patch of loose dry red soil up under a low semi-prone Pisonia stem. Only 3 m from burrow where was on night of 13-14 Dec. 1969; still in area . . .

Pg. 158.
(openish) just N of nest #4, 12, 15 – This area is sort of a small adjunct of a nesting area to the main central part of Zone 3 NA.

Continuing sample a bit toward La Fe -
Region 7 – 1430 hrs. =- #1171 sitting in a burrow near nests #4, 12, 15 – in fact same exact one as used by #1151 on afternoon of 13 December and night of 13-14 Dec. 1969.
#223 - ♀ - in low area with open soil, almost to area where nest #5 is located; but a different low spot, however; one destroyed nest (pigs) in this area found when making trail to La Fe here in mid Oct 1969. She has moved a damn long way – all the way from Region 4 – Is she here to nest? Would seem very likely, however no obvious nest or diggings in surrounding immediate area. She does have some loose dry soil on rear bottom of carapace, but could be just from wallowing. No obvious mud on her anywhere. CL 81.8; CW (CDRS) 88.0.

Pg. 159.
Came back by #223 ♀ at 1615 hrs – she is now eating herbs and has moved only about 2 m. Doesn't look as if she will be digging tonight. But really hard to say, so will check for her and this area in the morning on my way to La Fe.
Combed overall the openish area with exposed soil, both low places in lava and or plain-like areas in lower parts of Region 7. There is simply no more sign of nest here other than the 3 which I previously found that have been destroyed by pigs and nest #5. It seems now that the small amount of nesting activity which occurs in this part of Region 7 must be over and done with for this year – in fact done with in early November if not even sooner.
Region 7 seems about as before, the one exception perhaps being that there are not any large ♀♀ of obvious nest – laying size in the zone 3 Central Nesting area part.

Back to Zone 3 for night.
Found #918 under a small Pisonia tree just 15 m S of nests # 3, 6, 7, 9, 14 – This animal certainly seems to have small home range- only about ½ - 1 acre right around these nests and including mostly fairly open flat herb covered ground – he does go into treed area to escape solar radiation however – but just into fringes of wooded areas.
Some comment to add to those of Dec 13 and 14 on activity of tortoises at this altitude.

Pg. 160.
The tortoises, at least these small ones of 60 cm CL approximately and less are very sensitive to solar radiation. It was entirely overcast, and mostly heavily so today. At about 1300 I found #1196 in the trail in region 6 in the open – the overcast was still heavy and had been all day till then. The proceeded to Zone 3 NA Central part. The cloud thinned a bit and got some more strong weak radiation from about 1315 or 1330 till 1430. Just at the end of this period I went looking for tortoises and found 3, #'s 1171, 1197, and 1193 – and all of them were in shade resting. It would seem then that only 1

hour (or less?)of weak solar radiation was enough to cause animals of this size class to seek shelter.
Then about 1500 hrs saw #'s 1197 and 1171 become active and leave shade - i.e. 30 minutes after heavy overcast began again. Did not check on #1193 again till 1620 but at that time found it had moved back to its old burrow site of 13-14 Dec. Thus between 1445 and 1620 must have become active, moved around awhile and then re-burrowed.

End of notebook.

Isla Santa Cruz Volume #6.
Field Notebook of Craig MacFarland

Pg. 1.

17 December 1969 – Continuing sample toward La Fe –
Region 7:
New #1198 ♂ prob. But very small and therefore hard to sex accurately. No f. disease; no smooth areas on scutes yet; w.g. i.'s incomplete, but well-developed where present. CL 55.5; CW(CDRS) 56.7; CW (VD) 50.0; Near Reg 7/8 border.

Region 8: no tortoise seen at all and virtually no sign except for a few scattered dry, mostly broken –up droppings. Area appears just about as in Nov. in terms of tortoises and vegetation condition.
Region 9: - In the area just below the upper raised plate lava area which is at the beginning (i.e. upper part) of Region 9.
#1162 – near a burrow – loose dry soil – sitting and resting – only 50 m from where marked in October!
New # 1199 – can't sex; too small and tail int. [?intermediate]; CL 61.7; CW (CDRS) 63.2; CW (VD) 57;.5; grazing in a plate-lava like area on small herbs and shrubs; w.g.i.'s clear but very very thin.

New #1200 - ♀ prob.; also no f. disease, no scutes worn smooth; eating cactus pad on plate lava area, not more than 14 m from #1199! W.g.i.'s very, very thin and incomplete. CL 62.2; CW (CDRS) 66.5; CW (VD) 61.0.
Pg. 2.
This area is of great interest because with the 2 new animals above, it makes a total of at least 6 animals of this size class which have been seen by me in this one small area- there is simply and clearly a concentration of 55-65 cm curved length beasties right in here. This is re-enforced by the almost complete absence of any animals near the trail through Region 8 and the few and scattered animals along the trail for the rest the way to La Fe.
Now, in addition this is the area with lots of exposed soil and 2 large dead ♀♀ which I commented upon in November sample notes. The 2 adults were both about 95-105 cm CL size class and 1 is definitely a female and the other almost surely was – both carapaces are very similar to #'s 131, 133, 127, etc. in characteristics. Can't tell age but not too old – probably killed by fishermen from the coast below within the past 5 years. The bones are not separated much in the carapaces and weathered only very slightly.
Pg. 3.
There is more exposed surface soil in this immediate area than any other part of the trail between the La Fe NA (Region 10) and the open soil areas of Region 7. There is of course not as much soil as in these latter 2 areas, but still quite a lot for this rocky desolate terrain. I poked around in these areas for about 1-1.5 hrs. this morning. Could find no nest. Most of soil is in low spots surrounded by lava piles- quite like area where nest #5 is located; but also are some small wedges and spots of soil up on plate lava areas – just little areas in between lava rocks – very much the same as the areas in which 2 of the nests in the lower – middle part of Region 7 were laid (both destroyed by pigs). The areas often only 30 x 30 cm or less.
The goats use the low areas extensively as dust wallows(?) and defecation – urination spots; so even if nest there might at times be hard to spot – but same is true for Zone 3 NA. Central part and can find nest there in spite of goats, so probably not a major obscuring factor.
Most of these open soil area in both type of locations are merely a few cm. Soil on top of hard lava and thus unfit for nesting. But about
Pg. 4.
. . . . 1 out of every 10 places I probed there was somewhat deeper soil – often 15 cm or more – as deep as I could push the machete in and further occasionally. Thus I think some nest possible here, though few in any one area of an acre and certainly very scattered – no concentrated nesting area potential at all. It is tempting to think that all these small tortoises were hatched around here, but then again they may be moving into this area from "pampas coloradas" below – or even from areas like zone 3 NA above. Simply can't say anything definite now, except that #1162 certainly hangs out in this area – saw here in mid Oct. and now again 2 months later – almost same exact location.

Went only about ½ way to La Fe today; i.e. to turn – simply can't do all this month because of time shortage. Will sample all the way in early January and since so for the rest of the trail has been much like the November sample, will use the #'s gotten in Jan. sample for the Dec. sample for
Pg. 5.
. . . . 2nd half of trail and La Fe nesting area. This is not too much of fudge and I really think tortoise distribution and veg. Moisture conditions from Zone 3 NA to La Fe are about same now as were in November sample period. In fact am certain of this.

Returned to Zone 3 NA and camp. – completed sample here – only one more tortoise – moving through fairly dense Pisonia forest 150 m east of central NA – moving very deliberately north an upwards.
#441 ♀; CL 89.7; CW 98.9; 90.5. Patches of substantial f. disease on rear 1/3 of carapace; scutes smooth only in central ¼-1/3 of them; w.g.i.'s clear and fairly thick. No mud on her, but reed soil ground into lower parts of carapace.

More on activities in Zone 3 NA
Between 1200 and 1300 when returned saw #'s 918, 10511, and 1193. Till now and probably till sunset has been a cool, overcast day - high has been 80° F, already passed. Interesting thing is that #'s 918 and 1051 out grazing; also saw #441 in this same period – she was moving actively. All 3 were in openish areas at least some of the time – but #1193 is in his daytime shelter – one where found him yesterday – well into shade – thus is this
Pg. 6.
. . . . a reflection of heat tolerance being less in small one or is it more a case of his behavior being more secretive and restricted to early morning and late evening hours?
1300 hrs. leaving Zone 3 NA; weather: rain 0.0 inches; Max (today's) – 80 ° F (yesterday's 79.0 ° F; Min (last night) – 66 ° F; Evaporimeter reading 10.3 ml, refilled full at this time.
*Note: took some photos of roll #54, pictures #1-9 of #1193 in and out of burrow site.
Left in misty garua getting soaking wet in short time. Did not sample on return but did note some animals.
In Region 6 about halfway between nest #13 and central part of Z3 NA saw a small animal (about 60-65 cm curved length) #1020, in trail moving about.
Then in Region 4 discovered something of great interest – at the area with big flat rocks found a concentration of
Pg. 7.
. . . . .10 tortoises all within a space of 20 meters in any direction. All were up on these large flat lava blocks avidly drinking water from potholes and cracks and low places in the large lava blocks where H20 has collected. There were slowly moving about from place to place drinking a bit then moving to another spot a few dm or m further on. This was at approximately 1500 hrs and it had been raining only since about 1230 –1300 hrs. – What is of main interest here is not simply that the utilize this interesting source of ephemeral water, but that the animals clearly know these rocks in this particular area and moved in on it very rapidly and in apparent response to the rain – no other explanation is possible for when sampling in this area on 12 Dec and on linear sample through here yesterday, there were only 3 animals at any one time within a very short distance of or at these rocks. Now there are suddenly 10 all in a small 60 x 60 foot area and all doing the same thing; in addition heard 1 more and saw 1 more moving toward this area.
So even when the pond in Reg. 4 is dry, these rocks may have a holding power which keeps the tortoise population high in this immediate area around Region 4.
Pg. 8.
Little holes and pockets worn into the lava which can collect and hold water are scattered all over the rail from lower Region 3 all the way to La Fe. What is different about this area is that it is a large area with lots of little holes rather than just on little or a few small collecting pockets. The animals were (got #'s and or checked 10 of them). #'s 1194, 1103, 709, 1034, 217, 1026, 206, 109, and 2 unmarked ones, one about 60-65 cm CL, the other about 70-75 cm curved length.
It is interesting to note that of these 10, saw only #217 in this area (rocks per se) yesterday, and lonely 3 of the 10 while sampling yesterday - #1194 was a short ways north of here, and #206 was quite a ways south in Region 5 and has thus moved back into this area since about 1200 hrs yesterday sometime. ;
While sampling in Region 4 on 12 Dec. and 14 Dec. saw only 2 of these animals.
Pg. 9.

Therefore it is clear that there are plenty of animals in Reg. 4 and that they moved to this area rather specifically in response to the rain I am certain. Took photos of this –
Roll 54, #10-20.
Weather data here at 1500 hrs. Rain 0.08 inches (emptied); Max 79° F; Min 68 ° F; Evaporimeter reading 6.8 ml. Refilled full.
1900 hrs. Caseta Weather: cool and overcast all day ; drizzled all afternoon till about 1630 hrs; now still overcast but not raining. Max 79° F; Min 67 ° F ; Rain 7.5 mm; Evap – 0.3 ml. (reading 15.1)l\
18 Dec. 1969. – to Zone 1 for Dec. sample.
#216 ♂ (painted #7K) – same area on trail , only 100 m below Caseta
#220 ♂ - just 50 more meters beyond #216 These 2 are undoubtedly much of the cause of the activity just to SE of Caseta and above C. pond #4 which I commented on in notes of 14 Dec. 1969.
#287 ♂ large; CL 120.7; CW 136.0; 127.0; About ½ way in between point where Caseta trail leave E-W running reserve border and the pond just 20 m off of the R. B. – i.e. A good ways from both this pond and Zone 1; where did he come from – can't really tell very much – has undoubtedly been in a small 5 m. long strip of the trail
Pg. 10.
. . . . for a day or two because has chewed all herbs down to the ground and several fresh droppings lying about. Most interesting thing is that he has clearly been in a fairly deep mud wallow recently because has fresh sticky mud caked onto upper surfaces of front and rear marginals – thus is there a pond near here? No f. disease on carapace except for a few small spots on front and rear marginals. Scutes worn smooth only in central ¼ - 1/5 of carapace scutes. Abundant green algae on rear ¼ of carapace – i.e. lower half of 4th vertebral scute and backwards and downward; same on front marginals – actually mostly in cracks between and borders of these scutes with first vertebral and first 2 costals (1 on each side, I mean). w.g.i.'s only very, very thin and incomplete; some read soil deep into carapace cracks on rear marginals and supracaudal scutes – thus from down below?
* Correction – misjudged my distances- he is only about 100 meters down the trail to the west of the pond right near the reserve border.
Pg. 11
Puzzling thing is that I can see no obvious trails leading to where he is either from either side of the trail to this spot or from either direction along the trail; but as one gets within 25 meters of the pond, find a number of trails coming onto reserve border from it and also going off to and coming in from forest to the south; thus I strongly suspect his muddy condition is due to this pond and he has simply been here for several days and his trail just obliterated due to rapidly grown vegetation and rain of past few days (very steady garua for past 4-5 days off and on). [Marginal note: But almost no mud in this pond now – certainly not enough for as large an animal to wallow; thus either small pond around here somewhere or is old mud re-wetted by recent rain.]
At pond beside reserve border - #357 ♂ heading into pond – CL 106.9; CW 116.5; 105.0; No f. disease; scutes smooth only in very centers of them; w.g.i.'s not present at all as far as I can detect. Lower portions of carapce4 have much red soil ground in – where from? Perhaps coming up from south to this pond. #268 ♀ - grazing at edge of pond; This pond about as when first examined in terms of tortoise activity – saw 3 maybe 2 or 3 more the area judging from very few trails and burrows in dense herb layers = plenty of burrow sign. Clear that animals are coming up to it from S and SE – can see many trails crossing R. B(?) in space of only 50 meters along this ponds S. side. Pond now dry and only one small muddy spot which could collect
Pg. 12.
. . . garua H20 now – about 1 x 2 m; rest of pond covered by a dense ½ - 1 m high growth of Heliotropium sp. Simply not abundant use by tortoises here – also no real sign they are going further north of this pond and if were in even small #'s would expect to see so in this area as it is a rather natural semi-open pathway. They are also not moving along R. border between here and Zone 1 = no trails or other sign along trail in between – are coming from S and SE, probably in part from Zone 1.
To Zone 1 –
#817 ♂ ; CL 109.6; CW 115.0; 105.5; Along my trail parallel and 200 m west of zone 1 pond #1. w.g.i.'s very fine and thin and incomplete but visible. No flaking disease; only very centers of scutes smooth – walking rather deliberately northwestwards on my trail through semi-open area of plant #1. Spots of same

green ala on rear 1/3 of carapace – same as seen in #287; Also some faint hint of read soil on rear marginals.
Pg. 13.
#114 ♂ prob. , but tail somewhat int. in length CL 97.4; CW 102.3; 95.0.
Covered with flaking disease all over rear 1/3 of carapace, all over front marginals and scattered small spots on rest of dorsal surface and sides. W.g.i.'s very thin, incomplete and faint. In fact most scutes do not have them in between. Something of great interest. – this stuff I have been calling green algae above is all over rear part of this beast also very often right on tope of flaking disease areas. There is no 1:1 correspondence of the white flaking areas and the algae (? - if that is what it is) but makes me wonder if this green stuff is not really a fungus which causes this flaking – it is really a deep green – black in color and is embedded in the low areas between growth ring especially; as has been noted before this is same place white stuff is worst and most animals (not all however) which have become smooth scuted don't have this flaking disease. Also the green alga seen at El Chato and Naranjo is certainly different than this – both in color (much brighter almost yellowish green there) and texture (feels like a somewhat slimy algal growth there; this tuff here looks dry and flaky a bit). Took photos – Roll 55 - #'s 5-9. But this green stuff is also growing where is no sign of f. d. – thus probably not connected.
This animal also on my trail, just SW of pond #1.
Pg. 14.
#200 ♂; in between ponds 1 and 2 in open herb covered area – mostly plant #1 grazing. Only a few spots of f. d. seen on front marginals, supracaudal and last 2 costals on each side; has same dull green – black alga on rear ¼ of carapace where is no f. d. and all over spots of f. d. on front marginals where they join first vertebral and first costals. Scutes smooth only in very centers; w.g.i.'s very spotty, thin, and incomplete. CL 120.5; CW 130.5; 120.5. Fresh mud and green Azolla on front and rear marginals. Probably from pond #2.
#822 ♂; just a bit further on toward pond #2; same area which must be a small pond when plenty of rain. Dry now (as was in Nov., in Oct only mud), covered with grass, Heliotropium, plant #5. No f. d.; green – black alga allover rear 1/3 of carapace and front marginals. W.g.i.'s not present mostly , where so are very thin and incomplete. CL 105.0; CW 116.5; 109.0. Some fresh mud on carapace.
#871 ♂; CL 125.4; CW 135.4; 127.0. Also in open plant #1 covered area-= in between pond #1 and 3; grazing . Only a few spots of f. d. on rear
Pg. 15
. . . . marginals; green blackish alga allover rear ¼ of carapace from lower part of 5th vertebral scute downwards and backwards; some of same on front marginals and a spot on front right first costal. W.g.i.'s present but very thin. Fresh but sticky drying mud on lower part of carapace.
#234 ♂; same area as last animal; CL 120.0; CW 130.0; 119.5. A few small spots of F. d. on marginals, front and rear; and central areas (smooth!) of vertebrals #2 and 3 with deep f. d. areas. Green – blackish alga all over rear ¼ of carapace and on front marginals, 1st vert. And over most of rest of scutes in low areas and in between virtually all scutes – i.e. seems to be in areas less exposed to abrasion. Fresh mud on carapace marginals. Can't detect any w.g.i.'s.
#1038 ♀ - at pond #3 on edge – probably drinking and has been wallowing. No f. disease; scutes smooth only in very centers; no detectable black –green alga! W.g.i.'s not detectable; has some well ground in red soil color on lower portions of carapace and scutes have lightish cast as if have been abraded some – thus probably up from down below. CL 83.1; CW(CDRS) 89.5; - of egg laying size?
#419 ♂; in small pool, drinking, near pond #3; can't get measure becaus3e in mud and water rather deeply.
Pg. 16.
New #1201 ♂ prob. – definitely a ♂!; but tail somewhat int. w.g.i.'s clear and well developed; no f.d. and scutes not smooth except for tiny spots in very centers. Abundant alga on rear ¼ of carapace from lower half of 4th vertebral and backwards. The algae on this animal is I think the same one have been seeing all day, but is more green and fresher looking than that seen on larger animals. [Marginal note: almost certainly the same]. Fresh mud on carapace; near pond #3, but in open plant #1 covered area. CL. 88.2; CW 92.5; 84.0.
#1023 ♀ - in another different small muddy pool near pond #3; eating herbs and wallowing. No. f. d. and scutes smooth only in very centers, but has lightened worn appearance and reddish soil cast of #1038.
[Marginal note: definitely a ♀, but why not all worn as #131, 133, 127 etc.?] In mud so can't measure

easily – CL 92.3. w.g.i.'s very thin and intermittent. *Note: has green alga of same kind from lower part of 4th vertebral and backwards.
Pg. 17.
#335 – I am still in same general open area near pond #3. CL 126.3; CW 136.5; 126.0. F. disease only on front marginals and adjacent scutes smooth only in central 1/3-1/2; w.g.i.'s present but thin, faint, and incomplete. Green –blackish alga in typical places all over rear ¼ of carapace and on front marginal and first vertebral – mostly not where is f. disease. Red soil ground in well all over marginals. Carapace lightish and looks more worn than similarly large ♂♂ without evidence of red soil Fresh mud and Azolla on carapace – marginals.
General comments on the ponds and the area:
Saw no animals at pond #1 itself, but the tortoises have clearly been wallowing all around its edges. Likewise none seen at pond #2, but are also clearly using it for drinking as can see several trails to its edge – not really fit for wallowing because all of it is surrounded by and the bed is made up of large rocks. Both of these pond and #3 still have plenty of standing H20 in them, even though all 3 have obviously gone down in level and are continuing to dry.
Pond #1's stake reads 35 cm deep now. In addition to these 3 large ponds, there are a whole bunch of smallish one (about size of those ponds in Zone 6, i.e. 10 x 10 m or less) to west of pond # 3 -- these are all scattered through the vast open fields of plant #1 which lie west of this large pond. Most of the ponds are open with some
Pg. 18.
. . . . manzanillos around the borders of some of them. Many are dry now with floors covered by herbs , but some have good quantities of soupy mud and even some have standing water also. All those with mud are now being heavily used by tortoises and the wallows in them are plentiful with many fresh tortoise tails leading to and from them. The whole zone 1 area is still lush and verdant, but is drying some still; certainly obvious that tortoise activity is greater here now than it was in early November – maybe twice as much I would guess from abundant trails, burrows, and droppings. The #'s of animals seen today also testifies to the increased activity – perhaps many of them are moving into this area from south and all around in order to obtain water. It is interesting that this area, except for the 3 large ponds is very much like zone 6, a yet not many tortoises or activity in the latter area – perhaps due to human disturbance farther one goes to east. [Marginal note: no evidence of tortoises moving north out of Zone 1 at all].
The small pond shaded heavily by manzanillos just at the beginning of the Zone 1 trail (i.e. near the reserve border) still has H20, green Azolla cover and does not seem to be used by tortoises yet.
Pg. 19.
In afternoon to the Caseta upper ponds:
#267 ♂ just entering open area behind Caseta – looks as if came down from above.
#720 ♂; in open area just below Caseta u. ponds; has fresh mud on carapace.
#76 or 96 (prob. The latter) ♂ ; just beside #720, perhaps some aggression? Spotty f.d. on rear ¼ of carapace and on front marginals and here and there elsewhere. Has this greenish –blackish algae all over rear ¼ of carapace in similar fashion to animals in Zone 1. w.g.i.'s only very thin and incomplete; scutes smooth only in central 1/3-1/4 of them. CL 120.0; CW 130.9; 120.5.; no mud on carapace.
#450 ♀ - same general area as previous 2 animals; no mud on carapace. No algae.
#852 ♀ - same area; no mud on carapace; algae in typical locations, rear ¼ of carapace.
#712 ♂ - same area; no f. d. ; front marginals and rear 1/5 of carapace with green – blackish algae in typical places and growth pattern. Scutes smooth only in very centers; w.g.i.'s complete and clear, but thin and fine. No mud on carapace. CL 102.8; CW 112.2.; 104.0.
1067 ♂ - in easternmost dry pond, eating tall grass – stretching neck and real way up – quite humorous to observe! Fresh mud on shell; no algae.
#308 ♂- at pond #2 , mud on shell, but up on grass eating at edge. Spots of flaking disease scattered at various points around lower parts of shell, but not bad. Has algae (green-black)
Pg. 20.
In typical locations on rear ¼ of carapace; no really smooth scutes areas; w.g.i.'s in complete and mostly absent. CL 113.3; CW 121.7; 112.0.
#258 ♂ - in mud wallow in pond #2.

#598 ♂ - on eastern side of pond 2 in a herb covered open area grazing; w.g.i.'s thin but visible; central area of scutes only smoothed; mud on carapace; blackish-green algae in a few spots on rear 1/3 of carapace. CL 80.0; CW 86.9; 80.0.

#505 ♂ no mud on shell; on Devine eastern cut; just east of open area below Caseta upper ponds. Has the green –blackish alga all over rear ¼ of carapace in typical fashion and a bit of it on front marginals. Activity here about same as in mid – late November now – perhaps just a bit more. Plenty of trails, droppings, wallows, burrows. Went up toward Guerrero's and found fresh trail of one tortoise along this human trail – however soon turned off – no evidence of tortoises any higher on this trail than in November.

Pg. 21.

The ponds here are continuing to dry. #2 has become just a bunch of isolated mud wallows and potholes full of standing water – about ½ of the former water covered area is now verdant green grass up to 2l-4 dm high and is being grazed by tortoises. The area is being used heavily for watering and wallowing. Pond #3 has a small 3 x ½ m pothole of H20 now due to rains of past 2 weeks; however the rest of it is covered by Heliotropium, grass, and other herbs and is thus "dry" ground. Tortoises are also using this small water hole for drinking and wallowing. Rest of ponds in this area, as in Nov. and even Oct. are dry.

Greatest things of note in the Caseta upper pond area and open area just below it is lack of use (almost total)_ in late Aug – end of Sept. this year – then in Oct. animals began to come into the area and use has been fairly heavy all through November up to and including now.; other thing is its use as a springboard area to move onto Devine's middle cut and thence northward to much higher altitude.

Also note that the herbaceous vegetation all through this area is continuing to grow profusely and is at least wait high and taller everywhere now in the area. Probably a combination of garua of late and continually warming temperatures. –

Pg. 22.

Finally more comments on ponds in general:

1. Large ponds in all places have been drying continually since began study in late August and probably were so before that – probably every since heavy March rains filled them.
2. Smaller the pond and more shallow, the sooner in general that they become dry – of douse relative east – west position and altitude affects this. E.g. compare Zone 6 and Zone 1 with El Chato area.
3. Of these smaller ponds, open one dry up much sooner than shaded ones – in fact small ones shaded by manzanillo groves still have water and Azolla almost wherever they occur even if relatively shallow.
4. Small ponds with rocky bottoms and sides (relatively speaking_) and that get heavy continued use as wallows can and are collecting garua water and thus r3emaining a bit muddy – even soupy and some even with standing H20; others seem to rapidly be overgrown with herbs as dry out – once this has

Pg. 23.

Occurred even garua H20 will not collect in them - apparently plants suck it up rapidly.

For examples, Caseta pond #4 has been dry since just after began study in early Sept – Late August period – at first had a bit of mud and H20 o9ccasionally due to garua, but herbs soon took over and it is now dry withy a luxuriant growth of herbs on top; yet right around ti are several small 1 x ½ m potholes which alternate from sticky mud or even dryness to sloppy soupy mud and even standing H20 off and on all the past 3 months – just depends on garua amounts.

Caseta upper pond #3 belongs in this latter class – it was dry on Dec. 1, but now has a bit of standing H20 and enough mud for 1 to 2 animals at a time to wallow in it.

1900 hours – Caseta weather. Rain 0.0 mm.; Evap. 1.3 ml, (reading 16.4 ml): Max 81.5 ° F; Min 70.0 ° F; clear for last 2 hours before sunset – cloudy rest of day and cool.

19 December 1969 - To El Chato to sample –

#48 ?♂- notches in 2, 4, 7 scutes of units- if any of these are natural it is the 4, but even it looks cut on one side. Anyway, w.g.i.'s present but very thin and intermittent; spots of flaking disease all over front marginals, rear 1/3 of carapace and scattered elsewhere; scutes smooth in central ¼-1/3 of their area. No algae.

Pg. 24.

CL 137.2; CW 149.0; 137.0; ½ way between first hill and Camote patch – mora between Caseta and El Chato on reserve border. *Correction: there are faint spots of green –blackish algae along scute borders of rear ¼ of carapace.

#167 ♂; just a little bit further west than last animal – 50 meters. Haven't seen him since early Sept along reserve border. CL 150.2; CW 152.4; 141

Has both kinds of algae –

1. The bright greenish –yellow kind; a heavy concentration on lower half of 4th vertebral – i.e. area protected from abrasion; then scattered lines of it extending out from here in low areas along borders of scutes – radiates along these border in all directions from 4th vertebral.
2. blackish green kind along scute borders, especially it appears where flaking disease occurs, all over rear ¼ of carapace – Also 1 and perhaps 2 lichen species. Collected some of 1 lichen and both algae. Scutes smooth. Flaking disease scattered all over, but especially concentrated along border of scutes on rear ¼ of carapace.

Pg. 25.

. . . and front marginals and adjacent areas. Took photos of algae, fungi, and snail on shell before removing: roll 55, photos #14-17.

#73 ♂ - 150 m east of Camote patch -

#354 ♂ - 100 m east of Camote patch - off of trail 15 m; eating Camote leaves.

#97 ♂ and #98 ♂ - Camote patch.

#515 ♂; could be #415 but doubt it, looks cut at one time.

About 200 m further east than last sightings of animals from Chato area- just at foot of first hill when going east toward Caseta along reserve border from El Chato. Scutes smooth in central ½ - ¾'s of area; extremely worn and lightened at even in growth ring areas - whitish to pinkish color (soil from below?). Scattered flaking disease all over rear ¼ of carapace and all around sides of shell and front - cover parts of costals and all of marginals involved. W.g.i.'s extremely thin where present, mostly absent. Some scattered blackish green algae along scutes borders on rear ¼ of carapace. CL 112.2; CW 117.5; 105.0

#303 ♂ at pond next to R. border near El Chato turn off; CL 133.4; CW 143.5; 131.0. Scutes smooth in central 1/3 - ½; scattered f.d. on rear ¼ of carapace, front marginal areas, and here and there elsewhere. Blackish green algae especially along scute junctures on rear ¼ of carapace; w.g.i.'s present but very thin.

Pg. 26.

Comments on mora area of reserve border: tortoises from Caseta side have not progressed any further westward and those from Chato only a short distance (see # 525 ♂ below) more eastward - in fact only evidence of this one animal beyond area where general pop had stopped in November (and what I saw Dec. 1 was same as in Nov.)

Animals seem to be using areas off of border proper more and more - this is very evident in area from above Caseta to Camote patch - I think #'s of animals about same as before in reality, but harder to see because most are off of border by anywhere from 15 to 50 m. and the vegetation, especially Passiflora and grasses has grown tremendously in last 3 weeks - now knee to waist high all along this area- So use is about same, maybe even a bit more - but fewer animals are sticking right to the reserve border itself.

Chato- Region 1 (guayavillo forest above) Saw no animals but 3 very fresh (today!) trails, all of different sizes and with fresh droppings. Otherwise use seems down from in November = mostly just passing through here as head north it appears - 2 of trails

Pg. 27.

I saw today going rather abruptly upward and not eastward.

At pond #1 and immediate vicinity -

#212 ♂

#1361 - noted blackish green algae all over rear ¼ of carapace.

#68 ♂ - blackish - green algae on lower part of carapace in rear.

#101 - blackish - green algae on lower part of carapace in rear. And also on front marginals and generally whole back of ¼ carapace.

#318 ♂ - blackish - green algae all over rear ¼ in typical fashion.

New # 1202 ♀ prob. But small and hard to tell. CL 72.9; CW 77.5; 71.0; w.g.i.'s present but thin; scutes not worn smooth anywhere; no f.d.; blackish - green algae on rear 1/5 of shell, especially along scute junctures.

#281 ♂; blackish green algae all over rear ¼ of carapace and front marginal areas - especially where f.d. is worst - this animal has a good dose of the latter.
Between ponds 1 and 2.
#142 ♂ at a small mud hole - has a very bad case of f. d. all over; on rear 1/3 of shell is completely covered with blackish - green algae - same all over front marginals - am sure we photographed this beast in November - when did not have algae - only f.d.! Took photos of algae - Roll 55, #'s 18-22
Pond #2 area - #79 - has f. d. all over - blackish - green algae on rear 1/3 of carapace, on top of white f. d. areas.
Pg. 28.
New #1203 ♀; CL 70.1; CW 73.3; 66.5; no f.d.; no algae; scutes smooth only in very centers; w.g.i.'s clear but thin - mostly complete.
#201 ♀; CL 90.1; CW 102.4; 93.0; scutes smooth in central ½ - ¾'s of their area; flaking disease scattered all over, but very heavy on rear ¼ and front marginals area; very much like #142 - blackish - green algae all over on top of f.d. areas - especially heavy on areas from lower half of 4th vert. Band backwards and down ward.; w.g.i.'s present but thin.
#1066 ♀; CL 68.3; CW 72.5; 65.0; scutes smooth only in very centers but with whitish abraded look all over; w.g.i.'s clear and well developed. B. green algae on lover rear of carapace but not much ; no f. d.
#612 - bit of b.-green algae on rear marginals on top of f. d. areas.
#63 ♂ CL 127.1; CW 137.9; 128.5; well developed w.g.i.'s; central ½ - ¾'s scutes smooth; f d. and b - g algae in regular places front and rear.
#192 ♂ - g. - black algae on rear ¼ in association with f d. ; but not on front marginals where is f. d. also.
#608 ♂; CL 101.2; CW 110.8; 100.0; Only centers of scutes smooth, but can see are becoming very worn elsewhere; w.g.i.'s clear and well developed.
Pg. 29.
. . . . f. d. scattered, but heavy in front marginals and rear ¼ of carapace. Blackish green algae on rear ¼ also but in places where no f. d. as well as more with it. And vice versa; algae especially prominent along scute junctures.
710; ♀ prob. (almost sure but tail a bit long.) CL 96.6; CW 106.9; 96.5; Scutes smooth only in centers; only very light f. d. on rear marginals, nowhere else; b - green algae scattered all over rear 1/3 of shell in normal fashion, but not where f. d. is! W.g.i.'s clear, but very thin and intermittent.
#168 ♂ - b.- g. algae and f. d. scattered on rear ¼ and front marginal area; not always in association.
#616 ♀; CL 92.5; CW 107.7; 98.0. Central 1/3 - ¾'s of scutes smooth; only a few spots of f. d. on rear of carapace; b- green algae likewise on rear, but only along scutes junctures - very little of it in total; w.g.i.'s clear and complete but rather thin.
New #1204 ♀; CL 107.7; CW 121.5; 107.0; Typical smooth scuted type like #'s 121, 133, 129 etc. Deep groove between rear scutes especially. No f. d.; b - green algae between scutes - actually right in grooves of rear of carapace - especially along borers of marginals. Very muddy and can't tell about w.g.i.'s.
#1186, b.-green algae on rear 1/5 of carapace some with f. d.; some without and vice versa.
Near pond #3-4 and surrounding area.
#204 ♂ - small bits of b. green algae around scutes junctures at rear of carapace and on front marginals - not 1:1 with f. d.
Pg. 30.
#147 ♀; CL 97.3; CW 105.4; 96.5; Carapace in same condition as #142 in terms of f.d. and b.-green algae. Scutes worn only in central ¼ - ½ of their area; carapace with white-pinkish otherwise well abraded; w.g.i.'s intermittent but well developed where occur.
#60 ♂; CL 102.9; CW 110.0; 100.5; Almost no f.d., just a few spots on rear of shell; b.green algae on rear 1/3 of shell, especially along scutes junctures; scutes worn smooth only in central ¼ or less; but carapace well abraded and with pale white-pink coloration. W.g.i.'s very, very thin and incomplete.
#326 ♂; CL 144.5; CW 155.5; 144.0. b. green algae and f.d. only spotty, in typical locations front and rear of carapace- not always associate - mostly not ! Scutes all smooth- w.g.i.'s clear and well - developed in places, completely absent in others. Has a big gouge in front left 1st costal - has collected dirt and a couple of herb seedlings all growing in the hole ! Photos #23-25, roll 55.
New #1205 ♂; CL 73.5; CW 75.2; 69.5. No f. d., algae; scutes smooth only in very centers; w.g.i.'s' visible but very, very thin.
Pg. 31.

#339 ♂ - bad f. d. on front marginals and rear 1/3 of shell; thee areas well covered now by blackish - green algae - very close correspondence!
#10 ♂ - bad f.d. on front marginals and adjacent scutes, all over top of carapace in sots and on rear ¼ - as with #339 ♂ blackish green algae in all these same places in close correspondence. Took photos - Roll 55, #26-29.
#130 ♂ - f. d. not too bad at all, but with b.-green algae in assoc with some of it - typical locations.
#151 - no f. d. ; very little b.-green algae on rear end; very well developed thick w.g.i.'s
#711 ♀; CL 82.5; CW 89.8; 82.0. At turn off area toward zone 5, just beyond pond's 3 and 4. Only a few minor spots of f. d. on rear and front of carapace; no f.d. elsewhere; no b-green algae. W.g.i.'s virtually wholly absent. Moving northeast rather determinedly. Scutes smooth only in very centers.
** #376 ♀; note - <u>This is a different animal than the #376 ♂ near the Caseta.</u> CL 97.8; CW 103.5; 94.0. Scutes smooth only in very central areas - up to ½ of the area, but quite variable. Only a few spots of f. d. on rear of shell - only minor. B -green algae on rear of shell especially along scutes junctures-= mostly on marginals. W.g.i.'s variable, but clear and fairly well developed.
Note: identifying mark - has a big gouge out of 7 scute in thousands area - i.e. her left rear 4th marginal.
Pg. 32.
Open area on S. side of Chato just after turn toward Zone 5.
#774 ♀; CL 96.5; CW 106.7; 97.0; w.g.i.'s clear but thin; complete only a few scattered spots of minor f. d. on carapace - no clearly detectable b.-green algae; scutes smooth only in very centers.
New #1206 ♀; CL 76.7; CW 83.1; 76.5. no f. d., algae; only very centers of scutes smooth; moving northward when encountered; w.g.i.'s non-existent.
#1046 ♂; bad f. d. all over rear 1/3 of carapace, front marginals area and scattered on dorsal surface; also heave b- green algae all over rear 1/3 and front marginal area but not elsewhere! Not 1:1 although quite good correspondence.
#194 ♂; CL 138.2; CW 152.5; 143.0; f.d. and b- green algae as in #1046 ♂ almost exactly; w.g.i.'s intermittent, but most complete and thick ! Scutes smooth in central 1/3-3/4's of their area.
#105 ♂; CL 131.0; CW 141.8; 131.0. F. d. very bad all over, but virtually no b-green algae at all!; Very oblong shape!
Pg. 33.
#11 ♂; f. d. bad and b. green dist. As in #1046 and 194. Also has a nice patch of bright yellow -green algae on lower ½ of 4th vertebral scutes in non-abraded area; also some on back edges of 2nd and 3rd vertebral scutes where protected by raise humps of centers of scutes which lie in front of algae covered areas.
New #1207 ♂; CL 140.0; CW 152.5; 140.0; F. d. and b- green algae as in #1046 ♂; scutes all smooth; w.g.i.'s very thin and incomplete.
#14 ♂; few spots of f. d. here and there, especially in centers of completely smooth vertebrals; also blackish-green algae on rear of carapace, especially along scute junctures, but not in association with f. d. !
#229 ♂; CL 152.2; CW 153.0; 143.0; all scutes smooth; few spots of f. d. here and there on rear 1/3 of carapace and front marginals; b-green algae in similar places, but much of it not where f.d. is, especially algae along scutes junctures. Bright green algae in sunken in protected areas of last costal on each side, but not on vertebrals - interestingly enough this one is shaped such that rear areas of vertebrals 2, 3,4 are not well protected from abrasion and no algae! Of bright green type. W. g. i.'s clear but thin in places = in others well developed.
#1157 ♀ prob.; no f. d., algae; only very centers of scutes smooth; very thick, complete well-developed w.g.i.'s; CL 69.5; CW 75.2; 69.0.
Pg. 34.
#780 ♂; CL 145.0; CW 152.5; 141.0; Scutes all smooth; scattered f. d. and b.-green algae in typical locations, but not always together; w.g.i.'s clear and reasonably well developed.
#296 ♂; f. d. in spots all over back ¼ and all around bottom of carapace on marginals; b. green algae more or less same distribution but not 1:1. The latter especially along scute junctures but also other places. Bright green alga on protected areas of 4th vertebral (lower ½) and last 2 costals (indentations on sides). Also 2 lichen species on lower half of 4th vertebral.
New #1208 ♀; CL 74.5; CW 81.7; 73.0; Bad flaking disease all over this animal except for very top of carapace - sort of a ring of it all over costals, marginals, 1st and last vertebrals and supracaudal. But has blackish = green algae only on lower ½ of back 1/3 of carapace ! clearly not closely correlated.
This completes sample of El Chato area covering same parts as covered Regions 1 and 2 of Chato-
Pg. 35.

. . . . Cerro Gallina trail; will complete to nesting area below Cerrito tomorrow or day after.
Also saw #563 ♀ in Region 1 while leaving for Caseta - could thus include it in sample perhaps ?
Conditions at El Chato: As mentioned in November and on Dec. 1 weather check, ponds are all basically dry, even little ones well shaded by manzanillos; all have been so since early November and only ones with H20 in Oct. were small shaded ones and some standing H20 and soupy mud in others such as #'s 3 and 4; big ones all dry even then. Pond near reserve border - El Chato turn off also still dry. However rain of past 2 weeks has created some mud in smaller potholes and in shaded ponds - virtually no standing H20 but tortoise now using all these for wallows and can drink a little soon after heavy garua by drinking in foot impressions or by pushing snouts in mud. This is very recent - even these mud potholes were dry on Dec. 1, 1969.
Vegetation is even more lush here than in November - grass is very high - 2-6 dm almost everywhere.
Weather at El Chato - 1130 hrs. Rain 1.20 inches (=30.48 mm) emptied; Evap 23.3 ml - refilled;
1900 hrs - Weather at Caseta. - Rain 0.2 mm; Evap 1.0 ml (reading 17.4 ml); Max 80° F; Min 65.6 ° F; mostly cloudy today, some sun.
Pg. 36.
20 Dec. 1969 - To area above El Chato and Naranjo - i.e. near Lechoso mtn to check on northward Galapagos movements.
En route - #609 at El Chato turn - off on reserve border - grazing ; no f.d. or algae.
New #1209 ♀ prob. But tail a bit intermediate.; no f. d., but b-green algae on rear 1/4 ; scutes smooth only in centers; w.g.i.'s clear and medium in thickness. CL 89.9; CW 98.5; 90.0. Just 75 m southeast of big open areas - near IFRAC marker 21.
#601 ♂; CL 99.0; CW 106.5; 95.0; In open area - where found #1045 in mid November. Bad f. d. all over near 1/3, front marginal area and scattered elsewhere; b..-green algae on top of f. d. on some of rear, but most of f. d. with no algae. W.g.i.'s thick and clear in places, thinner in others, but well developed.
#920 ♂; CL 97.5; CW 109.5; 100.0. F. d. on front and rear marginals; B. g. algae all over rear 1/3 of shell; scutes smooth only in centers; w.g.i.'s thin and incomplete. Past area where trail running to ENE from Naranjo hits N. P. border - about 200 m east of the area of concentration
Pg. 37.
. . . . of tortoises (of November sample) just eat of Lechoso mtn. Near IFRAC marker #32.
At area of concentration of November - will explore here more - but first comments to this point.
1. area of Reserve border from El Chato to N.P. border turnoff to North west - IFRAC M 18-19 area - Scattered tortoise sign as in November all along - trails both to and from south and to and from N and NE. Only two really fresh with less than 1 week old droppings. Activity minimal here and have not been using border itself.
2. From turn mention above to area of concentration near marker m 32. Again scattered tortoise sign all along and trails to S and N both going and coming; more activity than segment discussed under (1) above and a bit more evidence of tortoises (trails, burrows, droppings) than in Nov. but not greatly increased. Saw #'s 1209, 601 along this stretch. [Marginal note: Much more use of the border itself than in Nov.] Activity evidence especially great in open mora area where #1045 was in Nov. - near IFRAC #21.
3. Went off to south to area along hunter's trail where was concentration of animals in Nov. - this it trail coming up from W - SW from Naranjo - no tortoises seen, most of sign at least 2 weeks old - probably mostly dating from when here in mid - Nov. ; saw one very fresh turd of a large animal in area but couldn't find him. [Marginal note: near IFRAC marker #23]
Went and scouted just to north of N.P. border directly above this area, but
Pg. 38.
. . . . could find no definite sign that beasts moved north from here- are plenty of areas of semi-open forest with Passiflora around here so some probably just spread out. Also, probably some to north (there are occasional tails and I did see one more from area of concentration to N.P. border in Nov. in period of only a few days) but in very scattered fashion. Almost certainly generally moving north - lots of droppings on border just off of it to north (not here in Nov.!).
Now to the present area near marker #34 - not many animals and most sign (i.e. drying and disintegrating turds, old trails) at least 2 weeks + old; looks as if have moved from here mostly. So I scouted ½ km to south - sign there even older and less abundant - plenty of open and semi -open areas of herbs there same as to north - in fact is a rather nice, 5-10° slope most of way to south = abundant fresh donkey shit and trails and scratching areas of soil But tortoises do not seem to have moved south or north through here recently -

sign is prob. From mid Nov. and before when I think they were coming up from Chato - Naranjo area - if so, I simply saw some of them near N.P.
Pg. 39.
. . . . border near marker #32 in mid - Nov. I think have probably done 1 of 2 and probably both of the following: 1. scattered out laterally some into open and semi-open forest and 2. moved to north - am going to north now to check for these things.
#1187 ♂ - in semi - open Xanthoxylum forest about at same altitude I went to on November trip - max altitude I examined in other words, i.e. has not moved north since mid - November.
New #1210 ♀; CL 76.3; CW 81.5; 73.0; same general areas as 1187. A few very small minor spots of f. d. on front and rear marginal scutes; b. - green algae on rear ¼ of carapace but almost dried up totally; scutes smooth only in centers; w.g.i.'s. 's thin and incomplete, but quite visible.
#207 ♂; on R. B., same general area as previous 2 (tortoises) marker #32. CL 102.5; CW 108.1; 98.0; w.g.i.'s very nice and clear, medium thickness.
#1188 - up toward Caballa - parallel with Lechoso on its east side - Highest seen - alt approx. 160-170 feet above M32 IFRAC post on trail (N. P. border)
#607 ♀ - same general areas as #1188; CL 99.0; CW 109.7; 102.0. W. g. i.'s in complete, but medium thickness where occur - mostly present. F. d. all over, worst on f. marginal area and back ¼ of carapace. Scutes smooth in central 1/5 - ¼ of their area; b- green algae only on rear areas, more or less correlated with f. d.
Pg. 40.
New #1211 ♂; CL 108.7; CW 113.0; 105.0; about 40 feet in alt and 100 m below in distance from #'s 1188 and 607 ; very clear well-developed w.g.i.'s . F. d. on front and rear marginal areas and scattered elsewhere - b.-green algae rather general on rear ¼ of carapace but very dry.
Scutes smooth only in centers but quite abraded in general - whitish cast because of this.
What is notable here is that theses animals are both more spread out and higher up in altitude now than they were in November =- also in general as I ascended the freshness of the sign, where it rarely did occur as clear tortoise trails, droppings, and burrows was greater. (Actually I made a loop, going almost to foot of Caballa and then back down, getting lost in a mora area for 1 hour in between - Christ!)
Highest definite clear sign I saw was in same area where #1188 was - and he himself is a clear example of an animal which has moved upward since mid - November - an unequivocal demonstration [marginal note: upward movement only about 150 -160 feet in altitude in total.]
In general, animals have gone higher here and are probably highest up ones except for a few like #143 who seems to be a more or less permanent fixture at Salasaca southern ponds. Clearly then, upward trend is continuing at least till
Pg. 41.
. . . . now - occurring in Nov. and Dec. -= will see what occurs when and if heavy rains come !
On return:
#860 in open area where #601 was this a.m. = grazing on edge of it. Very near here on November 14, 1969.
#1040 ♀; just on down border a bit from big open area - very near where #1209 was this a.m. Extremely bad and profuse f. d. all over rear 1/3, front marginals and adjacent areas, and all around lower costals and marginal; some b.g. algae on rear but mostly dry and most absent from flaking disease areas. W.g.i.'s present and visible but very thin. Scutes smooth only in centers. CL 80.6; CW 88.9; 80.0.
Summary of conditions: vegetation abut as in mid - November sampling - perhaps a bit direr, but not much if so at all - equally as lush and in general a bit taller than then. Animals could probably go all the way to colonized zone if need be, because although there are patches of mora all over above Xanthoxylum forest (i.e. on east and northwest sides of Lechoso and all around southern half of Caballa), those are only patches and are intermixed with patches of Xanthoxylum trees and open areas of Passiflora and other herbs. They simply do not seem to have gotten above an approximate altitude of 1180 - 1190 yet - highest can find clear sign of rough location of #1188.
Pg. 42.
While I was doing this today J. San Miguel sampled in Naranjo area, Zone 4 area, and along reserve border toward Naranjo from N.P. border intersect to west - he found the following:
1. In Naranjo central area - #750
2. In Zone 4 pampas area: #'s 580, 757, 743, 394, and one unmarked smallish animal.

Yesterday he sampled from beginning of Region 3 of Chato - Cerro Gallina trail to N.W. corner of Cerrito nesting area for me. Failed to take #'s and certainly did not spend adequate time searching in Zone 5 and none searching in N. A. below Cerrito -but found the following:
Region 3 - lower rockier part nearer to Zone 5 - 1 male; 1 female.
Region 4 (= Zone 5) - 2 males and 2 females at pond near our campsite (= pond #1).
Region 5 - none
Region 6 - 1 smallish one.
Region 7 - none.
Have not yet decided whether I will have time before January to cover this area again. Tomorrow want to check area to Northeast of El Chato toward
Pg. 43.
. . . . .Mirador and Devine's central cut.
San Miguel also took rain gauge data at Naranjo 1.25 inches, but failed to empty it -
1900 hrs. - Caseta weather - Off and on sun all afternoon - cloudy most of morning, but no rain. Rain - 0.0 mm; Evap - 1.5 ml (reading 18.9); Max 83 ° F; Min 67 ° F;
21 December 1969 - to area above El Chato. At pond near R. border and El Chato turn-off.
#483 ♂; CL 126.0; CW 137.6; 125.5; Scutes smooth in central ½-3/4's; w.g.i.'s clear, complete and medium thickness. F. d. slight on rear ¼ and on front marginals; no clear evidence of algae.
#513 ♂ - in open area - 100 m. above pond toward Mirador; CL 129.0; CW 137.7; 127.5; Central ¾'s + of scutes smooth; w.g.i.'s clear, but rather thin mostly; f. d. all over rear ¼, front marginal area, and scattered along scute margins all over shell; some b-green algae on rear ¼, but mostly dried up.
#303 ♂ - is about 250 -300 m in distance above pond, where was on morning of 19 Dec. 1969 - resting in shade- followed his long fresh winding path up through open Passiflora areas.
In big flatish open are which is at least ½ km above pond - to west of trail by several 100 meters. - where found 4 animals in Nov. sample [marginal note: saw #'s 154, 101, 82, 209 here in Nov.]: #287 ♂ (some question about 100's numbers - is a clear mark in 2nd normal scutes, but there is a very small extra scutes jammed in [marginal note: should be #487]
Pg. 44.
. . . . between 1st normal one and supracaudal - and it looks as if may have been cut - but probably not - it is so misshapen that cut appearance is probably part of the deformity - but could be -- thus for hundreds 2, 4, or 5 l- will call it 2 for now.
Medium large ♂; burrowed in, in shade so can't measure well.
#209 ♂ - also burrowed into shade.
#211 ♂ - same area, also in shade; CL 130.5; CW 147.0; 134.0; w.g.i.'s very clear and thick and complete. Scattered but minor f. d. on rear ½ of shell - scattered but mostly dry g. - green algae in same areas - not 1:1 relationship. Scutes smooth in central 1/3 - 2/3's.
[marginal note: + one more small animal - saw fresh trail here but didn't follow to it.]
Continued up toward north of this area towards base of Mirador - looks as if tortoises in this area now also - majority are in areas covered below but are some fairly fresh but very scattered trails as high up as I could go before mora stopped me - i.e. base of Mirador only ½ km or less away - about as high as I went in Nov. sample - Then cut over toward human trail
Pg. 45.
. . . . which goes up between Mirador and Los Hermanos - at same altitude as when saw highest animals last time (November - mid) found plenty of fresh sign and saw 2 tortoises in shade Couldn't get measures except CL for one. #177 ♂ - medium sized - about 110 - 115 CL I would guess.
#189 ♂ - large CL 135.5 [Marginal note: saw #'s 205 and 94 (4 or 7) here in Nov.
There is abundant fresh sign all around these animals and old sign from Nov. in some adjacent open Passiflora areas. Also at least 1 more animal in same small open patch of Passiflora where these 2 are because found very fresh trail and turds even though didn't see the tortoise - frail indicates of medium size or ♀ size scale.
As in November, it is obvious that animals are coming north from El Chato (and northeast) , mainly sticking to open and semi-open Passiflora and other herbs - grasses, Commelina, etc.) covered areas - this is especially noticeable when following their winding trails (they scrupulously avoid forest and dense shade when possible) and it is obvious today - by 1030 all in shade, but in shade under trees bordering right on the edge of the open herb covered areas - can see trails where was active in open this morning, then

moved to shade by late morning (sun has been out since sunrise!). Will now follow trail to north to see if they have gone any higher
Pg. 46.
. . . . since November sampling.
Discovered fairly fresh sign of Galápagos a number of sites where either was no sign in November sample or where was not nearly as much and was old. Most of this sign was, I could estimate made within the past week and that at the highest point was no more than 1-3 days old. Saw no tortoises, but clearly here and this fresh sign at highest point was just NW and slightly above Los Hermanos mountains. This altitude is about 1100 feet and this is about 809 feet above where were definitely at highest in mid-November - in fact at that time thought sign in area 80 feet below was 2-3 weeks old. "Also, there is much more sign in this latter areas now and it is not more than 1-2 weeks old. So are some few animals anyway right at base of Los Hermanos, to their western side and slightly above them - now !; altitude range of 1020 - 1100 feet. However, even though is more and higher up activity in this region now than in November, majority of animals still between El Chato turn off and an altitude of 930 - 940- feet - i.e. where #'s 189 and 177 were seen - much more sign in these Passiflora areas to this
Pg. 47.
. . . . altitude than in areas above. But in sum, nothing like concentration around El Chato up here - fewer animals and more scattered - but still quite a few in total am sure.
Then went on up to Morenos and over to Devines and down his central manga.
Tortoises not any higher on his land in maximum alt. Which had obtained by late November - but many more up at level of banana patch - approx. altitude of 910-950 feet where there is a lot of activity now - along central manga and in open area (with much grass and other herbs and some scattered mora) between eastern and central manga. Saw 4 animals by top of eastern manga at about 910 feet and 4 in between this area and top (at first fence - eastwest running fence) of central manga - Took 2 numbers of the latter 4 - #'s 44 ♂ (med.-large) and #1072 ♂. Plenty of trails, burrows, and fresh droppings all through this area. Then came on down central manga - all sign till about halfway between reserve border and top of manga at first fence is old - clearly from 3-4 weeks ago period when saw tortoises in this area. Then between 1/3 and ½ way up more fresh sign - saw two - #'s 692, 782. Then old sign again till just beside Caseta upper ponds - then saw brand new trails of 1 medium and 1 large
Pg. 48.
.. . . animal, but failed to locate tortoises - looks as if went off toward ponds.
So it almost looks as if may be moving up onto Devine's land somewhat in waves - 1 wave of 2-3 weeks ago, and a second on way up now. Also may be using his eastern manga to go up but J. San Miguel ascended there 4 days ago and saw no tortoises much above Caseta upper ponds.
Also they have clearly moved fairly extensively here and there out into mora from central manga - especially toward low area bout ½ way up which Devine says fills with H209 in very rainy spring season - is now full of mora - so could be moving north of his first fence simply by passing through extensive mora, but I think most have ascended by way of central manga. Devine's posa in the maternidad near his house still has H20. Anyway overall picture from Devine's, to NE and ENE above El Chato toward Los Hermanos, and N of Chato and Naranjo toward Lechoso and Caulla is that tortoises are continuing to move slowly northward.
Pg. 49.
. . . . but not in huge #'s - many obviously content to sit tight in other areas, but with H20 (e.g. Caseta pond #1, Zone 1, Zone 6) and without the same (El Chato).
J. San Miguel checked weather instruments in Zone 3 N. area and Region 4 of Caseta - La Fe Trail today - Region 4 - 0800 hrs; Rainfall 0.015 inches; Evap 11.0 ml.; Max 84° F; Min 64 ° F.
Zone 3 N.A. - 0900 hrs; Rain - 0.05 inches; Evap 13.0 m.; Max 84 ° F; Min 64° F. He refilled evaps. Full, emptied rain gauges, and reset thermometers.
1900 hrs. - Caseta weather - Max 85 ° F; Min 67.5 ° F; Rain 0.0 mm; Evap 3.5 ml (reading 3.5) Clear and sunny all day long; clear now and bright moonlight - perhaps clear tomorrow -

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22 Dec. 1969
Going to CDRS- zone 6 weather to sample enroute.
#220 ♂ - very near small mud hole (just mud now, no standing H20); very near Caseta pond #4.
Pg. 50.

#10 (painted #) very close to #220 - did not see, but Julio San Miguel saw here on 20 Dec. and can see where went down trail 20 m from pond #4 and then headed directly off to SW toward Caseta pond #1 through the forest of Scalesia.
#268 ♀ - 200 m west (on reserve border) of pond near R 3, east of Zone #1; clearly came straight down border all the way; just now turning north northeast and heading up into Guayavillo - Scalesia forest. - prob back to pond area ??
#287 ♂ - came to exact area where he was on 18 Dec. - a clear trail to north in NNE direction - to pond area ??
#392 ♂ (maybe 372 but probably not) - about 250 m east of same pond discussed above - clearly came up onto R. B. from south directly - very fresh trail there indicating did so.
Zone 6 - will use clear fresh trails as well as actual animals for a count!
Saw 3 trails (fresh and with droppings) on way in to pond area - 1 nearly to R. Border - 50 m. south ; 1 about ½ way to pond #1; 1 about 100m from pond #1 (to north)
Pg. 51.
#847 ♂ at pond #1 - just climbed out of mud and is grazing.
1 ♀ (unmarked) near weather instruments (i.e. near pond #2) - approx 70.0 cm curved length.
1 - fresh sign of a medium size one (♂ scale) at pond #1.
Ponds 3 and 4 - sign of at least 3 of different sizes - fresh - have been wallowing - found 2 of them.
#238 ♀; 1 unmarked ♀, approx 75 cm curved - length
1 sign of one between pond 1-2 area and pond 3-4 area -
So a total of at least 10 animals- certainly many more in the zone 6 area because did not search more than immediately around ponds and weather instrument area and along trail - thus clearly much more activity here now than in Nov. sample and even more fresh trails and droppings and many mud wallows than on Dec. 2, 1969 visit. Activity not as great as Zone 1, abut certainly increased. Using all ponds, especially 3 and 4 for mud wallows - all ponds mostly mud and only a bit of standing H20 in each - very soupy mud. Many small dry, low, shallow ponds all through the area.
Pg. 52.
Took weather: 1030; meter stick dry; Rain 0.96 inches, emptied; Evap 33.8 ml; refilled full.
3 January 1970
Returning to Caseta for January sample.
Stopped at Zone 6 and took weather data:
1330 hrs - Rainfall 1.83 inches, emptied; Evaporation 22.4 ml, refilled full; Meter stick in pond #2 - 7 cm.
Obviously has been raining extensively for the past 12 days (i.e. sometime during) - pond was only mud except for a small bit of water under some Clerodendron molle in one part of the pond on Dec. 22, 1969.
Some notes on tortoise distribution - The first time clear sign east of Zone 6 turnoff on reserve border - clear, fresh trails, droppings and an occasional burrow on from about 0.7 km to within about 150 meters of Zone 6 turnoff. No sign in this last 150 meters, but then scattered
Pg. 53.
.. . . . sign between Zone 6 and Zone 1 turn offs, and from Zone 1 turnoff to Caseta.
Trails east of Zone 6 turnoff all came up onto reserve border from south - signs indicated perhaps 2 or 3 animals - they apparently worked mostly along reserve border - only 1 clear trail went off to north of reserve border - animals probably still right in this area although I did not see them.
Sign from Zone 1 turn off to Caseta very scattered and mostly near pond along R. B. just west of Zone 1. However #268 ♀ has moved further toward Caseta than have seen any animal so far - she is at point where trail leaves reserve border and heads northwest toward Caseta - i.e. about 0.8 km beyond area where last seen. Appears to have been moving along reserve e border virtually all the way from pond mentioned above. After #268 no more sign till within about 100 m of Caseta Pond #4 where trails and droppings again in abundance.
In general, this all indicates animals moving up north onto and across reserve border from south - certainly more on R. B. area between Caseta and Zone 1 and area east of Zone 6 than before this time during any samples.
Pg. 54.
Also concerning rainfall and pond conditions, noted following around Caseta:
Pond #4 is dry, but small holes around it have a great amount of standing water in them. Ponds 2 and 3 have some standing H20, a bit more now in fact than in Dec. 20-22 period when last examined. Pond #1 now at 25 cm. - about same as when last saw at end of 3rd week in December - but many of small peripheral

areas which were only soupy mud holes or even sticky drying mud then, are now rather full of standing H20 - but overall pond is not any deeper or more extensive in total area - but also not reduced at all. And Heliotropium has grown up rapidly and is now 2-3 dm to 1.5 m high all over areas which were grassy areas where tortoises grazed through last half of November and all of December till I went to CDRS - has grown up very rapidly in last 2 weeks. [Marginal note: Caseta weather - 1900 hrs: Max 85.0; Min 71.0; Rain 12.0 mm; Evap 14.7 ml since Dec. 30 at 0700]
4 January 1970. While showing Akira Uchi Yama
Pg. 55.
. . . . areas to photograph around the Caseta today saw following interesting things:
#11 (painted) on trail between Caseta and Caseta pond #4.
12 animals in mud and water wallows at C. pond #1 at 1600 (one actually came to pond and wallowed at 1700, all other 11 were already in when we arrived). 8 unpainted and painted #'s 1, 2, 10, 15. Only got #'s for 2 of un painted ones - #127 ♀ (all way from zone 3 NA) and #1168; will check others tomorrow.
Caseta weather - 1900 hrs. Max 78.0; Min 70.0; Rain 11.0 mm; Evaporation - reading 14.2, thus gained 0.5 ml since yesterday due to heavy rain. Cloudy and rainy all day.
5 Jan. 1970. 1500 - am going to check around Pond 1 and Caseta to see if many new animals or much movement-
At Caseta in yard - #'s 31 ♂; 3 ♀; 267 ♂; 408.
Just below Caseta on trail near small pond #117.
At Pond #1 and vicinity: #15 (painted); #2 (painted); #1168; #97 ♂ (from Mora area of R. B. - not here yesterday / Camote patch!) - in pond!
Pg. 56.
#127 ♀ grazing on N. side of pond.
#135 ♀ - med - large size; S. side of pond grazing ; fresh mud all over shell.
#526 ♂ - S. side grazing ; saw here yesterday but failed to record information.
#628 ♀ - large, smooth shelled - S. side grazing ; mud on shell is fresh.
#10 and #1 (Painted) - S. side, grazing.
1 unmarked medium sized (ca 80.0 CL) ♀ in drainage area on SW side, 40 m from pond.
All preceding animals have fresh mud and have clearly been in pond very recently.
#62 ♀ - but small - CL 69.0; CW (CDRS) 76.1; # must be wrong; no other cuts or signs of them and those present are not very fresh, but are clear and not worn much ! Same exact area as unmarked ♀ mentioned above. No mud on carapace.
#1022 ♂ - medium - small ; way out about 100 m on SW drainage; no fresh mud on carapace only a few spots of drying mud present.
Pg. 57.
#717 ♀, medium sized; on west side of pond near small water and mud filled hole, grazing on plant #1. 40 m. west of pond. Saw animal here yesterday of this size - probably same one.
#13 painted - same area as 717 - this is incidentally same area where first marked during 3rd week of November 1969.
The above can account for only 8 of the 12 seen in pond (wallowing) last evening - so at least 4 more animals around here somewhere.
Caseta weather 1900 hrs: Max 78.0 ° F; Min 71.0 ° F; Rain 8.1 mm; Evap reading 13.9 thus gained 0.3 ml. Since yesterday at this time. Cloudy and rainy all day.
6 January 1970. To Chato for weather data and sample through mora area of reserve border (and hopefully up to Devine's)
#354 at Caseta trail - R. B. intersect - just below here.
#277 - 100 m west of forest edge on R. B.
#627 - in Devines most western cut - up it about 40 m from R. B.
'#450 - on R. B. half way between first hill top and Camote patch (? Rt turn area?)
#73 - 40 m off of R. B. (to north) - just 100 m before rt. Turn.
#98 - at rt. Turn.
Pg. 58.
No more tortoises till near Chato turn off - but scattered sign all the way from Camote patch to there - does not look as if moving along R. B. anymore than had done so by 3rd week of December - but , instead seem to be coming onto R. B. here and there from south - no more than 3-5 animals in all I would estimate.
Near Chato turn off:

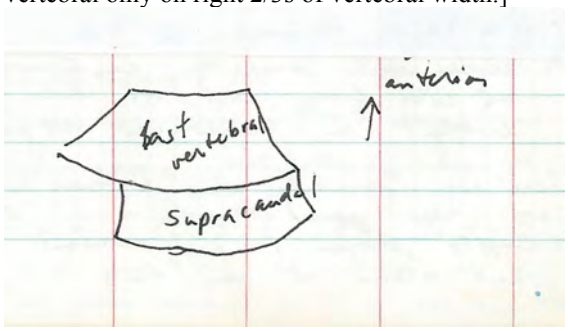
#172 ♂, #320 ♀, #316 ♀ all near small pond there - it now has some pools of H20 - first time since July 1969.
#632 ♂; #609 ♂ - near turn off proper.
Weather at Chato - 1130 hrs: Rain 2.17 inches, emptied; Evaporation 27.1 ml; refilled full. Conditions at Chato largely appear same as in 34d week of December - grass even higher, many tortoises; small potholes of H20 in most pond due to rain. These little hole with standing H20 are very often tortoise wallow holes which have filled up with water. Tortoises obviously wallowing in these areas now that moist again.
Pg. 59.
To Devine's by central manga - #258 ♂ - near spot where tortoises come onto manga from C. upper ponds.
#827 ♀ - 50 m further up manga - near where first seen. CL 84.5; CW (CDRS) 92.0; CW(VD) 86.0.
Only scattered, old (2-3 weeks +) sign till almost to first fence just below bananas. Then:
#695 ♂ just 40 m below fence - eating bean plants - looks as if has been here awhile from # of paths and open areas. Altimeter says 980 feet - may have to be corrected.
Continued all way on up to Devine's house along this manga - above #695 not even any recent or old sign. Tortoises appear thus to be avoiding this area I think, perhaps because of cattle - because have been this high since late November, but in 3rd week of Dec. not here - but over slightly to east where not as short a grass and as heavy a traffic of cows.
Will stay at Devine's tonight and then sample back to Caseta tomorrow.
7 January 1970. Bud and Steve Devine say that have not seen any tortoises any higher than those areas discussed in my notes of 21 Dec. 1969. I re examined the area just east of the central manga where #'s 1072, #44, and 2 others were on 21 December and saw a fresh
Pg. 60.
. . . . trail but did not see any tortoises - cows have been using this area heavily recently and thus may have caused tortoises to move eastward somewhat. Tortoises are certainly not higher than this 910-950 foot stretch of altitude because no sign above.
Over to east of this area saw several animals in altitude range of 910-960 feet - and less cattle activity here, but cows not absent and have been in the area. Area mostly mora except for several N-S and E-W running 10 m wide swaths cut for cattle and covered with herbs and grasses. Tortoises in these swaths mostly, especially where there is Commelina nudiflora. Whole area is very open, but herbs and mora full enough to provide shade when needed. Tortoises do work out into mora covered areas somewhat also.
#115 ♂, about 110 cm CL
#123 ♀, about 79 cm CL - both half way in between central and eastern manga at alt of about 910 feet - i.e. not far above most southern E-W running fence line.
Pg. 61.
In this area followed a cut out cleaned area covered with herbs up to about 980-1000 feet but could see no tortoise sign this high - highest animals in the area apparently the 2 above.
Then moved over to eastern border of Devine's land. Again in a cut out area covered with Pangola grass found the following:
#1072 ♂ at about 950 feet al. (did cattle drive him to east since saw on Dec. 21 1969?)
#214 ♂ - about 108 cm. CL just a bit lower than #1072 - same general area.
In this area of southeastern corner of Devine's fences - i.e. where his eastern most new manga starts downward toward reserve border (alt about 900 ft or so) saw many recently extensively used areas where tortoise had been grazing on Commelina and other herbs. This is same area where were 4 animals on 21 Dec. 1969 and I think they have simply stayed in the area. They have certainly not gone any higher because was no sign about #1072 and I went up to about 1000 ft alt. Above him.
Pg. 62.
Then came on down the eastern manga toward C. upper ponds:
Saw 3 tortoises en route -
#428 ♂ at about 810 ft. altitude - about 100 cm CL would guess. Actually about 35 m east of manga in an open area of grass and Commelina in middle of predominantly mora covered area; trails indicated got here from manga itself but extensive use (100 sq. m or more of flattened down and eaten over areas) indicates probably here for about 2-3 weeks.
#368 ♀ - about 100 cm CL - not far below #482, on manga itself - also a lot of grazed area around her - probably has been manga for a couple of weeks.

#403 ♂ - about 200 m up on manga above C. upper ponds - clear trail indicates has been moving along the manga for about 100 m or so within last few days from below - appears to have come onto manga from out of mora to west - i.e. on western edge of manga. As on the central manga, there
Pg. 63.
. . . . is abundant sign here and there all along the eastern one from the Caseta upper ponds to the E-W running fence of Devine's at 900 - 960 ft at; showing that the tortoise have been moving northward. The sign on the eastern one, however is fresher than on the central one - however except for those areas here I actually saw tortoises today, the sign is at least 2 weeks old I would guess. It is difficult to really guess it sage because there has been such abundant rain and plant growth for the past 3 weeks. However, it seems clear that the tortoises first used the central manga to move northwards in the first half of November, then more recently, probably first 3 weeks of December started up eastern one - its seems most probable that the tortoises up on Devine's land above his lowest fence area a mixture of animals which basically came up from the Caseta upper pond are utilizing these 3 manga. They could of course have move dup most or all of the way through the mora field between these 2 areas (pond and Devin's pasture) but no evidence clear for this - in fact appears that (they ? - word unclear) move
Pg. 64.
Through mora some, but only make loops out through it from the manga and then back again to the manga - however, ultimately the main traffic flow now is along the mangas I think. Yet the Devines say they have had tortoises up at the level of their house in previous years before the mangas were cut so if this is true (??), they must have moved through what was primarily mora all the way from the Caseta areas.
Secondly, it is of interest that tortoises do not seem to have gone any higher between Dec. 21, 1969 and now - possibly due to abundant rain and cool temperature (which are apparently unusual for last half of Dec. and early January according to Devines - that is , rain is often heavy, but also get many warm days often - so far till this date, most of Dec. and all of January have been overcast.
Pg. 65.
. . . . and rainy quite often.
Caseta - 1900 hrs - weather - Appeared to be mostly cloudy all day yesterday at Caseta but rain only spottily in morning before 0900 and a bit in late afternoon.
Today cloudy all day but rain only from 1200 -1400. Max 81.5; Min 71.0; Evap 2.0 ml (reading 15.9); Rainfall 3.7 mm.
8 January 1970. - sampling in Caseta area - around Caseta and tent: #'s 3, 31, 712, 267. In open areas just below C. upper ponds: #'s 852, 720, 354. Conditions in this open area as in 3rd week of Dec. - bit wetter and plants continuing to grow higher. Not much tortoise activity in comparison to Oct and Nov. '69. Probably not many more than the 3 animals seen.
At ponds: #598 in pond #2.; #782 near pond #2 - grazing on plant #1.
On Devines' eastern cut just directly east of upper ponds - #57 ♂ CL 125.8; CW (CDRS) 131.5; CW (VD) 122.0. Followed him up from eastern most dry pond bed - fresh trail from today - so had been in pond area. No f. d., b - green algae on rear 1/5 of carapace; w.g.i.'s thin and fine and intermittent. Scutes smooth only in centers.
Pg. 66.
Went up trail toward J. Guerrero's several hundred meters but no tortoise sign - as noted so many times before and in general, tortoises seem to definitely avoid forested areas in preference for open ground covered by herbs. See end of days notes for general comments on the upper ponds area and Devine's land and tortoises distribution.
To Caseta pond #1 and area in between it and Caseta.
#819 ♀ only 20 m below Caseta coming up trail! She is one with odd extra scutes on carapace and was on Devine's central manga when last seen in November - thus has moved down noticeably trail coming up to north obvious to about 75 m along trail.
#1184 =- moving directly northward at a deliberate pace - 5 m off of trail, and about 100 m above pond - i.e. heading toward Caseta; no mud on carapace. [Marginal note: one gave number III in late August and Sept.]
#862 ♀ (#5 painted) - on trail, only 20 m south of #1184. fresh mud on shell; moving toward pond.
#135 ♀; off of trail about 25 m heading north - trail coming up from pond area obvious - from today. Only 75 m N- NE of pond. Fresh mud on shell.
Pg. 67.
#421 ♂ - N. side of pond - feeding in open areas, 40 m N. of pond. Fresh mud on shell.

#1022 ♂ - at edge of pond in open eating grasses and herbs.'
#1138 - in pond drinking H20; CL 92.3; CW (CDRS) 100.0; CW (VD) 90.0. Almost no f.d. - just a few minor spots scattered on carapace; b. - green algae on rear ¼ of carapace, especially along scute junctures.
#754 ♀ (#9 painted) - near pond on N. side grazing.
#715 ♀ - at pond grazing on edge - W. side.
#835 ♀ - at pond grazing on edge - W. side.
#699 ♂ - at pond grazing on edge - SW. side; CL 94.5; CW (CDRS) 99.2; CW (VD) 91.0; (painted #16).
#220 ♂ - at pond grazing on W. side near above 3 animals.
West of pond in area of small pond surrounded by manzanillos:
#1168 - grazing on plant #1; then to water hole
#1135 - grazing on plant #1 CL 66.2; CW (CDRS) 69.4; CW (VD) 63.0; check against previous 1135.
#806 ♂ (prob.) - CL 87.2; CW (CDRS) 91.4; CW (VD) 85.0. NO f.d. or algae; scutes smooth only in centers. No mud on shell; w.g.i.'s visible but thin and intermittent.
Pg. 68.
SW of pond in general drainage area - 75 -100 m from pond :
#475 ♀; CL 74.7; CW (CDRS) 79.8; CW (VD) 73.5.; no f. d. or algae; scutes worn smooth only in very centers. W.g.i.'s visible but thin and intermittent.
#1013 ♀ - coming up trail from south toward pond - about 75 m from it still - no mud on shell.
#127 ♀; #526 ♂; #445 ♀ (#1 painted); #1070 ♀ (#10 painted) - all on S. side of pond with 10 -20 m of it grazing in open and semi-open areas. All have fresh mud on shells.
#1006 ♀ (painted #15) - on trail half way between Caseta and pond.
Then checked around small pond not far below Caseta just off of trail - no tortoises , but some recent trails and wallowing signs. Then from here worked up drainage through open and semi-open areas toward forest edge - mora junction. No more recent sign than that seen in Dec. ' 69 (3rd week of). Saw no tortoise till way up near mora - alt. About same as Caseta and just west of Caseta and tent area.
Pg. 69.
#1025 ♀ (prob) CL 76.0; CW (CDRS) 81.4; CW (VD) 75.0. w.g.i.'s clear and complete; no f.d.; b - green algae on rear 1/5 of carapace. Scutes worn only in very centers.
Sign of at least 3 more animals in this same area - recent.
But in all, not many animals here. There are a number of small water holes along the drainage from the Caseta level all way down toward pond #1 - these mostly now have some standing H20 and tortoises are using for drinking and wallowing. Trail to them all obvious. However some ponds have heavy herb cover and are dry or have only a little mud.
One pond with H20 is only 25-30 m west of our tent and I am certain from fresh trails and their locations this morning that #'s 3 and 31 are using this water hole pretty regularly and thus not having to go down to pond #1. Overall, the area has tortoises about in same density as present situation of Caseta upper ponds. More animals around Pond #1 proper than either of these other two areas.
General impressions of tortoise distribution now in these areas: largely same as in December - tortoises mostly at altitude of Caseta and C. pond #1, some up on Devin's land, but not many. Obviously many around that pond, probably in response to H20 - even more down there now than in November and December samples when they
Pg. 70.
. . . .were concentrating in the area. Except for some animals which have obviously come up from lower altitudes (e.g. #127, 1168, 1164) not much movement in these areas - mostly same tortoises in the area as have been here for past 1-2.5 months. Main question is where animals that were in Caseta upper pond area in November have gone - some are obviously now up on Devin's lower pastures or in between ponds and that point; others are back down (e.g. #819) near Caseta and I suspect rest are just spaced out more in the C. upper pond area altitude, mostly probably because of the increased rain of the past month.
Some observations by J. San Miguel -
1. Toward end of December Mrs. Segundo Herrera mentioned to him seeing a tortoise only 200 m below their house which she thinks came up their manga which as been cut down to within 25-30 m of the reserve border. Will check this out later. This would put this tortoise up very high =- at least as high as highest ones near Mirador and Los Hermanos and probably higher.
Pg. 71.

2. Sr. Manjares reports to Julio a tortoise near southern Salasca ponds - #143 ♂? - when ? - late December '69 (3rd week); his house is just above Salasca ponds - to east a short ways.
3. He says he saw 12 tortoise or more on morning of 28 Dec. ' 69 at pond #1 in Zone 1.
4. He saw a tortoise copulation in the Zone 5 area around 17-18 Dec. 1969. The same day he saw a pair doing same at El Chato! Today while working on notes I heard a male tortoise groaning rhythmically near our tent and upon investigation found male #31 mounted on ♀ #3 (0900-0930 hrs) He may have actually been successfully copulation with her at first but I disturbed him slightly upon approaching and then left immediately. The noise soon started again and when I returned he was rhythmically thrusting and groaning with each thrust but was mounted almost sideways on here and finally actually sideways after she moved a bit - certainly not successful ! - but he continued thrusting and groaning even then. So vocalization is no sign of intromission and successful copulation !! I was not able to time thrusts or groans and did not see any
Pg. 72.
. . . . of courtship behavior. However, the ♀ was all drawn up into shell and not doing anything to help the situation, she was entirely passive and a real frigid bitch about it all ' perhaps she was not ready for copulation ' the whole scene made me doubt that the male was successful even before I disturbed him. This and Julio's observations make 4 attempted copulations since beginning the study. But this is certainly not the real "breeding season" yet because often see many ♀♀ and ♂♂ of breeding size grazing in same areas now (El Chato, C. pond #1K) with no signs of either aggression or courtship.
Caseta weather: 1900 hrs; Max 86.0; Min 71.5; Rain 7.5 mm; Evap 0.5 ml; reading 16.4. Evaporimeter refilled full at 1900. Sun out for about 2 hours total in late afternoon -= off and on - rest of day cloudy, but rain only in night and till about 10 a.m. off and on.
Pg. 73.
9 January 1969 (actually 1970).
Did nothing today but write and read. 1900 Caseta Weather: rained all day long off and on - no sun at all and heavy clouds all the time. Max 75.5; Min 69.5; Rainfall 7.5 mm; Evap 0.0 mm; reading 0.0.
10 Jan. 1969 (actually 1970). Sampling to La Fe.
Region 1 : #31 ♂ near Caseta
#3 ♀ ; 25 m down trail from Caseta
Region 2/1 border around pond- on SE side.
#1022 ♀; # 715 ♀
Region 2 - #97 ♂; about in idle - alt must be about 520 ft.; about 1/3 - ½ km below pond; has been moving along trail a lot.
No more tortoises seen but some very fresh trails. = at least 2 or maybe 3 more tortoises. 2 trails close together (probably same animal) along and crossing my trail several times - near first big open plant #1 covered area.
1 other trail - at very lowest and last plant #1 covered area - virtually Region 2/3 border.
Region 3 - no animals seen at all! Conditions as in December sample exactly, with no more definite fresh sign than then. However, did see 2 possible fresh trails, one in upper guayavillo forest
Pg. 74.
. . . . past and one in central transition, steep slope part. Both may be fresh but found no droppings and hard to tell because herb not a lush cover - could be several to many weeks old and just appear fresh due to recent rainfall.
Region 4 - none seen in upper part just above weather instrument area - again, conditions and tortoise sign as in December sample.
Weather data - Region 4 - 1200 hrs. Rainfall 1.65 inches; emptied ; Evaporation - dry as expected; refilled full. Will have to estimate. Max 87.5 ° F; Min 65.5 °F. Obviously many tortoises here; will take #'s of some around weather instruments. Not in sample, but just in case miss on Monday the 12th.
#1058 ♀; #713 ♀; no pond mud on shells.
#109 ♀ - I think I have seen this animal before, but is very small to have this #; CL 70.2; CW 71.5; 66.0. Scutes smooth only in centers; must be a marking error. Fresh soupy mud on shell; pond prob. Therefore has H20.
#452 ♀; CL 91.1; CW 96.9; 90.0. Scutes smooth only in centers; no f.d. but for a few spots of green algae; w.g.i.'s very, very thin
Pg. 75.
. . . . and mostly absent. No mud on shell.

Back to sample - Region 4 - passing through
New #1213 ♀; CL 72.5; CW (CDRS) 76.0; CW (VD) 69.0. Scutes smooth only in centers; no f.d. or algae; some dry mud and Azolla on shell ! No visible w.g.i.'s. 15-20 m east of trail toward W. instruments.
#351 ♀ (painted #14) - near trail, moving northward in main part of Region 4 - all way down here from Caseta pond #1!
Region 5 - Nothing really changed since Dec. sample - lots of trails used burrows, but can not really tell how recent; no fresh turds.
At Region 5/6 border - big boulder area - 2 tortoises just beside trail -
#128 ♂ - very large = first one have noticed at these lower altitudes with b - green algae- has it all over f. disease areas and along scute junctures on rear ¼ of carapace and front marginals area, but not as heavy a coating of it as ♂ of his very large size around Caseta, Chato, Zone 1 etc. (i.e. at higher altitudes).
New #1214 ♀ maybe - rather small to sex; CL 57.5; CW (CDRS) 60.4; CW (VD) 53.0. Only scattered, few minor spots of f.d.; no algae; w.g.i.'s very thin and intermittent Scutes not smooth anywhere yet; red color from soil at lower altitudes evident on carapace all over.
There are obviously more tortoises here as I can hear some thuds l- thus stop sample proper for a moment and will see what others I can find.
Pg. 76.
New #1215 ♀; CL 67.9; CW (CDRS) 73.1; CW (VD) 66.0. Shell characteristics identical to #1214 except w.g.i.'s a bit more visible and complete, and no f.d. at all except on underside of rear marginals.
#1151 - shell characteristics as on #1215 but not even f.d. on underside; has been "wallowing " in sticky mud here created by rain - very dryish mud - like about consistency of a sticky bread dough. CL 61.4; CW (CDRS) 63.5; CW (VD) 58.0.
New # 1216 ♀, maybe but too small to sex. CL 57.2; CW (CDRS) 61.3; CW (VD) 57.0. Shell characters like #1151, but shell abraded more, with scutes having pale pinkish - whitish areas caused by abrasion.
Note - shell anomaly - supracaudal scutes is deformed so that most posterior point is not in midline but to animal's right side. [Sketch shows supracaudal that is narrower than last vertebral and bordering the vertebral only on right 2/3s of vertebral width.]



Pg. 77.
As a result has 11 marginals on left side and only 10 on right side. Looked around this area for a total of 35 l- 40 minutes. Certainly not an area of as heavy a concentration of tortoises as Region 4 but never the less I think this is certainly a secondary area of potential tortoise concentration in these altitudes. As described in December sample notes, there is a rather extensive, shallow, low area where water will collect in enough rain falls. It is surrounded and mostly covered by Clerodendron molle and still dry now however. Also, there are lots of boulders in the area and some of them have small pockets which can hold bits of water for short periods during and after rains, but not as extensive as the flat rock area of Region 4 at all.
One indication of tortoise activity here is that besides the animals seen, there are a lot of small dirt filled pits (which were wallows during the heavy rains of Feb. Mar. 1969 I('m almost certain)) which tortoises have clearly been using for the past week or 2 in attempts to wallow - saw about 10 -15 of them today and all have only sticky dough-like surface mud in them now, but all have been freshly utilized by tortoises. The 3 small animals found all showed signs of having been in these pits very recently - mud all over lower portions.
Pg. 78.
Region 6 - not any real change since Dec. sample - see notes further on. Above nest R - 3 area saw some fresh sign - wallow and scraping spots and a few droppings - but never saw any tortoises here - maybe 1 or 2 medium sized ones I would guess (♂ scale).

Then near nest #13 - east about 15 m. off of trail and only 30 - 40 m apart. #653 ♂ - quite large - prob. Biggest have seen this low. CL 124.9; CW (CDRS) 134.5; CW (VD) 127.0; very clear, wide w.g.i.'s; bad f.d. all over rear ¼ of hell and front marginal area; b - green algae in same areas and even spread more widely on rear ¼ - in non - abraded areas like below middle of 4th vertebral and on down and along scute junctures. But f.d. really bad on all rear marginals, and little or no b.g. algae over much of same area. #437 ♂; CL 96.0; CW (CDRS) 102.1; CW (VD) 94.0. w.g.i.'s thin, poor, and intermittent; no f.d., but b-green algae on rear ¼ of shell and front marginals; especially along scutes junctures where less abraded.
Pg. 79.
It is of interest that have seen 2 large, quite large in fact, males in lower altitudes today and one medium-large sized one also. Usually do not see so many - chance or movements of a general type taking place?
1600 - Zone 3 N.A. weather - Max 86.5 ° F; Min 65.5 ° F; Rain 0.865 inches; Evap. Dry as expected; will have to estimate.
11 Jan 1970 - Continuing sample to La Fe.
Zone 3 N. A. proper part of Region 7 -
#1020 - near camp; failed to get sex or measurements.
#1144 too small to sex- off of trail 10 m., near camp area - between nests 3, 6, 7 etc. and 12, 15, 4 - about ½ way. CL 58.4; CW (CDRS) 64.0; CW (VD) 58.0.
#1051 ♀, 1196 ♀ (maybe) - maybe a male I think - #1055 ♂ probably, but small to sex. CL 56.3; CW (CDRS) 61.1; CW (VD) 56.0. ---- all 3 of these within about 20 m of each other on and near area of flat rocks; prob for small pockets of H20.
Region 7 cont. - 40 m south of zone 3 NA proper -

#10 ♀ - same one that saw in Reg. 4 in Dec. am almost sure; will take measures to check - CL 89.9; CW 103.0; 95.0. Interesting thing is that now looks as if 7 notch may have been originally cut in 10's and units place - i.e. should be #87.
Pg. 80.
Will check file at station before remarking because if there were cuts can hardly tell it now.
New #1217 ♀; CL 61.5; CW (CDRS) 65.1; CW (VD) 59.0. About another 300-400 m on down the trail; no f.d.; no obvious algae, but rear ¼ of carapace is discolored darkly and may be dried up b - green type, can't tell really. W.g.i.'s very sparse and very thin - intermittent and poorly developed. In middle of trail.
#1198 - same general area as in Dec. but about 200 m closer to Zone 3 NA in direction; still in area of many red soil patches in Region 7 and 7/8 border; i.e. lower part of Region 7.
Region 8; no tortoises and almost no sign; a repeat of Dec. sampling conditions.
Region 9: several tortoises in that area - where always see some;
#1199 - same area as where marked in December.
#245 ♀; same as from Region 4 ? CL 78.8; CW(CDRS) 86.8; CW (VD) 80.0. No f.d., no algae, w.g.i.'s almost non - existent. Scutes hardly worn at all.
Pg. 81.
New #1218 ♀; CL 86.7; CW (CDRS) 90.5; CW (VD) 83.5. No f.d. or algae; scutes not much worn at all anywhere; w.g.i.'s clear and well-developed.
New #1291(mismarked - intended to be 1219) CL 42.8; CW (CDRS) 43.1; CW (VD) 41.0. Too small to sex- tempting to think is 6-10 years old based on CDRS raised tortoises. Moving along in open about ½ - 1 km toward La Fe from rt. Turn junction.
Region 10 - La Fe Nesting area proper - Bing! - found a really small tortoise (2-3 years old ??) walking around over open rock covered area at 1300 hrs when is quite warm - cloudy but weak radiation is warm and can feel it strongly now. CL 14.7 cm; CW (CDRS) 15.5 cm; CW (VD) 14.8 cm. [Marginal note: no f.d. algae or worn scutes; w.g.i.'s very thin and intermittent. To small to mark or sex, but marked 4th vertebral with a roman numeral #II with knife point. Rocky area he is in is surrounded by red soil covered "pampas coloradas". Certainly proves some nesting is occurring here! This spot is right near the tree where I saw #1360 on 2 previous visits. Looked around the immediate area surrounding this small one but found no other tortoises. Took photos of this beastie - Roll 65 - #'s 11 -21.
Pg. 82.
New #1221 (mismarked again) thus changed to 1221; CL 33.1; CW (CDRS) 35.2; CW (VD) 32.5; Too small to sex; no f. disease, algae or worn scutes; w.g.i.'s present but extremely thin and not entirely complete. So thin hard to see clearly. Was resting in shade but clearly visible from all around, when

discovered - under an open -grown Acacia. Has an anomaly - an extra costal, actually about ½ of one, on his left side. Two photos - #22 under tree resting #23 anomaly. Roll 65.
#1137 ♀; in floor bed of pond, burrowed up under Clerodendron molle - in good shade - 1430 hrs. weak radiation still coming through clouds strongly. CL 59.9; CW (CDRS) 64.1; CW (VD) 58.0. No f. d. or algae; scutes worn smooth only small amt. In very centers; w.g.i.'s mostly present but very , very fine and thin. Roll 65, photos #24-25 of in its shad burrow.
Searched around in La Fe nesting area itself for about 2 hours. And found only these 3 animals and a little sign. No fresh droppings at all, but some burrows sites up under semi- prone trees and against prone logs - but
Pg. 83.
. . . . hard to tell how freshly used these were since goats also can use some of them. But where a few clearly used more or less recently where goats couldn't get to them - Found 10 -15 little burrow sites up under logs and tree stems, shrubs, etc. which were clearly resting burrow sties for small tortoises of the size of #12221 and even smaller ones. This is further evidence, in addition to the 2 mall animals found today, that successful nesting is occurring here.
But found no obvious new nests - however I am beginning to think this is based on 2 facts -
1. most of red soil flats here are unfit for nesting (see Nov. and Oct. 1969 notes) because vast majority of the areas with loose exposed soil have lava bed rock right at or just barely below the surface - in testing dozens of spots found only a few where tortoise might dig an even half - adequate nest. I am sure that here and there the soil is occasionally deep enough, but the ♀♀ must do a lot of frustrated looking before successfully laying unless they learn over the years where the few good sites are.
2. The goats are very plentiful here and utilize literally ever(y) bare spot of loose red soil on the pampas as scratching - defecating urinating spots. Therefore even when a
Pg. 84.
Successful nest is made its top is probably rapidly obscured by the goats. In other word I have probably been searching and walking past nest here and there and simply not recognizing them because of this - I know this can and does happen because have seen what goats scratching did to surface of nest #5 after one jumped the corral wall recently - can't anymore recognize it as a nest. This factor may however not be as important as #1 overall, because for example nest #17 is still recognizable after 1 month in Zone 3 NA and it is not protected from goats -
Another point regarding where ♀♀ nest at La Fe - there are lots of spots , in what are otherwise areas covered exclusively with lava boulders, where a small patch of soil is open, available and collected in amongst these boulders. These are often about ½ - ¾ or even 1 meter in diameter and the soil is deep enough plus for a nest. However, the soil in these is a darker red -brown color and in larger clods and more crumbly.
Pg. 85.
. . . than the very fine red soil of the surrounding pampas- it does not make a mud as easily and is thus less workable. "Whether the ♀♀ could or would use these area I don't know. The goats don't appear to use them, but of many examined I have also seen no tortoise nest or general use of them either - however in 2 or 3 places saw ones which tortoise had used as soil wallows - perhaps last year during heavy rains. These areas look as if much H20 percolated through the, thus perhaps accounting for the crumbly soil structures.
Comments o behavior of young (smallest) tortoises seen today - watched him for about ½ hr.
1. freezing reaction - his reaction on may approach was to withdraw head and limbs into shell and remain very motionless; I tested this several times by getting out of sight, waiting for him to begin moving again and then moving into his visual range. He did this with no molestation by me and even while being handled and marked struggled not al all (thus quite unlike young at CDRS and older ones in wild). He remained withdrawn in shell anywhere from about 1- 5 minutes after each disturbance, and did not ever stick head out during this period. When he would finally stick head out
Pg. 86.
. . . . only and very slowly and a little at a time; when he thus had looked about several times and with head out more and more with succeeding times, he would put head out all the way, then limbs and finally beginning rapidly walking off. I tested this 4 times and each time he did the same sequence of actions.
2. hiding - finally when I left him alone, he went immediately up under a bush in the area and thus partially hid himself from above in a sort of little burrow like place.

3. time of day - don't know if he was just in transit from one resting spot to another or feeding or what, but activity at 1300 on an admittedly cloudy, but never the less quite warm day, shoots holes in Castro's and other ideas that he small ones are active only in early morning and late evening hours.
Comments on vegetation: All the way from the Caseta and above the Devines to the coast the vegetation is greener, more
Pg. 87.
. . . .abundant and growing weekly as compared to Oct. and Nov. samples. In Dec. this trend was obvious, but is even more so now after another 3 weeks of fairly steady, light rain. These effects are most pronounced from about Region 4 upwards and especially so in Regions 3 (upper part), 21, 1, and on up to Devine's - the vegetation is (lush or much?) abundant and there is certainly no food shortage for tortoises (never appeared as if was one in these areas in previous months of the study either but surplus now is even greater. From Region 4 to La Fe lushness is not as nearly pronounced, but things are in general a bit more luxuriant and there is certainly a regrowth of plants toward the position the vegetation was in these lower regions in August and September. There is more to eat there now than in Oct. Nov. and first ½ of Dec. for certain. However, in lower regions veg has not become as lush and plentiful again as we saw it in late Aug - early Sept. 69. In higher regions - Devines' Caseta, upper half of Reg. 3 it is certainly more lush and plentiful now than at any time since study began. Overall I doubt if food is limiting tortoise at all except perhaps in Regions 8, 9, 10 - but even there it is
Pg. 88.
. . . .. doubtful that this is the case.
Finally - weather data at Zone 3 for a little over 25 hours. 1730 hrs. Rain 0.02 inches; Evap 2.0 ml; Max 81.0 ° F; Min 69.0 ° F.
12 Jan. 1970. Sampling at Zone 3 NA l-
#1196 - near nest #2.
#1171 - 25 m SE of nest #2.
#1051 - same location as yesterday morning more or less but in burrow used previous night (10-11 Jan. by
#1144.
#1144 - 20 m east of former burrow sites; near #1193.
#1193 - very small one - in same area exactly as where last saw in Dec. = also has clearly been using 2 small burrows up under semi- prone Pisonia trees which was using then - in both places dirt has been freshly disturbed by an animal of his size. When spotted he was about 5 m from one of these burrows, out in the open, lying still and basking with head and limbs resting on ground.
Pg. 89.
This was at approx. 0835 when of the others (4) seen, 2 were active and 2 were basking like #1193. Sun out for about 10 minutes only all morning (about 0830-0840) k- rest of time overcast rather heavily.
#1055 - about 70 m to SE of where saw yesterday - over one lava rise and down into a flat soil covered area.
#131 ♀ - again - in same general area as #1055 - only about 40 -50 m from here nest (#12) where saw here lay in early Sept., and about 80-85 m from NW part of open area of Zone 3 (near nest 2) where saw in Dec. (about 1 Dec.).
#918 - near nest #1, slightly to NE in an openish area with soil.
#130 ♀ - CL 97.0; CW (CDRS) 108.8; [Marginal note: b. green algae and f.d. on rear ¼ of shell! Resting in shade of a Clerodendron molle to NNW of Nest 3, 6, 7 etc. area by about 40 m This area has a bunch of these bushes and some open soil and have noted dried droppings here before - this is first tortoise have seen here. No obvious nests in the area.
Weather data at Zone 3 NA upon leaving - 1000 hrs. - Rain, no more since last night; emptied. Evap total 2.6 m. since 1600 hrs., 10 Jan 70. Low (Min) last night - 64 ° F; Refilled evaporimeter full.
Pg. 90.
On return toward Caseta -
#1020, about 100 m N of Zone 3 NA near trail.
Reg. 6. #1216 - on tail, at least 400 m to ½ km below big boulder area where marked on 10 Jan. '70. Certainly moving south toward Zone 3 NA.
Reg. 6 l- about 75 m more N of #1216 - #1031 ♀; CL 62.0; CW(CDRS) 65.6; CW (VD) 59.5. No f.d., algae or smooth scute areas, w.g.i.'s thin but complete and well developed. Moving south on trail when encountered.

Reg. 5 - New #1219 ♀; CL 70.3; CW (CDRS) 75.2; CW (VD) 68.0. In big boulder area moving along south; w.g.i.'s well developed, clear and complete; No algae and almost no f.d. but for a few tiny spots. Scutes worn smooth only in very centers of some of them.
Reg. 4 - weather - 1100 hrs. Evap 2.7 ml, refilled full; rain 0.035 inches, emptied; Max 82 ° F; Min 66° F.
Pg. 91.
Noticed a few animals in passing through Region 4 - #713; 1058, 351, 452.
On toward Caseta l- Reg. 3 #274 ♀ (painted #2) moving along trail southwards - Now about in middle or just into lower part of Region 3 -= in just into lower part of Region 3 - in steep ascent - descent part near river bed. Altitude about 370-380 feet. Very clearly moving downward and rapidly since saw at C. pond #1 just 3 days ago.
#464 ♀ - just a short ways in distance and about 20 ft. in altitude above #274; also appears to be moving in a generally southward direction - however was crossing trail obliquely NW to SE when encountered so may just be active in this general region - nevertheless is certainly further south and lower in latitude than when first seen while taking November '69 sample.
**As proceeded up through Region 3 noted that there is a clear fresh track running down or near the trail for hundreds of meters - in leaves trail here and there and then rejoins it later at lower points. Seems to me that this (judging from its size and the fresh trail which was able to follow for about 100m above #274 ♀) is due to #274. It is all new since I was by here on morning of 10 Jan '70. The trail of the animals no longer parallels my trail to the lower regions just before get to Region 2/3
Pg. 92.
. . . . border - ♀ was clearly following drainage system (river bed) south of C. pond #1 and this point where trail is lost corresponds to where my trail shies away from river bed.
Note: found some fresh trails along my trail here and there in Reg. 2, but larger than this ♀'s and not extensive - just here and there along trail and some accounted for by #'s 220 and 97.
Reg. 3 - #248 ♀ - also found moving S along trail and could follow his trail along mine for about 50 m. above - then veers off to NNW toward C. pond #1 along drainage; about 100 -150 m S of Reg. 2/3 border l- in Reg. 3. Alt must be about 480 -490 feet. - thus also moving south.
Reg. 2 - about 2/3's of way up this region - thus closer to C. pond #1 than Reg. 2/3 border in open grassy area under manzanillos - only 15 m apart - #97 ♂ - thus has moved up a bit since saw him on 10 Jan. '70.
#220 ♂ - also moved south some therefore
Pg. 93.
Reg. 1 - Beside C. pond #1 on E edge - #628 ♀
Half way above pond to Caseta - #1006 ♀
**Note l- certainly an overall indication for past few days that some animals are moving southwards l- probably due to cessation of general drying trend I followed in Aug - Dec. '69, and increase in rainfall since mid Dec. '69. Note movements of #464, 274, 278, 97, 220, 351 from Caseta pond #1 area (or even above l) toward south. In same period (mid Dec. to now) few have with certainty moved upward - e.g. #127.
Of course most animals still seem to be staying in same general area from south to north and not moving much at all in a vertical or even horizontal sense. Also, if Devine's land is an indication, have seemed to cease moving northward and furthest upward limits also. Will have to see about all this later after more sampling.
**Note - #'s in Zone 3 NA sample - why larger than usual, especially since almost all animals encountered have been seen there 1 to several times each in recent months and are probably virtual residents, at least for this time of year (Oct - Jan, anyway) ?
Pg. 94.
Two factors may be involved:
1. Previous samples taken in daytime (usually afternoon) when was sunny or at least partly so - thus many of animals were in shady places and harder to see (especially smaller ones). Today sample was taken in very cool time - heavy overcast - animals not in shade.
2. Recent rainfall may have moved many animals into Zone 3 NA because are some large smooth flat rocks there which can collect small pockets of H20 on a daily basis; also just above to NNW (where #130 ♀ was today) is a low area with Clerodendron molle which may collect some water and form a shallow pool if rain is strong enough.

Caseta weather - 1900 hrs. - Cool and overcast almost entirely for 10th, 11th, and today, but no rain here today and probably none or little during daylight for 2 previous days.

Note - was coolish and overcast all way to La Fe on all 3 days also.
Pg. 95.
Rainfall - 4.2 mm; Evaporation 2.0 ml (reading 2.0); Max 81.0; Min 66.0
13 January 1970 -
with guests to C. pond #1 - at 0830 eight there in wallows - #'s 117, 1138, 421, 526, 628, 127, 1013, and 445.
At 0930 - #1184, 20 m above pond heading down trail toward pond.
Then to upper ponds - at 1030 -1130 hrs. #819 ♀ half way between C. and ponds in middle of trail - burrow nearby.
Just below ponds - #354, 598.
At pond - #782 and 1 unidentified.
At Caseta - saw #1021 ♀ (probably) CL 81.4; CW (CDRS) 83.0; no f.d. except on rear marginals underneath and that only light; no algae; scutes not worn smooth yet anywhere. W.g.i.'s mostly complete but rather thin on the whole.
Took some photos on Roll #65 (27- end) and Roll #66 (1-10) at C. pond #1 and Caseta upper ponds of ponds and tortoises.
Juan Black and J. San Miguel made a loop down trail to C. pond #4, through plant #1 covered areas to NE till hit reserve border and then along reserve border to area just below Caseta upper ponds - also looked around a bit in openish plant #1 covered areas along R. B. just above Caseta and to east and NE a bit.
Pg. 96.
They found the following animals and took their measurements.
#216 ♂ - CL 123.5; CW 133.2
#720 ♂ - CL 85.1; CW 94.5 (Black recorded as ♀)
#388 ♀? - CL 89.7; CW 92.3.
#57 ♂ - CL 127.0; CW 131.3.
#852 ♀ - CL 89.7; CW 92.3
#267 ♂ - CL 106.0; CW 117.5.
#819 ♀ - CL 98.1; CW 112.7. (Black recorded as ♀?)
The also went up trail toward Guerrero's almost to his fence (first one) but saw no tortoises and no clear sign once a bit above C. upper ponds.
**Note: I have recorded all these animals but #388 recently myself in the Caseta area.
On way in this morning, they recorded tortoises and measurement along the reserve border -
Pg. 97.
. . . . .ones encountered as follows -
#189 (maybe 389) ♂ CL 128.1; CW 137.0 - area above zone 6.
#810 ♂ - CL 99.6; CW 111.4.
#1170 ♀ - CL 88.9; CW 98.6 - the pond beside R. B. just west of Zone 1 turn off. (Black recorded as ♀)
#1 ♂; CL 126.7; CW 143.2. - same pond.
#268 ♀ - CL 81.0; CW 88.6; same pond
#1023 ♀ - CL 92.4; CW 99.0; same pond.
#3 or 403 ? ♀? - CL 84.5; CW 89.4 - "zone 1 area" - but must have been further along trail to west beyond pond. Probably #403 ???
#1108 ♀ CL 69.4; CW 70.4. - "zone 1 area" same comment applies as on previous animal.
**Note - all of these animals are new for me except #'s 1170, 268, and 1023.
Caseta weather - 1900 hrs. - Clear and sunny almost entire day - some clouds off and on (mostly not) from 1430 till sunset. Max 86.0 ° F; Min 69.0 ° F; Rain - 0.4 mm; Evap. 3.2 ml (reading 5.2).
Pg. 98.
14 Jan. 1970 - to Chato to sample.
#819 ♀ - same as yesterday.
#627 - top of first hill.
#450 - ½ way hill to rt. Turn.
#106 - 75 m before rt. Turn.
#73 - 60 m before rt. Turn.
#98 - at Camote patch.
#487 ♂ - CL 117.7; CW (CDRS) 127.4. No algae; very little f.d.; scutes smooth in central 1/5 -1/3. At the pond beside R. B. near El Chato turn off. (Was #287 in Dec. sample!)

Chato - (Region 2)
Pond #1 area: #1361; #71 - very well developed thick w.g.i.'s
New #1220 ♂ (prob.) CL 73.8; CW 74.8; 69.5. f.d. in usual places; no algae; w.g.i.'s mostly complete and moderately well developed; scutes worn smooth only in center!
Between pond 1 and 2 - #612 ♀
Pg. 99.
Pond #2 area - #169 ♀ - CL 95.5; CW 105.3; 95.0 - Bad f.d. over most of carapace - especially sever on rear ¼; b- green algae on lower parts in rear but not co-extensive with f.d.; w.g.i.'s clear, thick and well-developed. Scutes worn all over but smooth only in central 1/3 -1/2.
#1046 ♂
#192 ♂
New #1222 ♀ (prob.) l- somewhat intermediate. CL 83.0; CW 90.1; 83.0 - bad f.d. all over, especially in rear 1/3 and front marg. Area B. - green algae scattered in many of same areas, especially rear of carapace. Scutes smooth only in very centers- w.g.i.'s. clear and well-developed.
#1186
#710 ♀ - very well developed thick w.g.i.'s
#168 ♂
Pond 3-4 area.
#318 ♂
#281 ♂
#202 ♂ - CL 140.0; CW 147.8; 136.0; very little f.d. - only along scute junctures of rear 1/5 and front marginal areas. Smooth all over; w.g.i.'s well developed and thick. Faint yellowish-green brightly colored algae at various low un-abraded areas all over shell.
1066 ♀
326 ♂
Pg. 100.
New # 1223 ♂, maybe (hard to sex, small) CL 62.0; CW 64.7; 58.0; no f.d. or algae; scutes smooth only in very centers; w.g.i.'s clear and well developed on whole but absent or thin here and there.
**Note: has my mark IV on last vertebral !! Originally seen way down low near Zone 3 N area.
#204 ♂ - CL 129.9; CW 137.0; 126.0
#130 ♂
On south side of Chato at Cerrito Trail turn off area and pampas there.
#297 ♂; CL 136.5; CW 146.0; Bad f.d. on rear 1/5 -1/4, front marginals and along scutes junctures; Some b-green algae in same areas. Mostly continued to lower 4th vertebral and downwards. W.g.i.'s very clear, thick and well developed.
#156 ♀; CL 95.7; CW 111.9; 102; no f.d.; some small patches of b-green algae on rear part of carapace, especially along scute margins but not much w.g.i.'s visible but thin and not complete! Scutes worn in central 1/5 - ½ of their area.
Pg. 101.
#150 ♂; CL 134.8; CW 150.8; 138.5. Bits of scattered f.d. here and there all over but nothing severe. B.-green algae also scattered on front marginals and along scutes junctures on rear ¼ -1/5 of carapace. W.g.i.'s becoming well developed and thick but still missing here and there. Smooth all over.
#11 ♂
#780 ♂
#241 ♂; CL 143.5; CW 154.7; 144.0; w.g.i.'s clear and thick; very little f.d. here and there in normal places; a few faint spots of bright yellow - green algae on rear and lower protected part of 3rd vertebral; b-g algae slight and only along a few scute junctures in rear and on front marginals. Smooth almost entirely except for faint signs of g. signs at outer borders of some scutes.
New #1224 ♀; CL 76.5; CW 80.5; 74.0; very worn and abraded shell, smooth in central 1/5 -3/4 of most scutes and rest worn and lightish colored; w.g.i.'s well developed and visible - medium thickness. F. d. very bad in usual front and rear sites and b. - green algae in same places, but not 1:1 correspondence.
#299 ♂
#616 ♀ - nicely developed w.g.i.'s -clear and moderately thick.
Pg. 102.

#622 ♀; CL 98.9; CW 114.0; 105.0; scutes worn smooth in central ¼-1/3 ; rest of them look well abraded. F.d. in usual rear and front marginal areas - rather severe; b.g. algae in same areas but not 1:1 ; mostly concentrated on rear marginals and supracaudal scutes.
w.g.i.'s - moderately thick, but somewhat intermittent - mostly complete.
#101 ♂ - w.g.i.'s very thick and clear.
#863 ♀ - w.g.i.'s moderately thick and clear.
On return toward Caseta. - Reg. 1
#515 ♂ about ½-2/3's way to Chato pond #1 from R.B. - moving through guayavillo forest NE to SW and not along trail - to east of it. Was last seen on R. B. several hundred meters east of turn off.
#1060 ♂ (prob. But tail intermediate; not extremely short); CL 95.5; CW 105.2; 98.0; Also in guayavillo forest not far above last animal - but 50-75 m to east along a tortoise trail (well worn) which I think is one of their paths from Chato to higher ground to E. and NE; have seen fresh
Pg. 103.
. . . . tracks going and coming along this trail on many previous occasions. This animal: f.d. scattered here and there all over, not too severe; no algae. W.g.i.'s thick and clear; scutes smooth in central ¼ or less only.
While I was dong this Chato sample in my regular fashion, J. Black, E. Black, and J. San Miguel made a circuit around from pond #1 in opposite direction through the mostly close area to check on tortoises on other sides of Chato than my sampling area- They found the following - notes taken directly from J. Black.
At pond on NNW side-
#898 ♂ CL 108.9; CW 119.2
#946 ♀ CL 82.6; CW 85.2 - bush on NNW side.
At big pond on west side:
#773 ♂ - CL 111.0; CW 116.5
#1045 ♂ - CL 112.9; CW 126.4
#1179 ♀ - CL 69.9; CW 74.6
#855 ♀ - CL 94.2; CW 108.9
#703 ♀ - CL 86.2; CW 92.9
#253 ♀ - CL 87.8; CW 100.0
#1152 ♀ - CL 89.0; CW 105.5
Unmarked ♀ - CL 96.1; CW 105.5
#319 ♂ CL 112.4; CW 120.3 (400 mark also cut , but enlarged - thus probably a mistake!)
Pg. 104.
#511 ♂ - CL 128.9; CW 138.0
#375 ♂ - CL 144.8; CW 159.2
Unmarked ♀ CL 99.7; CW 102.4 - This ♀ and one of these males may have just been copulating - (they thought, but no real sign; my (CGM) note!)
Unmarked ♀ - CL 72.0; CW 80.4 in bush on west side
#316 ♂; CL 132.6; CW 149.0 bush, SW side.
#142 ♂ - CL 140.5; CW 147.7 - S side; pampas.
#208 ♂ - CL 140.5; CW 147.7; S side; pampas.
#354 ♀ - CL 92.1; CW 98.2; S side; pampas.
**Note: of these I only had #'s 1045, 1179, 319, 375, 142, 208 and maybe ? 354 before. This 354 is perhaps a duplication.
Conditions at El Chato - On the 6th of January, El
Pg. 105.
. . . . Chato ponds mostly had a small bit of H20 and some little amounts of mud - now even more -
Pond #1 - rocky part all has 5 -10 cm standing H2; rest still dry.
Pond 2 - still dry
Pond 3 - standing H20 and mud (thin soupy kind)
Pond 4 - ditto for #3
Plus many small mud hole have very thin soupy mud and some of Manzanillo covered (shaded) ponds on S. side have standing H20 in small amounts and or soupy mud. Gras and other herbs continue to grow rapidly and grass in most of open area around N to S sampling area is waist high or greater in general ! In sum, rain for past 3-4 weeks has really changed H20 conditions and that plus temp. rise has probably caused lush plant growth.
Tortoises (several things):

1. Clearly more dispersed now than in Oct. Nov. and even Dec. (3 weeks ago); was sunny and warm today, but I searched bush and shady area all around open pampas also and still here were clearly less total animals. Than on all samples since and during Oct. 18, 1969. Maybe rain or maybe increased sunlight or maybe both are causes. - would guess
Pg. 106.
. . . it is rainfall and plant + H20 availability however because sun lacking for much of the period till yesterday! Also, data below from J. Black suggest that at least some of El Chato area animals are moving down to and or toward Zone 5 (maybe are also going up - will see in a few days). If Caseta and above is any indication, animals are generally stopping upward movement and some are moving down a bit now - ?
2. Blackish - green algae still on many animals, ♂♂ and ♀♀, mostly tending to be on larger (80 - 85 cm CL plus in size) animals. Perhaps most obviously related to rain and temp. because has only become prevalent since mid December, 1969. Virtually non -existent before then.
3. White growth increment are becoming much larger, thicker, more complete and thus more noticeable on animals in general, in particular larger and older ones, than ever before - seems to have really been a sudden spurt in their notice ability in just
Pg. 107.
Past 2-4 weeks - much more prevalent (in sense of being better developed) now in general, than even in December sampling.
** Took weather data at El Chato - 1330 hrs.
Rainfall 0.64 inches (emptied); Evaporation 9.5 ml (refilled full).
J. Black, J. San Miguel and E. Black went down to Cerrito area and sampled on the ay for me including a search of Zone 5 area -
Region 3 of Chato - C. Gallina trail- (all within first ½ of distance from S side of Chato, in pampas area, and Zone 5)
New unmarked ♀ (I marked later same day #1224 ♀) - CL 76.4; CW 80.9
#14 ♂ - CL 121.6; CW 138.1
#148 (or 145) ♂ - CL 139.1; CW 157.5
#685 ♂ - CL 134.7; CW 145.0
#339 ♂ - CL 132.5; CW 152.7
#139 ♂ CL 141.0; CW 152.7
Region 4: i.e. Zone 5 itself
#472 ♀- CL 98.0; CW 109.8
unmarked animal - too small to sex - CL 55.5; CW 57.5.
#449 ♀? - CL 81.7; CW 88.1
Pg. 108.
1 unmarked ♀ - prob marked next day - see #1225 - CL 87.5; CW 94.8
#777 ♀ - CL 93.5; CW 107.5.
#507 ♂ - CL 143.0; CW 147.6
1 unmarked ♂ (marked next day by me - see #1228) CL 79.7; CW 80.2
Copulating: #789 ♀ CL 99.7; CW 115.3 and #296 ♂ - CL 135.2; CW 151.0
Copulating: #826 ♀ - "CL 104.0; CW 1126.0 and #68 ♂ - CL 118.5; CW 127.8
#1182 ♀
#1181
Region 5 - to Cerrito -
1 unmarked ♂ - CL 84.0; CW 90.6
#445 ♂ - CL 134.8; CW 151.7 and #212 ♂ - CL 132.6; CW 1303 (both very near Zone 5)
1 unmarked - too small to sex - CL 60.3; CW 64.0 (probably marked by me next day, see #1226)
1 large ♂ - failed to get # or measures. (right on side of Cerrito- got next day - #613 or 653).
**Note - 2 more copulations
Caseta weather - 1900 hrs. Max 85.5; Min 69.0; Rainfall 0.0 mm; Evap 3.1 ml (reading 8.3 ml); sunny off and on (mostly on) in morning and sun all afternoon.
Pg. 109.
15 Jan '70
To zone 5 to check on J. Black's sampling area - size and where.
On way:
#1205 ♂ - near El Chato turn (75 m east) on R. border.

At El Chato - S side - Region 3 beginning -
#60 ♂
#780 ♂ and #1224 ♀ - in reality in pampitas along trail just like those of Reg. 2 (i.e. Chato area)
Bit further on - 50 m more S but still very near Chato.
#548 ♀

In "large" open pampa area - 200-250 m S of turn off on S side of Chato
#241 ♂
#549 ♂ - CL 142.3; CW 156.0; 147.0
#685 ♂ -
#148 ♂ - or 145 ♂ - has extra small tiny marginal between 2nd and 3d normal ones; marked in 1st and 3rd large ones
75-100 m further south - along trail just before closes up l- last pampita
#339 ♂ - still rather near Chato.

Almost to Zone 5; i.e. Reg. ¾ border;
#139 ♂ - was able to clearly follow his trail along drainage (and thus near my trail) for more than 250 -300 m - running N to S - clearly moving determinedly and rapidly from Chato area to Zone 3 (or below?)
At Reg. ¾ border - actually in zone 5 itself I found.
#10 ♂ - clearly has moved down from above sometime since 3rd week of December!
Pg. 110.
Reg. 4 (Zone 5) proper
#921 ♀ - CL 74.1; CW 78.0 - 100 m N of camp - pond area w.g.i.'s clear and well developed - no f.d, algae or smooth scutes.
Camp - pond area -
#1182 ♀
777♀
New #1225 ♂ - CL 87.8; CW (CDRS) 94.1; CW (VD) 86.0; very few scattered minor spots of f.d.; no algae ; no really smooth scute areas!; (slightly in centers only) ; w.g.i.'s clear and well - developed.
#296 ♂ near pond
#1181 ♂ - bright green algae on rear of shell very noticeable now; near pond.
#707 ♀ (prob., but tail intermediate.) ; just leaving pond area. CL 97.5; CW 102.7; 94.0; F.d. on very rear of shell (marginals, last vert. Last costals, supracaudal) Also b-green algae on rear 1/5 - 1/6 of shell. Scutes smooth in central 1/3 -3/4's; w.g.i.'s visible but thin and intermittent.
New #1226 (probably one of J. Black's from yesterday) Too small to sex accurately. CL 60.4; CW 64.4; 59.5. No f.d. or algae or smooth scutes; red soil color of carapace scutes evident; w.g.i.'s clear, thick, and well developed.
Pg. 111.
In pond under bush.
New #1227 ♀ CL 67.6; CW 70.5; 65.5; few spots of f.d., very minor on rear marginals; no algae; scutes smooth in very centers only ! w.g.i.'s clear and complete, but thin. Under bushes in pond.
#68 ♂ - near pond
#789 ♂ - near pond
#1228 ♂ CL 80.4; CW 79.8; [Marginal note: prob. One of J. Black's from yesterday]; small patches of fairly deep f.d. on one front marginal and on rear marginals and supracaudal; B.g. algae on rear 1/5 of carapace - but light covering and drying. W.g.i.'s clear, but thin and missing here and there. Scutes worn, but smooth only in centers.
#507 ♂ - CL 146.5; CW 147.1; now 75-90 m NE of camp and pond area; with a healthy looking grass filled turd behind him (fresh), thus maybe OK. F.d bad all over as before and some b.g. algae on many of same areas. Light, bright yellow green algae in patches all over rear of shell and most of sides and in front - not at all entirely in areas protected from abrasion - due to his general lack of movement. Was sleeping in open plant #1 covered pampa when found. [Marginal note: took 5 photos of him (Roll 67: #'s 8-12) and 2 of lichens and algae on him (same roll #'s 13l-14; Note; a yellow lichen!)]
New # 1229 ♀ - CL 81.2; CW 87.3; 81.0; no f.d.; scutes not smooth yet (except in very centers) but worn. Bit of dry, barely visible b-green algae on rear 1/6 - along scute junctures; w.g.i.'s clear, thick and well developed. 1540 to east of pond in forest - but semi-open type and near a well used trail.

Pg. 112.

Aggression:
1. About 1200 discovered #296 ♂ with #1181 ♂ at his rear in head to rear position - clearly aftermath of an aggression. ♀ #777 (adult, large) was nearby and I don't know if this had anything to do with the activity. She was perhaps 15020 m away under shad of a tree but in full view.
Anyway, discovered them after the main bout must have already taken place, #1181 having on the head on part - of course may have not been such a part. Then they sat there only centimeters apart while I watched for 30 minutes - nothing more occurred except once #1181 raised up some, drew head in and rammed into #296's rear end; the latter responded by moving forward a few dm and then both settled back down to former relative positions. Most of the time #1181 just had head extended about ½ way out sniffing and looking around #296's rear end - cloacal and leg pocket regions but no biting or other attacks. [Marginal note: see photos #5-7; Roll 67]; Finally I left and when returned 30 minutes later #296 had moved off and #1181 was moving down trail toward pampita where #507 is located.
Pg. 113.
2. #777 ♀ and small # 1227 ♀:
At about 1315, #1227 entered campsite area, spotted #777, still resting beneath tree and proceeded directly toward her; when the small one was about 2-3 dm away, and 777, who had her side to the small one and had been watching her approach, rose up , pivoted, extended her head and neck out and up as high as possible and moved toward the little one. Almost immediately, 777 opened here mouth and tilted head downward at 45 ° and tried to "bite down" on top of small one's head and forelegs.
Could not see #1227 as well because her back was to me, but at the very first as #777 pivoted and was first extending neck, she also started to raise neck and head up as height as possible. However as soon as the larger ♀ opened her mouth the small one quickly pulled in her head and forelegs (later only partly) and started turning to side just as #777 was biting down. Then ended up with #1227 with side an d part of rear in face of 777 who then had neither the head or forelegs as a target. (During turning of little one #777 appeared to try and bite closest foreleg at one point in the process). Then sat there only a few cm. apart for 5 minutes more
Pg. 114.
. . . or less, finally #777 rose up and started to (. . . .)but the small one anticipated this, rose up, and started off quickly before contact was made. #777 just slowly settled back down and id not follow at all. The small one wandered off only 2-3 m rapidly and then just slowed down and gradually wandered away, eating some in the process.
3. Just after the above, while eating, I heard some carapaces thudding together. Went down trail and found #1181, with side and rear to # 507's face. Apparently another aggression and looks as if #507 won. Now # 507 is sitting a few cm away form 1181 sniffing and looking about the latter's cloacal and rear leg area. Have been thus for 30 minutes; #1181 is even eating plant #1 now and then ! But he never "looks at" #507, as #296 never looked at him. [Marginal note: See photos #15-17, Roll 67.]
Photos also good for contrast of shell shapes - very strong contrast!!! #507 domed and rounded; #1181 very flat, depressed and ovalish.
Pg. 115.
Finally #1181 just walked off; #507 look at him, raised up and then when were about only 2-3 dm apart, just settled back down without chasing!

_____-
Continuing sample - pampas and pond area N and E of camp pond site..
#1157 ♀ CL 69.9; CW 75.5; From El Chato according to previous finding !!
New # 1230 ♀; CL 97.3; CW 106.1; 96.0; F.D. in usual sites, plus b-green algae in some of same area; Scutes about ¼ - ½ smooth in central parts. W.g.i.'s average and visible. Covered with a thin coat of dry mud even on top - thus H20 around here or at least soupy mud?
Really big pond (see notes below) area:
New #1240 ♀; CL 61.8; CW 64.5; 60.5; (♀ prob., but rather small to sex accurately). No f.d. or smooth scute areas yet; some very dry b-green algae here and thee on rear 1/5- ¼ of carapace. W.g.i.'s moderately thick, clear, and well-developed.
This large pond is at least 150 -200 meters long by 40 -50 m wide and is at the bottom of the long drainage from the El Chato area (which my trail follows down from).

It is completely surrounded by and largely filled with Clerodendron molle, but there are open areas of 10 X 5 and 10 X 10 meters and smaller ones here and there. The bottom is mostly made up of soil and can see that has been a bit of mud recently although now is all dry and has been so since
Pg. 116.
. . . . started coming here in October. Visited and sampled same area in November (and Julio did so in Nov. also) but failed to appreciate its extent at that time. Quite a bit of old trails and droppings in the area but few tortoises on any previous visits or now - not nearly as much activity or as many tortoises as near rock-bedded small pond near campsite. Lots of other low areas in the same vicinity where H20 can collect - mostly same size or smaller than pond near camp.
On return: Reg 3 - half way up to Chato from Zone 5.
New #1235 ♀; CL 77.5; CW 80.4; 74.0; Spots of f.d. on rear; b-green algae in same area; w.g.i.'s clear and well developed - moderate thickness.
Also note that #241 ♂ had moved further down trail toward Cerrito and Zone 5 by about 75-100 m - - now near where #339 ♂ was this a.m. - in fact together on my return - ** appears as if just had an aggressive encounter - actually both about 50 m further south of 339's location this a.m.
Also saw #14 ♂ in same area of pampas in Reg. 3 (but near Chato) as yesterday when J. Black saw.
While I was doing this today J. Black and J. San Miguel made a trip to nesting area below Cerrito.
Pg. 117.
. . . . and did sampling for me.
Their results were as follows:
Region 5 (Zone 5 to Cerrito trail)
New #1231 ♂ CL 84.0; CW 90.6
New #1234 ♂?; CL 75.5; CW 80.5 (both above just below Zone 5- for all practical purposes within it but in Reg. 5 by definition)
#613 (or 653 maybe) ♂; CL 143.8; CW 151.5; on side of Cerrito on trail (checked against measures - virtually certainly #613 ♂ - plus I thought other possibility was #683.)
Region 6 - none seen - little sign.
Region 7 - none seen and little sign.
Region 8 - zona de nidos (nest #16 of 1969/70 and surrounding area).
New #1232 - too small to sex; CL 51.9; 53.5.
They found no new nests or destroyed ones in this area. Then they went further to south than I have before:
New #1233 - too small to sex; CL 48.4;; CW 49.1.
#1023 ♀ CL 94.1; CW 110.0; large completely smooth ♀; just above a new large zone where found many destroyed nests.
The estimate this new zone is about ENE of C. Gallina and more or less directly north of the nest #16 area; almost certainly not known before from what
Pg. 118.
. . . O Chappy has told me personally. Is covered with open red soil like La Fe and they guess maybe 2-3 times as large as the main zone 3 NA. Also estimate is about 1 km above the coast. Also found 7 nest destroyed by pigs. But could locate no new undestroyed ones. They had clearly been dug up and found pieces of shells and "membranes" in all of them - all clearly from this year and somewhat recent because shell and "membranes" pieces not deteriorated or badly broken up yet.
[Marginal note: Caseta weather, 1900 hrs.. Max 83.5; Min 67.0; Rain 0.0 mm; Evap 1.7; (reading 10.0) sun early in morning and in late afternoon - rest cloudy.
Comments on Zone 5, Chato to there and below to Cerrito:
Zone 5: Ponds all dry in Zone 5 still; have been some bits of mud recently during rain but even they all dry now; plants bit more green and taller now than in Oct. and November, but not much increase over previous conditions.
Below - Zone 5 l- about same - bit more H20 and therefore bit more green and more growth.
Zone 5 to S side of Chato - same comments apply as to below zone 5.
Pg. 119.
16 Jan. 1970. To area above Chato. J. Black, J.S.M. and E. Black to Naranjo and Zone 4.
Near pond near El Chato turn off and R. B. -
#487 ♂ wallowed in pond.
#320 ♂(?) near pond grazing - remarked getting faint. W.g.i.'s becoming clear and well-developed.
#609 near turn off.

#563 ♂ (?, prob.); CL 87.8; CW 93.8; 86.0. rater severe f.d. all over rear ¼ of shell ; front marginals and scattered elsewhere all over carapace. Appears to have recently had b=green algae on rear 1/4 , below center of 4th vertebral, but very dried up now. Scutes smooth in centers only except 2 top vertebrals - about 1/5 smooth; w.g.i.'s clear and well developed, of moderate thickness. Remarked - getting faint. Has the conformation of a ♀ but tail length looks like ♂.
#18 ♂; just above pond by about 75-100 m distance in first big open area to north. Heading downward toward pond. CL 146.2; CW 152.7; 140.5; Scattered f.d. on rear ¼ and front marginals area; b-green algae on rear also but mostly dried up. W.g.i.'s clear, thick and well -developed; Scutes mostly worn smooth except for outer borders. F.d. interestingly, heaviest on these areas where still are some rough growth rings.
#206 - CL 88.3; CW 94.9; 87.5; Another 00 m north of #18 - in open Passiflora covered area, eating. W.g.i.'s clear, thick and well developed. No. f.d. or algae and scutes smooth only in very centers. Probably stationary here for awhile because lots of eaten down Passiflora and several burrows.
Pg. 120.
#303 ♂ - in big open area where always see 3 or 4 tortoises, about ½ km and above pond. Altitude is about 915 - 920 feet. Clearly has been coming up - can see trail to S. for 50 mt.
Remarked because getting faint.
#671 ♀; same area, a little higher up; eating in open Passiflora covered area. CL 87.3; CW 96.0; 87.0. No f. d., algae, and scutes smooth only in very centers, except topmost vertebrals which is smooth over about 1/5 of surface area in center. W.g.i.'s clear, thick and well developed. For fun I tried counting rings on this one's carapace scutes using 3rd and 4th vertebrals and 2 costals - got 15 , 15 ,15, 14 for the 4 counts. It would be nice if this indicated age!
#992 ♂; CL 133.1; CW 151.5; 136.0; Up over higher beyond last 2 - in Passiflora covered open area. Altitude about 950 feet according to Thommens. Few spots of f.d. in usual locations; not much B-green algae, same areas, especially along scutes junctures, but mostly dried up. Some of pale green-bluish lichen on protected lower half of 4th vertebral; some scattered spots of bright green - yellowish algae in low protected stops, but drying and pale. W.g.i.'s thick and well developed in places, but intermittent. He appears to have been in this area for awhile because
Pg. 121.
. . . . lots of new and old droppings, burrows and many square meters of eaten down Passiflora.
New #1241 ♂; CL 98.5; CW 101.2; 94.5; Bad f.d. on rear 1/3 of carapace and front marginals and minor spots elsewhere. Some remnants of b-green algae in rear areas about dried up; scutes smooth in central 1/5 or less only ; w.g.i.'s mostly complete, but thin. In area where found # . . . . in November, '69. Altitude is 970-980 ft; has clearly been coming up a bit because trail come out of "forest" from south and followed up for 50 m plus. Open Passiflora covered area; some grasses also has hundreds of ticks up against shell on leg - pocket skin.
#562 ♂ CL 109.1; CW 121.5; 110.0. Same area - slightly higher - in fact #1241 used this ones trail for a bit in going up. Also clearly going up in mixed Passiflora - mora area. Bad f.d. all over front marg. Area and rear 1/3 of carapace and scattered elsewhere; Scutes and b-green algae as in previous animal. W.g.i.'s moderately thick and well developed. Remarked because some getting faint.
New #1242 ♂; CL 94.5; CW 101.0; 94.0. Same area and altitude but east a bit - 50 -75 m. Only a few scattered minor spots of f.d. in various places on rear and front marginal areas of carapace; but big spot in very center of 3rd vertebral and deep and severe! No algae, scutes smooth only in centers. W.g.i.'s moderately well-developed, but thin in places.
Pg. 122.
Animal was moving up for about 75 m, then loped and now heading S - West again.
Went up to 1150 feet on human trail, on the other side of Los Hermanos; no tortoise sign (new) since that seen in December about 1000 feet where above 3 animals seen. Sign from December even more obscure: thus it does not appear to me that tortoises are up this high anymore. Indeed the majority of sign is all at 1000 feet and lower. In any case, may be a few animals higher, but if so very few and scattered widely. I poke around in several open Passiflora - grass - herb covered fields at upper regions 1100-1150 feet and saw no sign at all, not even old trails. Also, before the above trip and 3 beasts, went up toward foot of Mirador quite a ways as in previous samples - again - no new sign of tortoises at all.
In general they seem to be staying more east of Mirador (where there is much mora) and all more in a line from El Chato and small pond below up to Los Hermanos and a bit west of Los Hermanos - are many large

open Passiflora and herb covered field all the way nearly to foot of Los Hermanos and I think this is the path they are following in a general fashion.
Pg. 123.
On return down human trail -
#781 ♂; in brush burrowed so can't measure but is medium large - cerca 110-115 CL. At about 965 feet, but could follow trail down from above at about 1000 ft. - has been up there awhile because lots of chewed up areas and turds; now seems to be going down a bit.
This point where now is, is very close to location of (50-75 m east) #1242 and he is just on border of big Passiflora covered area which #12423 was coming up through today or yesterday. This same area is just above and only separated from (by a small bit of mora) open Passiflora pampa where found #'s 303 and 671 this morning (I almost always find a few animals in it in fact).
Then a bit lower down (15-20 ft in latitude) a lot of sign in grassy and Passiflora pampas on either side of trail. Searched around here a bit -
#377 ♀ to east of trail a bit, alt about 945-950 ft. Clearly in the area while because dozens of eaten down sq meters of open area herbs, burrows, and turds, old and new. CL 97.8; CW 105.3; 97.0.; Bad f.d. on rear ¼ of shell and a few spots on front marginals and elsewhere; b-green algae on rear area also but mostly drying up severely. Scutes smooth in central 1/5-1/4 of their area. W.g.i.'s incomplete (a bit only) and thin but developing probably.
Pg. 124.
#163 ♀; CL 90.1; CW 96.2; 90.5; Same area as last animal; Only a few minor spots of f.d. on rear of shell; no clearly distinguished algae although some dry crud on rear may have been same; w.g.i.'s clear, medium thickness and well-developed. Scutes smooth in central areas only.
On toward pond- more and more sign - same all the way, but for about last 100 -150 m distance little clear sign; however during this time one is passing though mostly forest with fairly closed canopy and as I have noted many time previously tortoise seem to definitely prefer open area and use only forest border for shade in large part.
At pond near El Chato turn off -
#'s 18 ♂ and #609 ♂ had made it to the pond by time I returned at 1345 hrs. Both are at its edge in the shade. See more comments on these two below.
<u>General conditions above El Chato:</u>
Certainly appears that animals, as a population in general, are no higher now than in December and the heaviest concentration is in the same general area as then - i.e. cerca 950 - 1000 feet and lower on down to pond. Virtually all
Pg. 125.
. . . . tortoises and all sign of them is in open fields of Passiflora and other herbs. They use the woods only when necessary to pass through them and their borders for shade on hot days. However, even many of shade and night burrows are made in open areas under few scattered trees and bushes or even in places where herbs are particularly tall - i.e. 1 m. plus.
The highest animals all even lower down now than in December. So in sum, I do not think that population has moved up since December sample and certainly some animals have moved won (e.g. #487 ♂. Many of others may have but can't tell because have not found many repeat numbers. Certainly not an overall ascending of altitude in past 3 weeks! Also, concentration of animals from pond to 950-100 feet appears to be about the same as in December.
<u>More on #'s 189 and 609.</u>
When I arrived #609 ♂ was partly burrowed into some hanging vines and herbs and #18 ♂ was right behind 609 with his front and front-side at the latter's rear end. Therefore perhaps an aggression or attempted copulation. (homosexual mountings?). I watched them for 1 hour, but both just set in shade. However #18 was poking about #609's rear (and perhaps sniffing, couldn't tell?) and when doing so s609 would retract with loud hiss. After about 1 hours 609 moved away, looped around and [marginal note: see Roll #67; photos #18-20]
Pg. 126.
. . . . entered pond 5 meters behind #18. The latter did nothing in response to all this. Could be they both happened to be in same place for shade, although is plenty of other shade available here.
While I was doing this J. Black and c. were at Naranjo and Zone 4 - their sightings:
#621 ♂; CL 90.0; CW 95.5; in mora near Chato on R. B. between turn off and woods as going west.
#922 ♀; CL 82.0; CW 89.8. Location as for #621 ♂.

#649 ♀; CL 82.5; CW 89.7; on R.B. between Chato and Naranjo - in forest; a little more than ½ way to west, between them.
Naranjo - only one -
#660 ♂ ; CL 141.7; CW 158.5
Zone 4 - at first pond
#766 ♂?- CL 100.0; CW 102.5.
New #1236 ♂; CL 69.2; CW 74.3.
#675 ♂; CL 126.7; CW 140.9
#1043 ♂; CL 103. 5; CW 112.0.
#759 ♂; CL 127.5; CW 137.2
#972 ♂; CL 85.7; CW 94.6.
Pg. 127.
#681 ♂; CL 105.8; CW 114.2
#678 ♂; CL 140.3; CW 152.8
#874 ♂; CL 118.7; CW 134.5
#767 ♂ CL 133.9; CW 150.8
#680 ♂; CL 128.3; CW 140.3
#955 ♂; CL 117.0; CW 126.8
On return:
#778 ♂?; CL 91.8; CW 101.5 - in between El Chato and Naranjo on R. B. - but only about ½ km from Chato to west.
#155 ♂; CL 132.3; CW 145.6; in bush near El Chato along R. B.
All ponds at Naranjo and Zone 4 were dry and without mud also.
Caseta 1900 - weather; Cloudy off and on all morning; sun, but cumulus obscured majority of time till about 1230 -1300; after that sun out till sunset. Max 85.5 ° F; Min 67.0 ; Evap 3.1 ml (reading 13.1); Rainfall - 0.0 mm
17 January 1970 - To Region 4 of Caseta - La Fe trail to sample.
#354 - about ½ way down to pond #1 - note that was above Caseta ½ way to R. B. yesterday at this time (0745).
Pg. 128.
In pond #1
#'s 526 ♂, 127 ♀, 1013, 1006 ♀, 445 ♀ (painted #1) 862 ♀ (painted #5), 97 ♂, 1166, 1 unidentified medium (♀ scale), 1 unidentified medium - large ♂ (probably #220 ♂), 1168, 408 ♂ prob.; CL about 95.0, and 1022.
Then found a trail to SW to plant #1 covered area - about 75 m long and fresh this a.m. now 0805. - followed and found #220 - came from pond; thus above animal in pond is not #220!
Total of 14 animals minimally in pond last night!
Reg. 2 -
#135 - beside trail, apparently moving up drainage; only 200 m or less below pond #1 in distance.
No more seen till Region 4.
Region 4 sample:
Near weather instruments-
#452 ♀, #109 ♀, #274 ♀ (painted #2) - down from Caseta pond #1 and fast!
#809 ♂
Pg. 129.
Pond circuit and areas between pond and W. instruments.
#351 ♀ (painted #14)
#2 ??, a ♀, medium -large; no other detectable cuts though 100 may have been - ??
n.m. But not 102 because I know that animal!
#1213 coming from pond with fresh mud on shell
#938 ♀ ; coming from pond with fresh mud on shell
n.m.
#913 ♂; in pond in mud wallow; n. m. [editorial note: its not clear what the n.m. means in this context]
#3♀ - in pond in mud wallow Down from the Caseta !! and rapidly !
Open areas just to south of W. instruments.
#908 ♀; #1058, #1194, # 713, #709 ♀

Weather in Reg. 4 - 1100 hrs. Rain 0.02 inches; Evap 20.0, refilled full; Max 87.0 ° F; Min 66° F.
On return:
#1021 - ½ way down to C. pond 31 along trail (but using drainage, not trail, as main pathway from Caseta area.
While I was doing this J. Black and J. San Miguel were sampling in Zone 1 and Zone 6 - Their results were as follows:
Pg. 130.
Zone 6 -
#829 ♀; CL 100.5; CW 112.9
#797 ♂; CL 120.0; CW 128.8
#455 ♂; CL 116.1; CW 124.5
#44 ♀ ?; CL 94.1; CW 101.2 [Marginal note: check on this one??]
Zone 1
39 cm. of H20 in pond #1
at pond #3:
#505 ♂; CL 109.4; CW 116.3
#333 ♂; CL 106.7; CW 117.0
#233 ♂; CL 118.5; CW 122.3
Around pond 3 and close areas near small pot holes.
#345 ♂; CL 96.8; CW 107.5
#1201 ♂; CL 88.7; CW 93.0
#335 ♂; CL 126.3; CW 137.6
#843 ♂; CL 135.5; CW 154.0
#411 ♂; CL 140.1; CW 151.0
#130 ♀ CL 82.5; CW 92.7
(They did not visit pond #2)
Around dry pond along trail to Zone 3; i.e. ½ -1 cm below zone 1 main area:
#1052 ♀?; CL 84.7; CW 95.1
#114 ♂; CL 97.4; CW 102.8
#718 ♂; CL 87.8; CW 92.6.
new #1237 ♀?; CL 89.5; CW 98.5
new #1238 ♂; 89.3; 94.5
#644 ♂; CL 105.9; CW 120.3
#266 ♂; CL 103.3; CW 116.0
#871 ♂; CL 125.2; CW 135.3
Pg. 131.
#113 ♂; CL 96.5; CW 98.7
#108 ♂; CL 74.7; CW 84.1
#273 ♂; CL 95.0 ; CW 108.7

Caseta weather, 1900 hrs. Sunny almost all day till about 1600, then mostly cloudy till dark; max 85.8 ° F; min 69.5 ° F; Rainfall 1.2 mm; Evap 3.1 ml. (reading 16.2 ml.) Evap refilled full at 1900.

18 January 1970
Going down to CDRS; upon leaving Caseta checked weather instruments:
Rainfall 0.45 mm; Evaporation 0.0 (reading 0.0); Minimum temp last night 73 °F.
Looked for tortoises on way down - saw only 3]
#444 ♂ (painted #11) near Caseta pond #4
#268 ♀ - 100 meters west of pond near reserve border, just west of zone 1 turnoff.
#810 -= very near #268 - just a bit further along reserve border.
Most of activity from area where #'s 68 and 810 were and east to Zone 6 turnoff - But spotty from Caseta to reserve border pond area also and a bit also on other side of Zone 6 turn off.
26 January 1970.
Returned to Caseta - checked for tortoises on the way.
Distribution about same as when went down 1 week ago. Saw 5:
#810 - same general area as on 18 Jan. 70, but about 100 m east of R.B. pond.

#1023 - just a short ways further west than #810 - also on border.
Pg. 132.
#403 - along reserve border at reserve border pond - note - has really moved since 7 Jan. '70. ** up on Devine's land.
#919 ♀ - drinking from a tiny pond beside Caseta pond #4.
#216 ♂; halfway in between Caseta pond #4 and Caseta.
Also ran down to Caseta pond #1 and took animals #
S = there were already 14 animals in the mud and water wallows when I got there at 1600. Could only get numbers of a few: #127 ♀, 862 ♀, 1190, and 11 more. 5 of these were large males and none were #526 ♂!! Thus certainly some new ones.
On trail just to east side of pond - # 1138, #135.
About ½ way up to Caseta - #538 ♂; 2 smaller unidentified ones - burrowed in.
In yard at Caseta - #450, #31 ♂, #1006 ♀.
Weather - 1900 hrs. - Max 88 ° F; Min 64.5 ° F; Rainfall 4.2 mm; Evaporation 22.2 ml. (reading 22.2 ml); refilled full at this time.
No rain all day, but cloudy (cumulus) most of time - not very hot; lots of light breezes all day too.
Pg. 133.
27 January 1970.
To Caseta pond #1 to check on animal's #'s there.
About ¼ way down - near little pond.
#538 sex ?; Tail looks to be long enough for male; but is very round and dome-shaped and has female "look: to shape; CL 99.6; CW 110.1; 100.0; scutes worn, but smooth only in centers. W.g.i.'s present but this and not complete everywhere; little f.d. on rear of shell but minor! No obvious algae, but some dried up stuff on rear of shell may have been b-=green type.
#1067 ♂; about ½ way down , moving up - fresh, 75 m above pond in distance -
#1072 ♂; all way down from up on Devine's place ! Alt. Here is about 550-560 feet - before at about 1000 ft or so. Mud on shell is fresh - certainly was in pond last night - now heading up trail a bit!
#862 ♀ (painted #5) and #1190 (painted #13), side by side only cm apart, on trail just 40 m distance above pond . Fresh mud on both.
#1021 - just east of trail about 30 m in same area as last 2 were seen - mud on shell but sticky - 1-2 days old thus !!.
On E. side of pond in open area - #1138 - fresh mud all over.
On E. side of pond in mud wallows - #127 ♀, #53 ♂ (maybe 153 ♂) - about size of #'s 220, 216, etc.
Page 134.
On N. side of pond in open grazing - #933 ♀ (painted #12).
In pond again - W and SW sides:
#60 ♀ (maybe 460 but hard to tell, marks very faint). CL 78.1; CW 84.0. Remarked as #60. W.g.i.'s present but about medium development only. NO f.d. or algae; just out of mud.
#94 ♂ - about size of #'s 220, d16 etc. in pond drinking.
#117 - just leaving pond and moving west along trail toward small manzanillos covered ponds.
#1135 - grazing on plant #1.
**1130 hrs. -- #351 ♀ (painted #14) - just entering pond from south ! all the way up from Region 4 !!! in on week.
#1022 - on edge going into pond.
** #626 ♀ - up from Region 4 !! - wallowing.
#785 - deep into a mud wallow - can't tell if head is even up enough for nostrils to be above water.
Also 2 more unidentified ones of medium size (♂ scale) - both in mud so can't see #'s.
Pg. 135.
West of pond in manzanillos area -
#62 ♀ - CL 69.5; CW 76.4, 70.0; Seems awfully small to have such a low #, but no others detectable and the marks present are clearly visible; w.g.i.'s incomplete thin and hardly visible in some places; scutes smooth only in center; no f.d. or algae; fresh mud on shell .
#1185 - in guayavillo forest bit more to west; no mud.
Swung out in wide arc to SW of pond - #715 - in guayavillo forest grazing. No mud.
S - SW side of pond - 10 -30 m from pond.
#699 (painted #16) ; ♂ prob. - tail a bit int. CL 94.5; CW 99.2; 92.0. ; fresh mud. On shell.

#835 - basking in sun in open - fresh mud on shell.
#1168 - feeding in sun in open - plant #1 (eating it); fresh mud on shell.
On return -
Small pond just below Caseta on way to pond #1 - #242 ♂ - up from Region 4 Only sign of mud on carapaces is slight bit of very old dry stuff - at this pond's edge grazing.
North of this drainage 50 m. -
#408 ♂; CL 85.8; CW 95.0; 87.0. No f.d.; no algae; scutes worn but smooth only in centers; w.g.i.'s clear, well developed and medium - large in thickness.
#444 ♂ (painted #11) now up around our tent - paths indicate has clearly been using small shaded pond just a short distance west of the tent -
Pg. 136.
To Caseta upper ponds:
#501 ♂; CL 114.3; CW 125.3; 112.5; Remarked because very faint. No mud; no f.d., no clearly visible algae, but some dry scum on rear of carapace; carapace scutes smooth in central 1/5 - or less only. W.g.i.'s clear and complete but thin.
#307 ♂; CL 113.5; CW 123.5; 113.5; Carapace conditions same as for one above with these exceptions; slight f.d. in spots on rear 1/5 of carapace and front marginal area. No mud. W.g.i.'s even thinner and not entirely complete - many areas with nothing visible.
These two animals (above) face to face but quiescent - #501 with head out a bit other withdrawn probably a recent aggression.
#98 ♂ ; CL 07.5; over from Camote patch on R. B. toward Chato! ; fresh green Azolla on shell - thus from upper ponds -
Above 3 animals all in open area along trail up from Caseta to R. B. - i.e. not far below upper pond area.
In open area just below ponds; #450; #354; #695; #852 (with fresh mud).
Pond area:
#688; most eastern dry one of pond; CL 85.0; CW 92.3; 84.0. no f.d. - a spot or two
Pg. 137.
. . . . on rear of carapace; bl-green algae may have been on rear 1/5 of carapace - but now only looks like dry scum; fresh mud on carapace; scutes smooth only in centers; w.g.i.'s mostly present, but thin.
At pond #2 - #258; #598.
Caseta weather - 1900 hrs. - Max. 84 ° F; Min 71 ° F; Rainfall 6.1 mm; Evap - 1.1 ml (reading 1.1) Rained till about 0700 (0530 -0700) then cleared to mostly cumulus clouds all day - no rain, but very little sunshine off and on from 1200 till about 1600 - cloudy completely at all other times. Appeared to be cloudy all way to coast. Started raining at 1800 and has been doing so off and on and lightly since then (now 2100 hrs).
28 January 1969 (actually 1970).
To zone 3 NA to take temperatures- On way looked for tortoises - not a good sample because did not scan both sides of trail just walked along and when saw one noted it - took only some numbers -
Region 1 - 6 animals between Caseta and pond #1 - #'s 1072, 242, 501, and 3 more -- 1 more near pond on east side - did not go to pond to look.
Region 2 - saw none
**Region 3 - only 1 - #3 ♀ heading back up along drainage definitely and not trail. Saw here with trail heading from below; about 50-70 feet altitude at least and ½ km or more above Reg. 4 l- just at beginning of steep ascent part of Reg. 3 - lower end of it.
Pg. 138.
Region 4 - weather - 0930 hrs. - Rainfall 0.18 inches; Evap - dry !, thus 35.8 plus; refilled full; Max 87.5 ° F; Min 64.0 ° F.
Animals in Region #4 along trail - #1058 - no mud on shell.
#1059 ♀; no f.d.; no algae, no mud on shell; w.g.i.'s clear but quite thin; scutes smooth only in very centers; CL 72.9; CW 89.5; 83.0. No f.d., no algae; scutes smooth only in very centers; w.g.i.'s almost non existent over most of carapace.
#1194 - no mud.
#713 ♀ - no mud.
#709 ♀ - dry mud on shell.
#1074 - dry mud on shell.
#109 - no mud on shell.

#220 ♂ - only a bit of very faint dry mud and dry b-green algae on shell. Down from region around Caseta !! CL 121.3; CW 143.8.
#756 ♀; CL 71.9; CW 78.8; no f.d., no algae, no mud on shell; scutes smooth only in very centers. W.g.i.'s very faint, thin and incomplete.
#479 ♀ moving south, just below rocky area.
All but 3 of the above animals were in flat rock areas trying to get H20 from small holes and pockets in lava.
Pg. 139.
Zone 3 nesting area - weather - 1130 hrs.; Max 88.0 ° F; Min 64 ° F; Rainfall 0.065 inches; ; evap dry !; refilled full (35.8 ml plus)
Saw no more tortoises till arrived in Zone 3 NA. Cursor examination there while taking temps and checking nest; #'s 1144, 918, 131 ♀.
Notes on weather while taking temps. -
06000 -1000 - mostly cloudy - gray overcast but no rain; toward 0930 clouds becoming lighter and some weak radiation can be felt.
1000 - 1200 - sun came out about 0930-1000 and stayed out most of time for next 2 hours - lots of cumulus clouds and occasional shade from these.
1200 -1400 - sun out most of the time - cumulus clouds continue but shade only rarely.
Since 1000 has been clearer above also, but clouds certainly heavier in Region 4 and even more so at Caseta - probably cloudy predominant amount of the time in these regions.
1400-1600 - ditto to last 2 hour period. From about 1530 on looks just as clear in higher regions also.
1600-1800 - from about 1600 -1645 same as from 1400=1600; then virtually all cumulus gone and completely clear till sunset at about 1815. Appears same in higher regions.
1800-2000 and 2000 -2200 - still clear sky; plenty of stars and moon. At 2200 went to bed; failed to get temps at 2000 and 2200 because of being ill with stomach pains.
Pg. 140.
Next day - 29 January 1970.
0600-0800 - Heavy overcast from 0600 till 0715; then a bit lighter but still no rear weak radiation which can be felt. Even more heavily overcast in higher regions.
0800-1000 - Sun came out at 0925 for first time and was out and in (1/2-1/2) from then till 1000.
1000 -1200 - Sunny off and on, mostly not sunny - say 65 % vs. 35% - cumulus clouds very prevalent.
1200-1400 - sunny most of time - about 70% vs. 30%.
1400-1600 - ditto to last 2 hours period - but sunny damn near whole time from 1400 till 1600.
1600-1800 sunny almost entire period.
1800-2000 - clear and starry
2000 - 2200 - clear and starry.
Next day - 30 January 1970.
1600 - 0800 - clear and sunny.
Took measures of soil moisture every 4 hours for entire period - results were always the same -
Nest - cap (5 cm) - just barely registers
Eggs (14 cm) - just barely registers.
Soil - 5 cm - no register
Pgs. 141-143 (entered as separate excel file)
Pg. 144.
When I arrived at 1100, check all the close nests (#'s 1,2,3,4, 6,7 9,12, 13,14,15, 17K) and found all as before except #'s 3, 6, 7 have large hole to side of and partly in hard cap and appears if young have emerged. Will open these later to verify this. Nest #4 has a disturbed place just to one side of the hard cap but no hole yet.
Upon close examination I discovered that there is a young one coming up out of nest #4. It is about 2.5 - 3 cm below the surface, but the soil above it is broken into clods and crumbles and has caved in enough so that its head and the very fore part of the carapace (marginals) and forelegs are out in the open. The animal is almost level, in a plane parallel to the ground surface and is thus not coming up along a steep grade - this appears to be due to the fact that as he digs and moves upward the loose crumbly soil fall beneath him.
Saw him moving now and again from 1100-1230, but mostly
Pg. 145.
. . . . quiescent - a short burst of activity every 15-20 minutes - sun beginning to hit him at this time.

From 1230 till now (1500) he has been completely quiescent and sitting in a position so that all but a small part of his head and front marginal area of the carapace are in the shade; it is quite hot and the animal is obviously not being active because of this. If he were to continue to struggle upward during his hot period, I am sure there would be a great danger of becoming too much exposed to the sun as he reached the surface and as a result the beast might suffer heat prostration before he could successfully dig all the way out of the surrounding soil.
At 1415 I took the temperature of the cavity and soil just beside his head in the shad - depth about 1.5 cm - it was 37 ° C! From his position his temperature must be about the same as this. - seems quite high!
I took a few photos of him in this position - Roll 70 , #'s 3-5.
At sunset the animal is still in the same position an d has had his head and forelegs drawn in since about 1500. Does not appear that he will be active today. Max. temp today 86 ° F.
Checked last egg in nest #1 - like all previous 13 - either infertile or dried due to Castro's methods used by O. Chappy; impossible to say for sure; no evident embryo and egg dried inside.
Pg. 146.
29 Jan 1970. Max 87.0 ° F; Min 67.0 ° F (last night).
0630 - begin taking temps again recorded on previous pages with yesterdays records.
** Progress of animal at nest #4.
At 0630 just as was last night. At 0715 is lying with head out (forelegs also) but quiescent. At 0740 begins first observed activities - moving forelegs and stretching head and neck way out and generally trying to free himself of the surrounding soil. (It is interesting to note that the temperature of the soil around him is only about 25-26° C now whereas it was 37 ° C yesterday at 1415 hrs.)
Struggled briefly off and on from 0740 till 0850, but making absolutely no headway in freeing self. So at this time I checked soil around him and found that he was wedged in between a number of very hard large firmly packed clods. I do not think he would have ever been able to fee himself alone and would have certainly died on the spot. There are no other young ones near him as far as I can detect so he is getting no help in digging. So I loosened up the soil and clods around hi. At 0855, almost immediately after my loosening the soil, he emerged, and rapidly
Pg. 147.
. . . . without any looking about headed southeast (toward the sun, although if this is significant I can't say - sun is not out fully but can see its position through clouds).
0900 - He quickly found an opening in the wall (perhaps by chance), passed through and continued in same direction about as fast as he could locomote. The area he is passing over is mostly covered with rocks (small embedded ones) and low growing and largely or partly dry herbs.
0912 - still moving in same direct line toward sun. Does not look around and take the easiest path necessarily- even climbs over some small rocks. At one point, he went up onto a rock, reached its other side and saw the drop off he was facing, turned 90°, got off of rock and then turned back to same S-Easterly direction and continued as before!!
He has moved approximately 38 feet in straight -line distance in 14 minutes - of course he has made little side movements etc. so actual distance has been a bit more, probably more like 45 feet. He has shown absolutely no sign of investigating or attempting to eat any of the plants on his level and there are many herbs on his level and within his reach!
His locomotory ability, as with young Duncan tortoises hatched this season (69/70), is awkward and stumbling in appearance, but he moves right along, never stopping to rest so far (0922).
Pg. 148.
0923 - after 23 minutes he has moved about 60 feet.
His movement through the herbs is attracting a number of animals - several Tropidurus have seen the herbs moving and come to investigate; however they quickly leave upon seeing that there are no prey items. Once a mockingbird flew down and landed on the ground near him and twice finches did the same on nearby twigs. In each case he stopped moving immediately and froze. The birds left immediately in each case. He then remained still for awhile before starting off again - in the case of the mocking bird for about 20 seconds. And the finches, 1 minute and 30 seconds respectively.
He does to some extent avoid very large obstructions, but for the most part does not detour much and just keeps plowing forward through herbs and over low rocks.
1000 = have to go take temps so will leave him. - He has now reached the first truly and clearly rocky pile about 100 feet SE of nest #4; he is still going in the same direction onto this pile and has slowed down his

pace considerably because of the rougher going. Has just reached the 100 foot straight line point after 1 hour of movement, but the last 20
Pg. 149.
. . . . minutes have been very slow going with many short detours and slow climbs over rocks and through dry tangle herbs. In this 20 minutes I do not think he has gone more than 25 feet straight line, but probably 50 % more than that when turns and twists are added.
When I returned at 1030 could not locate him - can't hear moving so may be resting in the area because sun is quite hot now.
It is interesting that although he passed many rocks and tree stumps (where could have found shelter and a hiding place) in the open part of the nesting area, he passed straight by these without even investigating them and headed straight out onto the less green, more densely vegetated and rough rack piles, the latter being the type of terrain which surrounds the nesting area on all sides. This correlates well with the locations of all the small tortoises I have found so far. Except for #1193, all were actually in these rocky areas and even #1193 was in between 2 of these areas, no more than 10 m from each of them. In fact this morning he was coming from one of these rocky areas into the more open flat, soil covered area where his 2 burrows are which I have seen him in so frequently.
Finally condition of young one on emerging.
1. covered all over by red soil
2. yolk sac and umbilical area
Pg. 150.
. . . . .well dried up and wrinkled and only about 3 mm wide at its widest point - obviously 1 week or even more since hatching - probably closer to 10 days to 2 weeks from what I've observed with Duncan tortoises. Umbilical area dry skin was typical dirty pale - yellow in color;
3. plastral fold all gone'
4. two indentations in body toward front of carapace - not deep but involved marginal and costal scute areas about ¼ of distance around carapace circumference (from nuchal notch toward supracaudal scutes) - probably due to being wedged into dirt clods in trying to dig out, since were large solid clods on each side which were pressing into these indentations.
5. did not get measurements, but certainly not much different than Duncan animals - if anything appeared to be a bit larger;
6. was not still "rounded up" in shape as Duncan animals often are at hatching and for a few days afterwards; had clearly straightened out and become flattened and of normal shape by time escaped from nest, assuming that was rounded and compressed when hatched.
Pg. 151.
Examination of nest where young seem to have escaped.
Nest #7 - large squarish exit hole, about 8.5 x 8.5 cm, largely to one side of hard cap, but partly up through it; dirt in part, which young therefore dug through was quite hard and crumbly; but they did avoid the main thick hard cap over the center of the nest. Inside found 3 obviously bad eggs and shells of either 4 or 5 which seemed to have hatched successfully and escaped. None of the broken shells had any odor of putrification and all were only ½'s or less and were sitting around the underside of the flask overhang as if the young had hatched facing the center of the nest and then escaped. Of the 3 bad ones, upon opening fully discovered the following: all appeared to have been crushed by wgt. Of soil from above - 2 were broken from top, 1 on bottom.
1 measured 62.3 x 62.3 mm; 1 measured 61.0 x 61.7 mm
All 3 were rotten and appear to have been infertile - no embryo whatsoever detectable.
Nest: appeared to be normal flask shape, with all eggs in one layer and most pushed at least partly under flask overhang. Interestingly, all 3 rotten one were in central part and the 4 or 5 young that hatched were under the flask overhang, at least in part. Nest was 21 cm deep at deepest point in center and bottom was made up in part by 3 rocks. The egg broken on bottom could have
Pg. 152.
. . . . been broken in laying when it hit one of these in the center of the nest - it was on top of one of the rocks. The eggs were immediately overlain by the hard cap material. When the ♀ made the nest she must have begun covering them with wet mud from the very start. This mud is of course dry now but it seems almost like unfired pottery and each egg's position can be seen in the nest where it was laying in the now hardened mud. This is interesting for it means that an animal in the side of the nest, under the overhang, if he hatched in an outward facing position would have nothing to face but hard mud; of course, he could turn

inward after hatching. It appears to me that the nest is so hard and dry inside, that the effort of the young as a group in digging out might have real survival value; in addition, the exit hole is large enough to indicate that 3 or 4 would well have dug out in unison. Also, there was sort of
Pg. 153.
. . . . an air space maybe 5- 7 cm in depth between the eggs and the hard cap - I think this mostly, however, was due to the absence of the eggs and young - i.e. this space is where they were - it is interesting however that the cap is so dry and solid that they could dig out from under it and it remained intact l- this certainly aids them by not continually caving in on them in large chunks. They came out to the side of the main hard cap, but still had to go through at least 4-5 cm of hard, dry, compressed hard cap material. Since no more eggs or young in nest I filled in.
Nest # 6 - Can't tell much about the nest shape, but again looks to have been a normal flask, but perhaps without much overhang. Eggs were more or less in 3 layers - not good layers, because one group or layer of course, fits partly down into one below it. There were 3 eggs on very bottom; the top of these 3 is 22 cm below top of cap, and thus bottom of nest must be about 12-28.5 cm deep. These 3 eggs are all still in position and unhatched - appear OK and are surrounded by "loose" dirt - but firmly held in place by soil. Above these 3 were 4 more eggs, partly overlapping this first layer (bottom layer). One of these is rotten and infertile and I discarded it. 2 appear OK and I left them in place to see if will hatch.
Pg. 154.
The fourth was broken open and contains a baby tortoise, alive, but quite deformed (see more below) and embedded solidly into the soil - again not baked hard soil, but firm, slightly moist and semi-loose stuff all around these eggs. He probably could have fired himself, but his deformity makes it hard for them to move, so took him from nest and will return him to CDRS for love and care. [Marginal note: No - let loose in nesting area!]
Finally, above and partly fitting into these 4, were 3 more eggs - all 3 of these have hatched and left the nest. In doing so they made a hole to the side of the hard cap but just partly up through it. Hole measures 10.5 x 7.5 cm. The clearly dug up mostly through looser soil and pieces of hard cap only fell in on them from the roof as they dug out. From size of hole could have been a joint venture. Top of these eggs was about 11-12 cm below the hard cap top I would estimate. As in nest #7 the hard cap sat down right on top of these top 3 eggs and their impressions can
Pg. 155.
. . . . be felt in it. And, as in nest #7, the cap is so dry and baked that it remained intact as the young hatched and then dug out from beneath it, thus leaving an air space of 6-8 cm between it and the second layer of eggs.
This ♀ clearly put loose soil in hole first (which filled in around bottom and second layers of eggs) and then mud in on top of that and over the uppermost 3 eggs.
It is very interesting that the top 3 eggs hatched and the young left before any of the lower eggs (except perhaps the deformed young one) had even hatched ! Must be related to heat flux and depth position!
I did not have to even disturb the 3 bottom eggs in this opening, but did have to take out the 2nd layer - replaced them and restructured nest just as I had found it, including leaving the hole made by 3 young in escaping. Note that all eggs inside are covered with loose soil due to 3 escapees pushing loose soil in on top of lower 3 layers of eggs as they dug out. So 5 eggs remain in this nest.
Nest # 3 - Again appears to be a normal flask shaped nest; eggs apparently in 3 layers more
Pg. 156.
. . . . or less; 6 on bottom, the top of these at a depth of 23.5 cm - (from top of hard cap) - 5 appear OK now, but not hatched; one putrid - examined and found dead in 1st incubation cycle - just barely started - looks like a 48-72 chicken embryo; then 6 more on next layer - 3 putrid and appear infertile at least as I can determine, 1 is decomposed badly but contained a tortoise in the 3rd cycle of incubation - in fact looks nearly read to hatch but badly decomposed, 2 hatched and lying in their shells upside down (see below for further comments). The uppermost layer appears to have contained 3 eggs, all of which have hatched and the young have escaped.
The escapees went out to the side of the hard cap as in nest 6 in particular and also similar to nest 7. Again seemed to pick softer soil to dig through, with hard cap pieces cracking up and falling in on them a bit as the excavated to side of and beneath it. However, as in nest 7 they must have had to
Pg. 157.
. . . dig through at least a few centimeters of the dry, compact hard cap from the look of things. The hole where they exited is about 4.5 x 10 cm, but a largely area of the hard cap is cracked and beginning to fall in

- about 14 x12 cm. Again, as they exited they appear to have deposited loose soil over the eggs below them. Also, the hard cap again is so firm and hard and dry that it has remained intact and where they left is now a small air space about 6-9 cm deep above the nest layer of eggs. Finally it is again interesting that the highest up egg hatched first, followed by the second layer, and none have hatched yet in the 3rd layer. I restructured the nest as before, even replacing the 2 hatchlings and will reexamine it later.

Comments on these hatchlings -

1 from nest #6 - This animal is extremely compressed and is extremely round from the top view; it was obviously severely compressed and restricted in the egg. The plastron is very notably deformed because of this, the entire abdominal scutes area being all pooched out severely. The plastral fold is of course as a result very deep and markedly so. The umbilical area is dried up, wrinkled, very withered and certainly 10 days to two weeks in age or more is indicated (from beginning of hatching). The animal is all covered with red soil. Took some photos of the deformity since it is difficult to describe Roll 1; photos 10-13.

Pg. 158.

Photographs -

Roll 54 -

1-9: #1193, small tortoise, in zone 3 NA - showing in and out of burrow site has been using for several days.

10-end: group of 10 tortoises drinking during garua from small hole and pits in flat lava rocks in Region 4 of Caseta - La Fe Trail

Roll 55-

#'s 5-9: photos of rear of #114 ♂ showing flaking disease and green-black algae which has suddenly become noticeable in past 2 weeks on many animals.

14-17: algae, fungi, and land snail on shell of #167 ♂

18-22: blackish - green algae and flaking disease all over rear end of #142 ♂

23-25: #326 ♂ - small seedlings growing in bit of soil collected in gouged out hole in 1st costal scutes.

#26-29: #10 ♂ - blackish - green algae and flaking disease.

Roll 62-

A few shots of Caseta upper ponds and tortoises after 2 weeks of rainy weather - refilling a bit.

Roll 63 - concentration of tortoises wallowing in Caseta pond #1 after 2 weeks of rain and cloudiness.

Pg. 159.

Roll 64 -

#'s 28-36 - ♂ #31 and ♀ #3 - attempted mating near our tent on 8 Jan. 1970.

Roll 65 - #'s 11-21 - small tortoise, about 2-3 years of age probably at La FE nesting area - 11 Jan 1970.

#'s 22-23 - tortoise #1221 at La Fe nesting area- seems abut 6-10 yrs. Old- 11 Jan. 1970.

24-25 - tortoise #1137 burrowed into shady spot at dry pond at La Fe NA - 11 Jan. 1970.

#27 - end - tortoises at C. pond #1; 13 Jan 1970.

Roll 66-

#'s 1-10 - tortoise at Caseta upper ponds - 13 Jan. 1970

a few photos of lichens, mosses on trees; also of the orchid Hionopsis utricularoides on a Xanthoxylum tree.

Roll 67 -

#'s 5-7 ♂ #181 agressing ♂ #296 at zone 5 on 15 Jan '70

8-12 ♂ #507 - large and very bad flaking disease; zone 5, 15 Jan. 1970.

13-14 - lichens and algae on #507 - Note maybe a new lichen - one is yellow!

15-17 - #'s 507 ♂ and 1181 ♂ just after aggression sequence.

Pg. 160.

18-20 - photo of #18 ♂ (tail size) and 2 of #609 walking - pond near El Chato turn off. 16 Jan '70.

Roll 70 -

3-5 - young tortoise escaping naturally from nest #4, Zone 3 NA

6-8 - nest #7

9-11 nest # 3

12-14 - nest 6 (all of these 6-14 in zone 3 NA - shows natural opening made by small ones when they escaped.

15- end - matasarno (Piscidia) in zone 3 NA - with fruits and leaves. 28 Jan. 1969 (actually 1970?)

Roll 71 - 1-6 Opuntia echios - Zone 3 NA

7-9 - Nest #7 showing hard cap and where young escaped to side of it.

10-13 - Young one from net #6 - shows extreme roundness and plastral deformity - certainly due to being compressed in the egg. Also note condition of umbilicus.
14-15 and 16-18 - Young from Nest #3 - some deformities due to either egg or more likely soil compression in nest. Also note condition of umbilicus.

End of notebook.

Isla Santa Cruz Volume #7
Field Notebook of Craig MacFarland

Pg. 1.
29 January, 1970 (continued)
The animal's measurements are as follows (used vernier calipers and graph paper) SL 60.8 mm; SW 62.7 mm; H 42.0 mm (note deformity); CL 86.5 mm; CW 92.8 mm. I will release this animal tomorrow just after sunrise.
Two animals from nest #3 – neither of these 2 is markedly deformed but there are some slight indications that they were under some pressure in their eggs and after hatching in the nest; each has some deformity of a slight degree as can be seen in photos 14 and 15 and 16 –18 of Roll 71. Their measurements:
First one – photos 14 and 15; more deformed of the two. SL 66.8 mm; SW 62.8 mm; H 40.9 mm; CL 86.9 mm; CW 93.0 mm.
Second one – photos 16 – 18; SL 68l.8 mm; SW 59.3 mm; H 35.4 mm; CL 86.9 mm; CW 87.0 mm.
Both of these were also covered with dirt when dug up from the nest. Both appear to be about the same age as their yolk sac areas are not bulged out at all, the plastron is nearly essentially closed on each one, and the yolk sac – umbilicus area is dry, wrinkled and only about 4-6 mm wide at the widest. The must have hatched some 7 days – 2 weeks ago, but had obviously not yet begun . . .

Pg. 2.
. . . to attempt to dig out as they were found upside down in their shell (bottom 1/3 of shells that is) and soil around them was pressed right upon them and showed no signs yet of their rasping or digging into it. [Marginal note – see pp 157-157, Vol. 6]. When I restructured nest placed these 2 back inside to let them escape naturally.
Activities today – when I arose at 0630 quickly checked locations of #
S 1144, 918, and 131 and found all already active. Also saw 2 more animals today in the area:
#1193 moving along only 20 m out into more open areas away from its normal haunts, i.e. two resting spots beneath semi-prone logs.
#528 ♀ prob.; CL 62.5 cm; CW 67.4 cm; 60.0 cm; about 25 m W of campsite near nests #'s 3, 7, 6, etc. No flaking disease, algae or mud or carapace. W.g.i.'s very thin and incomplete. Scutes not smooth anywhere yet.

Pg. 3.
30 January, 1970.
Continued taking nest temperatures with thermocouples.
Installed a new rain gauge this morning (Taylor "clear-vu" type) in place of old Tru-check. Should cut down on evaporation sharply.
Also exchanged Taylor max.-min. thermometers because one in the nesting area is clearly reading a maximum temperature each day which is too low and not accurate. I therefore checked one of those at the Caseta against the one set up at the Caseta and when satisfied that they were reading the same took one to Zone 3. Exchanged it this morning. Will

now have to check one removed against that at the Caseta and see by how much to correct all previous readings.
On leaving the area at 0800 – Evap. 9.3 ml; refilled full; Rain 0.0 mm; Max (yesterday) 87.0 ºF; min (last night) 67.5 ºF.
At Region 4 – 0900 hrs. – Evap. 10.1 ml; Rain 0.0 mm; Max 87 ºF; Min 68 ºF.
As went up to the Caseta noted several animals moving in interesting fashion.
#452 – in Region 3 just above Region 3-4 border, moving up along tail – altitude about 330 – 340 feet.

Pg. 4.
#782 and #754 (#9 painted) moving along the trail in the middle of Region 2 about 200 – 300 m in distance below Caseta Pond #1; altitude about 500 –520 feet. #9 is moving upwards; #782 downwards.
#2 (painted) = #374 ♀ - just coming to Caseta Pond #1 from S along trail; therefore just returned from Region 4 area.
1300 – At this time left the Caseta for CDRS to prepare for a 2 week trip to Fernandina.

16 February, 1970.
Returned to Academy Bay today after a 17 day trip including Fernandina and Pinzon. No one has been to the Caseta to gather weather data or to make observations in my absence, but it has clearly been very hot, clear and dry from 31 January to this date; Jan has been watching the . . .

Pg. 5.
. . . highlands all during my absence and says has been clear to the very top of the island every day we have been gone and almost in all cases from sunrise to sunset; occasionally there were a few light clouds in the mornings, but these always lifted and blew away quickly. Due to this very clear, hot, rainless weather I expect the evaporimeters are all dry and the ponds have dropped seriously in water level during the past 2 weeks. I can't go up till baby arrives so will have to rely on readings taken by other people.
22 February, 1970.
T. DeVries was at Caseta (along with his valet a la campamento, Camilo Calapucho) from 16 –22 February, 1970 and made some observations for me as well as took weather data at Caseta and put it in the Caseta booklets (I will check this later).
1 – Caseta Pond #1 is quite low and has standing H20 only in smallish potholes in central part and Western side; meter stick was dry when he first observed

Pg. 6.
. . . it at 0830, 17 February Continued to dry all through the week he was at the Caseta and he expects it to be dry within 4-5 days except for mud – i.e. end of standing H20. There are, of course, now many soupy, mud – filled holes where tortoises are wallowing frequently.
2 – Tortoise use of the pond is very heavy. On 17 February when he arrived at 0830 there were 27 tortoises wallowed in at the pond (#1). Just after he arrived another entered mud, making a total of 28. None had painted numbers. By 1000 he estimates at least ½

of tortoises had left pond moving to shadier places because of solar radiation. By noon all were gone.
On February 18, 1970 at 0830 saw 27 tortoises wallowed in at the pond; among these were #3 with painted numbers 4, 8, 13.

Pg. 7.
3 – On 17 February, 1970 he saw painted #'s 9, 14, 15 on trail between Caseta and Caseta Pond #1.
4 – On 19 February he went to Naranjo, and saw no tortoises and only a few trails between just above Caseta and El Chato while passing through the mora-covered region!
5 – On 19 February walked to Devine's by way of passion –flower covered areas from "right-turn" area of Reserve Border between Caseta and El Chato. Just W of Devine's near a small hill covered with Scalesia they saw 2 tortoises and numerous trails. This area is "considerably above Devine's banana tree plantation" which lies at about 850 – 900 feet elevation along his central manga. I would guess that this area is at about 1100 feet or so, but will try to locate it myself more exactly at a later time. Anyway, the animals are clearly up in an are to which they had not ascended by late January 1969.

Pg. 8.
DeVries then cam back Devine's central manga seeing no tortoises and only 2 trails one shortly below the bananas and another about 2/3's of the way from the bananas to the Caseta upper pond area.
6 – He remarked how must have been clear, sunny, hot, and dry from 1 February till his arrival on 16th because almost no rain in gauge and evaporimeter dry. Says there were a few nice brief rainy showers during the week they were at the Caseta.
2 March 1970 – A number of people were at the Caseta recently and gather some data for me. Pepe Villa and Julio san Miguel from 24 to 17 February and Robert Silberglied and Frank Sulloway (+ 2 others) from 27 February to 2 March (all from Harvard U.). Peter Pritchard (WWF, Marine Turtle Specialists Group, and U of Florida) was also there from 26 February to 1 March.
1 – Tortoises at Caseta Pond #1 and Caseta area –
A – Villa and San Miguel visited the pond on 25 February at 0700 and found that no standing H20 was remaining - only a few soupy -mud wallows on western side; only 2 tortoises there, in the mud. Not much mud in total. Meter stick dry.
B – Pritchard saw 2 tortoises in pond on 26 February in late afternoon; not any standing H20 and only a few soupy mud holes. By mid-morning on 28 February no mud even left except the very sticky stuff; no tortoises seen there at this latter date. He also saw painted numbers 9 and 14 in the pond area on 26 February 1970.
C – on 27 February in late afternoon R. Silberglied saw only 2 tortoises in mud wallows. Most mud getting very thick by then. On 28 February, midmorning saw none in the pond. Also saw painted number 14 at the Caseta, painted #9 in between Pond #1 and the Caseta, and painted #4 at . . .

Pg. 10.
. . . the pond.

D – F. Slowly says he saw approximately 15-20 tortoises in the semi-open and forested areas immediately around the Caseta Pond #1 when poking about for a few hours on the afternoon of 28 February 1970. He saw painted numbers #12 at the Caseta, #'s 14, and 4 near Pond #1.
2 – copulations –
A – F. Slowly saw a very large smooth shelled ♂ and a large smooth shelled ♀ copulating at Caseta Pond #1 on 28 February, 1970.
B – P. Villa and J.S.M. saw a pair copulating at El Chato on 26 February, 1970 about 0800. ♂ #123 and ♀ #619.
3 – Weather and ponds.
A – Caseta – see above for pond conditions. Villa took from February 24 to 25 at night (1900 hours) at the Caseta. On 27 February Pritchard took all but rainfall (couldn't get into Caseta).

Pg. 11.
1900 hrs. – Max 95 ºF; Min 68 ºF; Evap. 13.9 ml; Rain - didn't take.
B – Other instruments – P. Villa and J.S.M. visited almost all of them – excluding only Naranjo.
Region 4 of Caseta – La Fe Trail
25 February - 0800 hrs. – Evap. dry, refilled full; Max 94 ºF; Min 65 ºF, reset; Rainfall 0.20 inches, emptied. Pond completely dry; no mud.
Zone 3 Nesting Area – 25 February; 1000 hrs. – Evap. Dry, refilled full; Max 96 ºF; Min 65 ºF, reset; Rainfall 0.4 mm, emptied.
El Chato – 26 February, 1970 - 0800 hrs. Evap. Dry, refilled full; Rainfall 0.05 inches, emptied; all ponds completely dry; no mud of any type.
Zone 1 – 27 February – Pond #1 – a very small bit of standing H20 in the center; very much soupy mud filling about 3/4s of the pond; tortoises wallowing here heavily; but virtually nothing left to drink. Stick does not register.
All smaller ponds here dry completely; 2 other large (upper) ones also with soupy mud but no standing H20; lowest large . . .

Pg. 12.
One completely dry.
Zone 6 – 27 February – 1200 hrs. – Evap. Dry, refilled full; Rainfall 0.28 inches, emptied; all pond completely dry.
6 March 1970 – J. San Miguel was at Caseta again from 2-6 March and took weather data for me there and at other sites.
El Chato – 3 March - 0900 hrs – Evap 19.4 ml, refilled full; Rainfall 0.0 inches.
Naranjo – 4 March - 0900 – Rainfall 0.20 inches, emptied; Evap 0.0 (dry), filled full.
Region 4 of Caseta – La Fe trail – 5 March – 0800 – Max 94 ºF; Min 64 ºF, reset; Evap dry, refilled full; Rainfall 0.0 inches.

Pg. 13.
Zone 3 Nesting Area – 5 March – 0900 – Max 96 ºF; Min 62 ºF, reset; Evap dry, refilled full; Rainfall 0.0 mm.
Zone 6 – 6 March – 0800 – Evap. Dry, refilled full; Rainfall 0.0 inches.

Also on 25 February, 1970 P. Villa and J.S.M. checked all nests in Zone 3 Nesting Area. For me to determine if young had escaped. Presence of a hole indicates some young had escaped; I will examine all later.
Reports:
Nest # - Comments:
#1 - No openings (see my earlier notes) all probably infertile.

#2 - With an opening; 7 eggs inside remain – appear rotten; left in place; 1 live one inside nest; buried; taken to Caseta; crushed a bit on each side.

#3 - See my notes of 29 - 30 Jan 1970, with an opening.

#4 - With an opening; see my notes of 29 – 30 January, 1970.

Pg. 14.
#5 - No opening; they examined; all 8 eggs still inside and all appear rotten; left for me to examine.

#6 – With opening; see my notes of 29 –30 January, 1970.

#7 – Same as #6 above.

#8 – With opening – they examined and found 4 eggs inside; 3 appear rotten, the other OK. Left in place for me to examine; others appear to have left.

#9 – with an opening in hard cap.

#12 – with an opening in hard cap; opened to check; 1 partly deformed live one inside; taken to Caseta; 1 dead one inside; appears perfectly normal but apparently was caught under a rock while digging out. Died in process.

Pg. 15.
#12 (continued) – Rest of eggs left for me to examine later.

#'S 13, 14, 15, 17 – no openings

San Miguel then rechecked these nest on 5 March 1970; status same for all except #13 which now has a hole in its cap from which some young have escaped.
11 march 1969 [sic] Definitely 11 March 1970
Came up to Caseta arriving at 1200. Enroute stopped at Zone 6 for weather data.
1100 hrs – Rainfall 0.0 mm; Evaporation 27.2 ml, refilled full.
In Zone 6 near Pond #2 saw #797 ♂ in the shade – completely inactive. Then saw an unmarked ♀, about 80 cm CL inactive in shade along Reserve Border between Zone 6 and Zone 1.

Finally, saw #919 just below Caseta in shade, inactive, at Pond #4. Most notable thing is that tortoises are obviously moving and have moved upwards and even Eastward; lots of dry turds and old . . .

Pg. 16.
. . . as well as fresh trails all along Reserve Border from about 1/3 –1 km E of Zone 6 turn off to well past Zone 1 turn off and large pond alongside Reserve Border near Zone 1. Trails are going in both directions across the Reserve Border.
Then went down to Caseta Pond #1 to look thing over and record animals there. Arrived at 1500; sun is out strong as has been all day and all animals are in shade resting; very hot, dry vegetation abounds, and pond is completely dry; not even any mud.
Animals at the pond:
#452 ♀ - can't get measures because she is in the shade well under some Clerodendron shrubs. About 80 cm CL.
#217 ♂ - CL 93.1; CW 101.4
#1023 ♀ - CL 76.6; CW 81.7.
#450 – can't reach to measure.
#119 ♂ - (probably; tail long, but small for such a low #); CL 78.2; CW 85.0.
[Marginal note: All in shade, inactive]

Pg. 17.
#701 ♀ - (painted #8); burrowed in at 1620 hrs; in dry leaves and soil under a prone, dead log which forms an arch.
#1168 – feeding in shade of a manzanillo.
#1135 – in shade; inactive; CL 67.5; CW 70.7.
#668 ♂ - inactive in shade; CL 128.3; CW 140.4.
#791 ♂ - CL 94.4; CW 102.0; inactive in shade.
#408 ♂ (prob.) – inactive in shade.
#891 ♀ - inactive in shade
#1165 – inactive in shade.
#445 ♀ - inactive in shade, (painted #1).
Also saw 4 more animals in shade under Clerodendron around the Caseta Pond #1 but was unable to reach them because of dense brush.
On return to the Caseta saw one animal (#626) just below it, coming out of a burrow at 1715 hrs!
Most of the above 20 animals were inactive and resting in the shade when first seen. They remained so during the period I was around the pond – 1500 – 1700. However, some were beginning to come out of the shad and beginning to graze on grasses and herbs between 1630 and 1700. The interesting fact was that these animals were becoming active again, after resting in shade during period . . .

Pg. 18.
. . . when afternoon sun was so hot, exactly during the period when most individuals were burrowing in during the garua season. This surely indicates what I would have expected; a sharp, pronounced change in activity period corresponding to change-over from garua to hot season.

Pepe Villa checked weather at El Chato for me this afternoon –
1600 hrs. – Rainfall 0.0 mm; Evap. Dry, refilled full.
Weather at the Caseta today –
Hot, clear, sunny all day long; Max 91.0 ºF; Min 67.0; Evap. 11.6, reading 11.6, last filled on 9 March at 1300 hrs; Rainfall 0.0 mm.
John Nanson, "Linea A" guide was here today; yesterday afternoon he saw painted #2 at C. upper pond area.
12 March 1970.
Yesterday we spotted smoke from fires in the region just NE of and above El Chato. Because this may be the area with much passionflower and a goodly scattering of tortoises we will investigate the area today. On the way to el Chato saw scattered tortoise sign all through the mora; obviously not as concentrated as they were here in the garua season (i.e. though mid – December) . . .

Pg. 19.
. . . but there are certainly 8-10 animals at minimum along the mora trail. Saw only one, #627.
At Chato area we found that 2 new mangas have very recently been cut down to the Reserve – National Park Border. One comes down only 25 – 30 m W of the small pond near the Reserve Border – in between it and the El Chato turn off. The other comes down to the Reserve Border at the Western side of Chato just where the Reserve Border re-enters the guayavillo forest on the other side of the mora-covered area. These run up to the NE into the colonized zone, almost to the Santa Rosa – Bellavista trail.
We followed these up and found that burned area begins at about 900 –1000 feet at the base of Mirador and then runs on up to about 1150 – 1200 feet altitude on the land owned by Srs. Chappy, Garcia, and Ramos. The total area burned over looks to be about 150 – 200 hectares, most of it being covered by mora and passionflower – Commelina – grass – covered areas. The Eastern part of this burned are is just above the open passionflower covered areas where I have found scattered tortoises each month since and including November.
We walked up through the burned over areas to the Santa Rosa – Bellavista trail just to the W of Mirador. Saw scattered tortoise sign – old trail and dried . . .

Pg. 20.
. . . droppings scattered all through these areas, mostly where there were small patches and fields of herbs and grasses. Saw no real fresh sign and no tortoises so can't say if they are here. Probably were throughout the area from 1000 – 1200 feet in small numbers recently (see notes below). We saw no clear tortoise sign above 1200 feet.
It was clear that any tortoises caught in these burned over areas could easily have been killed by the fires – did not find any such animals but it would not be surprising if somewhere in the area a few were killed. I took some photos of the burned areas and the mangas – Roll 87, #'s 31 –35; Roll 88 #s 1-17.
We continued investigation by talking to Ramos and Sra Chappy (Sr. Chappy was not at home). Ramos claimed that Chappy was solely responsible for the fire and that it merely spread onto his land. Sr. Chappy readily admitted that her husband had . . .

Pg. 21.
. . . made the 2 mangas and also had been burning in the same areas: apparently she is not aware that, although the people can clear land legally in this area, that the practice of burning at all is against the laws (completely) in Ecuador. Sra Chappy also said, however that Ramos and Garcia were also doing a part of the burning. Ramos is also starting a manga down toward the Reserve Border he said.
The disturbing thing about this continual land clearing is that it is destroying more and more tortoise habitat; although the majority of animals are down lower at all times, they clearly seem to move upwards in considerable numbers as the weather becomes more and more dry from January through May. The especially move up in large numbers in the area above Chato toward Lechoso to the N and toward Vassan to the NE. The utilize the abundant herb- covered, open areas which occur over much of this area, sometimes mixed with mora, from Chato up to 1150 -1200 feet L(and perhaps even to 1300 – 1350 feet).
Of course there is also the immediate danger of killing tortoises if the practice of using fire to burn over . . .

Pg. 22.
. . . these areas is utilized.
All the above will be summarized on a map which I will make and put in this volume.
Other evidences of tortoises being on move to highlands during past 1-1.5 months. –
1 – see also page 7 of this volume.
2 – Ramos saw 2 large males right near his house toward the end of February; this at an altitude of roughly 1250-1300 feet.
3 – P. Villa saw 3 tortoises on trail to Moreno's NE of Chato; they were at an altitude of about 1200 – 1250 feet; this was during the last few days of February. This is notably higher than the tortoises were when I last checked this area in January.
4 – Came back by Segundo Herrera's this afternoon. They saw a tortoise about 300 meters below their house (distance) in late January. This is at an altitude of about 1100 feet.

Pg. 23.
But they haven't seen the animal since then.
We returned by Segundo Herrera's manga to Reserve Border just W of right turn. Saw absolutely no tortoise sign or animals all along this manga.
Returned to Caseta seeing no more tortoises. It is intriguing to wonder where #31 ♂ went.
Caseta weather – 1900 hrs – Clear and hot most of the day but by late afternoon clouds piling up and cooling off – perhaps prelude to a big rain in net few days. Max 93.5 ºF; Min 69 ºF; Rainfall 0.0 mm; evaporation 3.9 ml. (reading 15.5 ml).
13 March 1970
Rained much of morning so I could no go anywhere. At 1400 cleared so am going to Zone 3 Nesting Area. As was leaving saw a tortoise near tent - #264 ♀; CL 98.3; CW 105.5.
Enroute stopped off at pond #1 to look for my hat – many tortoises just moving to shade now – sun came out about ½ hour ago and they are getting into shade <u>fast</u>!

Pg. 24.
Took some #'s –
#421, #1165, #445 (painted #1), #862 ♀ (painted #5), #1215, #134, #217, #668, #450, #119, #452, #699 (painted #16), plus 5 more I can see under shrubs but can not reach to get numbers.
These were all right around very edge of pond only – thus many tortoises in this area still!
Then in forest on W and S sides as I was walking along - #791 ♂; 3719 ♀, #701 ♀ (painted #8), #891, #109 (up from Region 4!).
On way down – Region 2 - #819 ♀ - very near to Caseta pond #1 – only 50 m distance below it.
#909 ♀ - a bit lower than last animal – upper part of Region 2.
#242 ♂ - middle of Region 2.
#64 ♂ - in trail, lower part of Region 2 . Could be #44 – hard to tell because #20 scutes has been badly chipped – appears as if was cut. CL 107.2; CW 117.2.

Pg. 25.
Region 3 - #262 ♂ - Region 2-3 border
#136 ♀ - upper part of Region 3 – guayavillo forest.
#1125 and #258 ♂ - close together 25 m apart) in middle of Region 3 – about 425 feet altitude.
#314 ♂ - lower part of Region 3 – about 350 feet altitude.
Continued on to Region 4 but in heavy rain – hard to see from 350 feet altitude to Region 4; because of this probably missed many animals.
Interesting thing abut this is that even though I have not yet taken an accurate, normal sample at Caseta Pond #1 or along the trail to Zone 3 NA and Region 4, what I have seen indicates many animals are around dried up Pond #1, a lot of these being from regions below; also, animals have been and are clearly moving upwards along trail to Caseta (and its ponds) area. From all I have previously seen, there has not been any indication of many animals moving along this route till just this dry period (February - March) since last August. On all previous sample (October – January) and on the many dozens of hike I have made down this trail, have seen only . . .

Pg. 26.
. . . an occasional tortoise and almost no fresh sign (burrows, turds) between Caseta Pond #1 and Region 3-Region 4 border since August. There have been occasional movements by animals, but nothing of great note till now. On just my 3 hour walk this afternoon however saw 9 animals in Regions 2 and 3 and abundant fresh sign – many droppings, some trails and burrows. Most animals appear to be ascending if direction facing on the trail is indicative. Certainly at least 4 of them are doing so because they had moved up some in the 1.5 hours in between when I passed them going down and my return to Caseta.
Because it was raining so damned hard and I do not yet know how to judge these storms, returned to Caseta for night arriving at dark - 1830 hrs. Will try again tomorrow to go down.

Activity budgets: noted several animals already burrowed in, . . .

Pg. 27.
. . . but several also actively grazing at 1800 hrs as was returning to the Caseta. At 1815 there were 6 animals actively moving about on the dry bed of Pond #1, eating vegetation now moistened by the rain. [Marginal note: Air temperature then about 73 – 74 ºF at 1 m.] This is more data to indicate a remarkable shift in activity budgets. The animals certainly appear quite incapable of with standing long exposure to direct sunlight and therefore must be active only in early morning (till 0900 –1000) and late afternoon (1600 – 1700 and later) during this hot season when the sun is out all day.
Caseta weather – 1900 hrs. – Max 88 ºF; Min 71 ºF; Rainfall 5.0 mm; Evap 0.8 ml, reading 16.3, refilled at 1200 hours today. At 1900 0.5 ml more, thus total for 24 hours = 1.3 ml.
14 March 1970 – Sampling to Zone 3 NA
Region 1 –
#53 ♂ - just below the Caseta. CL 121.7; CW 132.5.
#626 ♀ - just below the Caseta.
#408 ♂ (prob., tail intermediate, but long than most ♀♀); CL 86.6; CW 94.8. near Caseta Pond #1 near trail.

Pg. 28.
#891 ♀ - also near Caseta Pond #1 near trail; moving toward pond.
Region 2 - #819 ♀ - Region 1-2 border – just into guayavillo forest, but heading up trail toward pond and open area.
#862 ♀ (painted #5) – same location as previous animal, but off of trail a bit in the bush.
#403 (♂?) – CL 97.4 ; CW 108.7; tail intermediate in length; appears to be a ♂ but am not sure; tail is somewhat thick and short and perhaps has seen injured in the past. In upper part of Region 2.
#97 ♂ - middle part of Region 2.
Region 3 –
#262 ♂ - very upper part of Region 3 in guayavillo forest ; a bit lower down than was yesterday afternoon. CL 119.1; CW 135.0.
#2000 ♂? – CL 133.7; CW 146.2. Only mark is a very clear cut in the 2000 scutes; perhaps other cuts made but many marginals badly scarred and broken. Perhaps meant to be 200? Very clearly moving down the trail; but while I was watching him he moved off into forest heading E.

Pg. 29.
#136 ♀ (almost certainly; tail is short and fat and just a bit longer than average). CL 104.1; CW 116.5. In trail in steep descent part of Region 3 at about 400 feet or so; certainly lower down than yesterday.
#1125 ♀ - CL 77.7; CW 84.8. Also lower down than yesterday a bit; in trail moving down; about at 390 – 400 feet altitude.
#258 ♂ - also a bit lower – at about 350 feet, in region 3; in trail.
Region 4 – None in upper part and not very many fresh turds; area is very dry and vegetation in terms of herbs is very, very sparse.

In central part of Region – all along trail and in shade - #709 ♀
#1103 ♂, prob. CL 76.7; CW 82.0. Sexing difficult because tail a bit intermediate.
#713 ♀
#734 or 1034 or 1734 (?) ♀ - CL 76.5; CW 81.0. Cannot figure this one out; has clear marks in 1000 and 700 scutes as well as 30 and 4.
#890 ♂ - very large; can't measure because of brush.
#1194
Saw 4 others but cannot include in sample because are too far away from trail and only saw because I was beyond sampling area.

Pg. 30.
#216 ♂ (painted #7).
#117 ♂ and #376 ♂ down from Caseta area!
#206 ♂? (or maybe 906; have seen here before; may have had a cut in 700 slot but impossible to say definitely now – so small that I doubt it is really 206); had to sex – prob. ♂ but tail intermediate in length.
Weather at Region 4. – 1015 hrs.- Max 91 ºF; Min 64 ºF; Evap. Dry, has certainly been dry since at least the 10th – all days between then and now except yesterday (13th), clear and sunny; refilled full; rainfall 0.47 inches – all this yesterday afternoon!, emptied.
** I was in Region 4 from 1015 to 1200 and during that time heard one mating – was unable to locate the animals before the male stopped bellowing; this was at about 1030 hrs. May ell have been #216♂ or #890 ♂ involved because they were both in the general area from which the bellowing was coming. Could not find a ♀ close to either one; but #709 ♀ was within 25 m of #890 ♂.

Pg. 31.
Region 5 - #106 ♂ - Region 4-5 border – (He has moved) down from Caseta and mora region!
#1214 – in big boulder area at very lower end of Region 5.
Region 6 – None seen up to point when reached nest #13. This nest had no external hole on 25 February, 1970. On 5 March it had one at 0830 when J. San Miguel passed by. He opened it and found 2 unhatched rotten eggs and the clear remains of 4 eggs from which the young had hatched and escaped. He left everything as it was for me to examine. Upon examination today I verified his estimate of 4 young hatched and escaped. There was a nice hole in the hard cap almost right above the eggs, but a bit to their side – maybe an incline of 75 – 80 º through which the young ones ascended. The two remaining eggs were both rotten and infertile.
The nest is small and it appears that the six eggs filled it up completely – they were all in one layer at the bottom of the nest. The hole was slightly flask-shaped and of typical structure. The bottom of the nest was at a depth of 26.5 cm from the top of the hard cap. This means the top of the eggs . . .

Pg. 32.
. . . was about at 20 –20.5 cm deep from the hard cap – ground surface.

The nest appears to be as deep as it possibly could have been because the bottom in part and the sides nearly all the way around are made up of rocks of varying sizes from a centimeter or 2 in diameter up to 2 x – 3 x my fist in size. The rocks in the sidewalls slant inwards somewhat so the nest tends to be a "funnel" in shape from top to bottom. The hard cap is thick and still solid and was resting on a bit of looser, clod-like soil which was on top of the eggs.
Region 6 continued – no animals seen on rest of trip to Region 7.
Region 7 or Zone 3 NA –
Weather at 1300 – Max 94.5 (some previous day; not today); Min 64.5, (reset); Rainfall; 3.9 mm, all from yesterday afternoon); Evap. Dry!, certainly has been so since at least the 10th – as with Region 4 instrument.

Pg. 33.
Made a quick tour past all the nest because looks as it may rain soon. Sun was out from 0730 to about 1230 today but cloudy since 1230 –1300 all the time.
Nests 14, 15, 17 still intact and show no signs of any openings made by young animals yet. Others as reported by P. Villa and J. San Miguel from 25 February and 5 March trips. Will dig into all thee nests with holes in them tomorrow. Rain started at 1430 and looks if could last a good long time. Was able to get small tent set up just as it started. Took temperatures from probe #2 , nest 9 – the one in the soil, at 1400 just to see what they are like. Cannot yet take from probe #1 in the nest until I fill it in a bit with soil; escaping young have exposed about ½ of the column to the air.

Switch position	Temp (˚C).
1	42.4
2	41.1
3	40.2
4	35.4
5	31.8
6	30.3
7	30.0

Pg. 34.
Rain stopped at 1530 and by 1600 had cleared and was sunny and hot again, so will examine some of the nests.
Nest #6 – All 5 of the eggs which were left by me from my Nan 29-30, 1970 examination are still present – all appear rotten so will examine. Top 2 in upper layer (actually middle layer originally).

	Mm	x	Mm	Condition
1	60.9		61.2	infertile
2	60.7		62.5	infertile
Bottom layer of 3				
1	60.0		60.5	infertile
2	60.7		62.3	infertile
3	60.0		61.1	infertile

Nest #3 – 2 young which were inside on 29 –30 January have escaped. Other 5 remaining eggs are all rotten so will examine for condition:

Pg. 35.

1	can't measure		infertile
2	61.2	61.3	infertile
3	61.7	63.8	infertile
4	61.5	61.2	infertile
5	can't measure		infertile

Nest #9 – with thermocouples.
Hole opens out right through hard cap directly above the eggs; no slant to hole to side at all. Examined inside – appears that all eggs were at one level and that there were 10 of them in all. At least 9 of these hatched; 9 had already escaped and left the nest; one young one was alive inside but was caught up under a rock and apparently was stuck and too stubborn to stop trying to dig out in that direction. He certainly would have died in the nest – almost a sure thing. The 10^{th} egg either hatched or nearly hatched – there were the remaining scutes and pupae of maggots inside indicating that the animal had died and been decomposed. From the size of the scutes the animal had either hatched or must have been late in the 3r4d incubation cycle and about to hatch.
The nest was flask – shaped, very similar to nest #12. It was clearly "stuffed" full by the 10 eggs at this one level; I doubt the nest could have been any . . .

Pg. 36.
. . . larger because as with #'s 13 and 12, it was made right down in the middle of a bunch of rocks of many sizes. There were many rocks in the walls and the floor of the nest (22 cm below the surface of the hard cap) was a solid mass of rocks. I removed the young animal and will describe and measure him tomorrow. I then filled in the nest carefully leaving the probe in place and will attempt to take some temperatures if we get some sunny weather – this will serve as an indication of how hot the nest leve3ls must have been in February during the long, dry spell.
Nest #1 – final remaining egg- infertile and rotten (see January, 28 notes – actually exhumed then.)
1900 hrs – checked high for today – 88 ˚F.

Pg 37.
15 March 1970.
Looks as if may be a good hot, clear day so am going to begin taking temperatures in nest #9; can't take in nest #12 anymore because it is too disturbed. Will also examine rest of the eggs and nests today and do the regular sample for this Region.

General weather comments:
0600-0800 – was overcast till about 0715 and then sun was out about ½ of the time off and on till 0800.
0800 – 1000 – Cumulus clouds still many and heavy; it has been cloudy about 55 – 60% of the time since 0800 – rest of time sun out strong.

1000 –1200 – Sun out about ¾'s time; obscured heavily by cumulus for ¼ of it.
1200 –1400 – Sun out virtually all of time; occasionally very brief obscuring of it by a cumulus cloud but never for more than a few seconds.
1400 –1600 – Sun out all the time; cumulus clouds have decreased in size and all now only very few and scattered..
1600 –1800 – Sun out from 1600 to 1710 most of the time; clouded up at 1710 and never came out again.

Pg. 38.
1800 –2000 – heavy overcast ; no rain.
2000 –2200 – heavy overcast; no rain.
0600 nest a.m. – Clear and sunny; will be an entirely clear day it appears because I can detect nothing but sunlight in all directions; no clouds whatsoever – will probably be beastly hot. Remained overcast most of the night I think, but last time I was conscious of the weather was midnight. So cleared between 2400 and 0600 completely.
Weather at Region 4 much the same as here it appears – however, much more cloudy there at times; probably half again as much clouds as here in general.

Pg. 39.
Nest #9, Probe #1, in the nest. 16 Jan

Switch position	0800	1000	1200	1400	1600	1800	2000	2200	0600	0800
1	24.2	46.6	57.3	61.1	50.5	34.1	29.5	27.8	22.1	24.9
2	23.8	35.6	46.9	50.0	46.0	35.8	31.0	29.1	23.4	24.9
3	24.8	29.2	36.0	41.1	41.7	37.8	34.1	31.9	26.9	26.5
4	28.3	27.8	28.3	30.7	32.5	34.1	34.1	33.6	30.7	30.3
5	28.9	28.0	28.3	30.1	31.2	33.0	33.4	33.1	31.2	30.4
6	29.6	29.0	29.0	30.0	30.4	31.5	32.9	32.6	31.4	30.8
7	29.6	29.1	29.0	30.0	30.4	32.1	32.4	32.6	31.4	30.8
8	30.0	29.5	29.3	29.5	30.1	31.6	32.0	32.1	31.5	31.1

Pg. 40.
Nest #9, Probe #2, in soil beside nest. 16 Jan

Switch position	0800	1000	1200	1400	1600	1800	2000	2200	0600	0800
		Shade			Shade					
1	25.0	40.5	53.7	57.7	40.4	33.0	29.5	28.0	23.2	25.3
2	24.5	36.6	48.0	50.7	41.2	34.5	30.8	29.7	24.1	25.3
3	24.9	33.4	42.4	46.1	41.3	35.8	32.2	30.8	25.7	26.0
4	26.7	28.9	32.9	37.0	37.5	36.7	34.6	33.2	29.1	28.3
5	28.6	28.4	29.6	32.0	33.2	34.6	34.0	33.7	30.6	29.9
6	29.5	28.9	29.1	30.5	31.0	32.5	32.5	32.8	31.5	30.5
7	30.0	29.5	29.3	30.3	30.3	31.2	31.2	31.8	31.5	30.7

Pg. 41.
Sample at Zone 3 Nesting Area.
#918 – near nests #3, 6, 7, 9, etc., grazing at 0800; eating some rather dried up herbs.

31144 – just SE of nest #12 area; grazing very determinedly on a fallen cactus pad beneath a tall, trunked Opuntia.
31193 – found it just entering one of its 2 regular resting spots at 0930 when sun had been out strong for about 20 minutes. See s to have a very definite and localized home range and uses these 2 burrow sites constantly. CL 31.3 cm; CW 33.6 cm. Re-measured just to check on recent growth.
These were the only 3 animals I saw on the usual large loop out to the SE from my camp. This leaves central open area and N to W side loop yet to do. Since sun is out now and it is quite hot most or probably all tortoises are in the shade; thus will resume sampling at about 1600, weather permitting.
Nests:
Nest #12 – opened and found 4 bad eggs; one of these was expected because of its being cracked at laying. Apparently all other 7 hatched; 5 of these had already escaped on 25 February when P. Villa examined the . . .

Pg. 42.
. . . the nest; 1 had hatched and been caught inside and died and was decomposed badly and eaten by ants. The 7th was alive and in the nest and apparently trying to dig out; whether he would have made it cannot be determined but probably would have. He is now at the Caseta – I will measure him there on my return.
Hole to exit was right straight up above eggs, no angle at all – as in case of nest #9; directly through the hard cap.

4 bad eggs-	mm	x mm	Condition
1	58.2	59.6	infertile
2	60.4	61.9	infertile
3	60.9	64.7	infertile or 1st incubation cycle; can't tell.
4	can't measure; caved too much – infertile or no good do to cracking at being laid.		

Nest #4.
Found 5 rotten eggs and 1 hatchling inside; couldn't tell anything of nest structure because Chappy had messed it up so much. However,

Pg. 43.
. . . was certainly a small tight hole down midst some rocks (which lined the sides, had a rock bottom at about 25 cm deep and the eggs rather filled it up on this one level; was a bit flask shaped. Eggs appeared to be in one layer. Saw one live hatchling escaping on 29 January and one more must have done so since (or even before the one I saw) [Marginal note: no – no other had escaped because had removed 1 eggs on Oct 29 – rotten]. The one found today was slightly above the eggs and digging his way out; he was certainly well embedded in the soil and might have not made it, but it is hard to say in certain; if the hadn't I would argue it was because of Chappy's improper restructuring of the nest as a possible cause. Anyway I removed him. This makes a total of 3 eggs hatched, (2 escaped, 1 escaping) and 5 bad and not hatched. [Editorial note: the above marginal note suggests that the nest had 1 escaped, 1 escaping and 6 bad –not hatched].
The 5 eggs-
1 - Can't measure – can't tell too badly decomposed and eaten out. Perhaps infertile because no scutes, etc.

2 – can't measure – 3rd incubation cycle nearly ready to hatch; but died; badly decomposed.
3 – 59.9 x 60.5 infertile

Pg. 44.
4 – 61.0 x 62.3
5 – 62.0 x 62.3 infertile
This nest was interesting because it had so much loose soil in it and the hard cap was so broken up and flimsy that the young never made a real "exit" hole as in nests with heard, durable hard caps.
Nest #2 – Villa was wrong on 25 February – In fact 1 egg had hatched and the young one escaped; he found one more inside on way out.
6 eggs remain – all are rotten:
1 can't measure infertile.
2 can't measure infertile
3 – 64.0 mm x 62.9 mm infertile
4- 62.8 mm x 63.1 mm infertile
5 – 62.8 mm x 62.9 mm infertile
6 – 62.0 x 63.0 mm infertile
I will examine nest 5 and 98 when return with Julio on Tuesday or Wednesday (17th or 18th) to get eggs. . .

Pg. 45.
. . . from nest 14, 15, and 17, or at least from #17 hopefully.
1620 hrs – continuing with sample since it has cooled off a bit.
Central area - #1217 – near nest #2; has moved up a bit from lower part of Region 7. Actually saw earlier today while examining nest #2 at about 1130 – was burrowed in under shade of a prostrate Pisonia branch. Just exactly now emerging – at 1625.
#131 ♀ - in shade of a pega-pega just a bit NW of Nest #2. CL 90.7; CW 101.6 (took for growth info.
New #1242 ♀ (prob.)l = under same large tree as #131 – in shade. CL 60.8; CW 67.3. No flaking disease or smooth scutes or algae; w.g.i.'s clear but rather thin.
West – North Loop:
#1196 – resting under Pisonia tree.
#1149 ♀ (prob.) CL 61.9 cm; CW 62.0 cm.
Moving along in open ; 1705 hrs. – shade now because of clouds and light low anyway. No flaking disease, smooth scutes, or algae; w.g.i.'s thin and intermittent. Near little pond (potentially a pond) area just NW of Central Nesting Zone. Appears to be just coming from it and a burrow site under some Clerodendron shrubs there.

Pg. 46.
#130 ♀ - under a Clerodendron shrub at same pond site.
I checked weather instruments at 1015 this morning- High yesterday 88 ˚F; Low last night 67 ˚F; Rainfall 3.0 mm (between 1430 – 1530 yesterday); Evap. 1.5 ml.

1900 – Weather – Max 92.5; Min (last night) 67 ˚F; Rainfall 0.0; Evap. Reading 6.0 ml; that means 4.5 ml since 1015 this morning or a total of 6.0 ml for a period of almost 30 hours.
Some general notes on activity – Most animals seem to be active from just after sunrise till about 0900 – 1000 when the heat and solar radiation become too severe for them. I saw 2 animals . . .

Pg. 47.
. . . enter shade this morning, one at 0915 (#1144) and the other at 0930 (#1193). O all the other animals I saw (2), they were in the shade by 1000 hrs. The all remained in the shade inactive all day, re-emerging again between 1615 and 1715, or in some cases just not bothering to re-emerge at all. Saw #1217 emerging at 1625, #1193 at about 1700, #1149 at 1705, #918 at 1645. On the other hand #130, a large ♀, never did become active again in the afternoon.
The animals which became active (the majority) remained so till just about sunset and then re-burrowed for the night.
16 March 1970 – Having un out of water I am going to return to the Caseta for today and tonight to make arrangements with Julio for obtaining eggs from the unhatched (or at least un-emerged) nest to take them to CDRS. Will leave some of the e2quipment here since I will return tomorrow or Wednesday.
Weather on way out 0800 – Max – yesterday 92.5; Min (last night) 67; Rain 0.0 mm; Evap. Reading a total of 7.0; not refilled; thus 7.0 for 43 hours.

Pg. 48.
Region 4 Weather – 0900 – Max 91.0; Min 64.0; Rain 0.32 inches; emptied. Evap. total of 8.2 ml, that for almost 46 hours, not refilled.

Saw a number of animals in central main area of Region 4 so checked on them –
#919 – medium size ♀ - about 75- 80 cm CL.
#117 ♂
#1024 – small animal; about 60 cm CL.
#258 ♂ - down here from above where saw on trail on 13 and 14 March 1970.
Tortoises noted on the way to the Caseta –
#97 ♂ − upper part of Region 3 not far below Region 2-3 border; down a bit than was on 14 March.
#827 ♀ − middle of Region 2; appears to be moving downward along streambed.
#242 ♂ - Region 2, only 100 m below Caseta pond #1; under a very cool shady grove of Hippomane eating their apple voraciously.
#'s 119 and 452 – face to face on trail half way between Caseta and pond – looks as if just had an aggression sequence.

Pg. 49.
#626 – just below Caseta – same area where has been since first saw there on 11 March.
1630 hrs – down to Caseta Pond #1 to get some photos of it in dry condition; will also record any animals I happen across.

At pond in shade-
#40 ♂ - very large fellow.
#418 ♀ - (400 mark obscure because scute broken badly) ; about 75 – 80 cm CL.
Interestingly, at about 1650 – 1705 all about me animals which had been in the shade became active – I could see the above 2 begin moving and heard 5 others. Up to this time all had been quietly resting in the shad; some burrowed in for the night soon after becoming active; others began grazing about and eating manzanillo apples. These animals included sizes all the way from very small 60-65 cm ones to the large-sized male - #40.
Julio took weather at Zone 6 on way in yesterday, but broke the evaporimeter tube in the process.
1630 hrs – Rain gauge 0.50 inches, emptied; Evaporimeter – 21.0 ml.
So till I get a new tube there, there will be no evaporation records.
Caseta Weather – Clear and hot all day; 1900 hrs – Max 93.0 ˚F (today in fact); Min 66.5 ˚F; Evap. 9.0, reading 9.5.

Pg. 50.
17 March 1970 – to Caseta Pond #1 to sample.
#626 ♀ - same burrow
#418 ♀ - entering pond ; CL 85.3; CW 89.7. No algae, smooth scutes, or flaking disease; w.g.i.'s present but thin.
#40 ♂ - in burrow at edge of pond.
? #98 – in pond are, basking.
#475 ♀ - CL 75.6; CW 81.2; no flaking disease, algae on smooth scutes; w.g.i.'s almost nonexistent.
New #1243 ♂ (prob.) – but hard to sex because is small; no flaking disease, algae, or smooth scutes, w.g.i.'s almost non-existent. CL 63.8; CW 67.5.
#819 ♀ - in shade on edge of pond – nighttime burrow it appears.
#891 ♀ - in shade on edge of pond – nighttime burrow it appears.
New # 1244 ♂ (prob.) – tail longish but intermediate. CL 75.3; CW 76.0. No algae or smooth scutes; w.g.i.'s almost non –existent. Flaking disease in small patches on front and near marginals.
#447 ♂ - can't reach to measure; I think it's a male – about 100-05 CL.
#1013 ♀, #423 ♀ (from Region 4!) – both at edge of pond basking at 0825.

Pg. 51.
#1135 ♀ - up from Region 4!
#134 ♂ - burrowed in still at 0835; N side of the pond.
#791 ♂ - inactive in shade – SW of pond.
#444 ♂ - (painted #11) – inactive in shade – NW side of pond.
#351 ♀ - (painted #14), #1190 (painted #13) and #701 ♀ (painted #8) – all on W side of pond; first two resting, one in shade, one in sun; latter grazing under a manzanillo.
3 tortoises all within 15 m of each other resting in shady forest W of pond: #526 ♂ - extremely large; #51 ♂ - CL 138.5; CW 149.2. Flaking disease all over rear ¼ of shell and front marginals; no algae or lichen; scutes all smooth; w.g.i.'s very prominent and well developed. #354 ♂ - down from Mora area.

New #1245 – too small to sex CL 56.6; CW 58.9. No flaking disease, smooth scutes, or algae; w.g.i.'s present but thin. In same area as above 3.
**This is smallest animal I have ever seen this high up!!! Has some deformities – 10 marginals on one side, 11 on the other; 5th vertebral badly misshapen and an extra triangular scutes in between 34d and 4th vertebrals.

Pg. 52.
#1215 – in forest SW of pond – 50 m.
#408 – in shade of large Clerodendron. SW of pond – 40 –45 m.
#1168 – in forest just SW of pond - in shade resting.
#1068 ♀ l- CL 75.7; CW 80.1; same area and behavior as #1168 (except grazing on grass. No flaking disease, smooth scutes, or algae. W.g.i.'s thin and intermittent.
#719 ♀ - same area as previous 2; sleeping in shade of a manzanillo** Up from Region 4!.
New #1246 ♂ - tail is long! CL 66.0; CW 70.1. No flaking disease, algae, or smooth scutes; w.g.i.'s present but thin. SE side of pond resting under a manzanillo.
Add to this 3 animals which I saw but was unable to get to for identification – thus a total of 31 just around the pond.
Then up to series of small hanging ponds on way to Caseta –
#668 ♂ - inactive in deep shade near 2 lowest small pond.

Pg. 53.
#715 ♀ - in area just W of the tent grazing in shade on floor of dry pond.
I did not search this areas as well as usual and from some sign in the area I would guess that there are 2 or 3 more animals present.
It is obvious that there are a large number of tortoises around the pond area below the Caseta – saw 31 there in a 2 hour sample this morning; and yet did not see many animals which I know are in the area also and which I saw on 11 and or 13 March- #'s 450, 452, 217, 277, 1023, 119, 1165, 445, 699, 862, 421, 109 – a total of 12 others. It appears as if the animals are crowded in around the pond simply waiting for the rains to commence and water to collect in the ponds. ;they are denser than any previous period taking the whole sampling area into account. However, before in the garua season and even early in the hot season when there was standing H20, they were most often concentrated in and along the edge of the pond with only scattered individuals in the surrounding forest; many were also, at least during the part of the day when feeding was common, around the pond in semi-open and open areas covered with herbs and grasses. Now they are all simply well scattered about, feeding on manzanillo apples and what little green herbaceous vegetation is available. They are . . .

Pg. 54.
. . . nowhere, around or in the pond as densely concentrated in small areas as they were 2 months ago.
A number of the animals around the pond are from the Region 45 area below or even further down (e.g. #1215) indicating that there may be general movement upward; however, there has also been a general increase in movement overall I think because, there are some animals down by the pond now which were up in the mora area in late

January. Also, some animals from the Pond #1 area have moved south to Region 4! Certainly more seem to have moved up than down, but one can not ignore the fact that some individuals have moved downward to even drier zones during this dry, hot season. Julio went to El Chato this a.m. and took weather there for me - 900 hrs – Rain 1.75 inches!!; Evaporation – 12.0 ml, refilled full.
Measurements and comments on 4 young taken to Caseta from Zone 3 nesting area:

Pg. 55.
1 – From Nest #2; brought to Caseta on 25 February, 1970 by P. Villa; found in nest hatched. SL 72.7 mm; CL 87.0; SW 66.0; CW 99.5; H 34.4. Plastral fold completely gone (about 1.5 mm at widest); yolk sac closed almost completely and well dried out; all but closed; a very large young tortoise! Has eaten a little at the Caseta on occasion but not much; has no extra scutes or deformities but is mashed in just slightly on each side in the middle.
2 – From Nest #12; brought to Caseta on 25 February by P. Villa; found hatched in nest. SL 72.5mm; CL 84.5; SW 58.0; CW 92.0; H 36.8. Plastral fold nearly gone, only slightly visible; Umbilical area almost closed up, still 3 mm wide at widest; yolk sac area very dried up and dark; no extra scutes; only a bit mashed in on one side.
3 – From Nest #9 – see my notes of 15 March; SL 67.8 mm; CL 85.5; SW 56.2; CW 90.0; H 31.5. Plastral fold almost completely gone, but hard to tell much about it because greatly pushed in below because of pressure in nest. Also caved in a bit on one side; otherwise normal. Yolk sac all but completely closed, 2mm. . .

Pg. 56.
. . .wide at widest; very dried up. Has 12 marginals on each side, one of them small and triangular on one side, more or less normal on the other side.
4 – From Nest #4 – see my notes on 15 March. SL 70.4 mm; CL 86.0; SW 59.3; CW 90.0; H 41.1 (bulged out). Plastral fold gone, but bulged out behind it so may have never been a fold. Scutes normal; but has 4 partite gulars where most have 2. Yolk sac area all closed up and dry.
1900 hrs – Caseta Weather - Another completely clear, hot day – Max 95.0 ˚F; Min 65.5 ˚F; Rainfall 0.0 mm; Evap. 5.5 ml, reading 15.0 ml.
18 March 1970 – To Caseta upper pond area –
In open field just below ponds –
#305 ♀
#137 – CL 106.3; CW 115.0. Scattered flaking disease on front marginals, sides, and rear 1/5 of carapace; No algae; scutes smooth only in very centers; w.g.i.'s present but extremely thin.

Pg. 57.
In pond #3:
#10 ♀ - (same one as before?) – CL 90.7; CW 96.7. Scutes smooth only in central ½ - 3/4's.
#96 ♂ - in between ponds #3 and #2.
Near Pond #2 –
#1072 ♂ -

#270 ♀ - CL 85.6; CW 89.9. A few minor scattered spots of flaking disease; no smooth scutes or algae. W.g.i.'s present and clear, but thin.
Then saw #627 just at entrance to open mora – covered area along Reserve Border as one leaves forest above Caseta.
The upper pond area as a whole appears to have been well used by tortoises for the past month and ½. There are abundant trails and lots of dried and disintegrating droppings and lots of burrow sites. However I would not say that there has been any increase in the numbers of animals in the area since the garua season – except perhaps in the first week or two of February when the ponds were really drying up and the animals were crowding in for their last drinking and wallowing until the heavy rains come.
One impressive aspect is the extent to which the animals have plowed their way into the mora and general mixed mora – shrubbery around the upper ponds. In so doing they have cleared about 1 – 1.5 acres more of land than was free of mora . . .

Pg. 58.
. . . all through the garua season. This all clearly took place since I last saw the area on 30 January and I suspect it occurred during the excessively dry periods when the animals were searching for more fresh vegetation and water. One area they cleared back near Pond #2 is a shallow depression and will certainly form a small temporary pond when the heavy rains arrive (assuming they ever arrive !) This clearly demonstrates the ability of these animals to push their way through mora and in fact to break it down. It seems to be more susceptible to drying and death from their crushing it during this dry hot time than during the garua.
Then came up Bud Devine's Central Manga. Saw no tortoises but there was scattered sign all the way to his first fence, circa the lowest banana patch – this is at a latitude of about 850 – 900 feet. From there up to the house saw no more clear sign. That in the lower areas consisted of trails, burrows, and droppings in various stages of drying and decomposition. From what I saw I would guess there are about 6-10 animals scattered along this manga up to the banana patch level. Most are near the bananas (just below) because this is where the freshest sign was.

Pg. 59.
It was clear that the animals have been forced to feed mostly off into the <u>Solanum</u> shrubs and into the mora because it is too damned open and hot in the P. grass.
In afternoon from 1430 t0 1800 went down over a good part of Western side of Devine's land.
In upper half of lowest banana patch – i.e. at about 900 –950 feet altitude –
#115 ♂ - CL 108.2; CW 117.3. A few minor scattered spots of flaking disease; no algae or lichens; scutes smooth only in very centers; top and sides of carapace covered with superficial small scratches – certainly from mora!! W.g.i.'s very thick, clear, and well developed. Should be -- is feasting on moist green banana trunks.
#304 ♂ - very near #115; same area; also very nice thick clear w.g.i.'s. Also same superficial scratches all over top and sides of carapace – from passage through the mora. (up from Region 4!)
There was scattered sign al through the banana patch from the upper (950 feet) to the lower end (850 feet). All of it is no older than 1 month. Bulmar (Bud's hired hand) says

he saw 3 animals in the upper area where I saw the above 2, only 2-3 days ago. They are clearly getting plenty of nourishment and H20 from the banana stalks there and are eating them avidly. From the sign through the area I suspect there are 6-10 animals within this banana area also, It is simply too large and too interlaced with . . .

Pg. 60.
. . . mora to walk all over it. I also found sign (mostly droppings and old trails, a few burrows) all the way from near the small ponds (the "Maternidad" section of Bud's land) at about 1200 –1250 feet down to the level of the lowest banana patch on the Western side of Devine's land; there was sign of the same type scattered at the same levels on the adjacent farm of Sr. Barerra. I stopped and talked to his sons who were laboriously gathering some moth–eaten looking pinto beans by hand / foot labor and they said they had not yet seen any tortoises up above this area by their father's house. However they seemed unaware of the sign (droppings) within 50 m of them so probably should not take their statements to mean much more than that they had not seen tortoises obviously walking about right around the house recently. Most of the droppings throughout . . .

Pg. 61.
. . . this whole region from the Maternidad area downwards were at least 10 days to 2 weeks old, some older – 1 – 1.5 months. However am fairly certain they are all since January 30 because to that date had seen no tortoises higher than upper end of the lowest banana patch and Bud and Steve Devine's and Bulmar's observations corroborate mine. A few of the droppings seemed to be within a week or so in age, these up near the Maternidad pond. The area where T. DeVries saw two tortoises on February 19, 1970 is also very close to these ponds and I saw droppings in the area which he described as the location of these 2 tortoises. Bulmar says they "in February" there were 4 tortoises right around the Devine's house, but he has not seen them for 2 weeks or so. He says they have perhaps moved upwards, but is not sure (must check this out with Bud). If in fact, some tortoises have moved past here and on to higher altitudes I would not be surprised because of the reports. . .

Pg. 62.
. . . of Sr. and Sra Ramos (see notes of 12 March, 1970) and the tortoises which was near the house of Segundo Herrera in late Jan – early February. Also, Gallo Torres saw a tortoise just above S. Herrera's house on this past Sunday (March 14) – it was nearly to the Santa Rosa – Bellavista trail – i.e. about 1300 feet in altitude. From his description it may have been #99 ♂, but will have to check this out because he did not yet know the numbering system when he encountered this animal.
This survey will be incomplete until I talk to Bud, look over Eastern part of his land below the house and examine area above the house to the Santa Rosa – Bella Vista trail. However, it is certainly clear that tortoises have come up higher during the February – early March period in response to the increasing heat and dryness. It also seems . . .

Pg. 63.

. . . clear that they have done so in relatively small numbers, probably only 150-300 or so are above the National Park – Reserve Border taking its entire length into account – but his in fact remains to be demonstrated.

19 March, 1970.
Came down Eastern border of Devine's land all the way from his house to the Caseta Upper Pond area. Saw no sign in upper areas even in a platano patch; began to see sign only beginning in the area where I last saw animals in mid January. This area is at the same altitude of the lowest banana patch – circa 900 –950 feet. Saw no really fresh sign – old, disintegrating and dry droppings, old trails, old burrows. Most of this clearly dates to January activity, but the area has a much greater total surface area clearly disturbed by tortoises than was present in January; therefore, it is clear that he animals were still here at least until late January or early February.
From this area downwards there was scattered sign all the way to Caseta upper ponds – (but) none of it was fresh till I was about only 150 m distance above the ponds. From here to Reserve Border there was scattered fresh sign, but I saw . . .

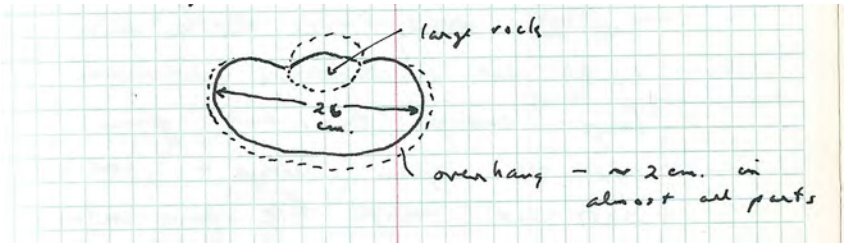
Pg. 64.
. . . no tortoises. The areas above here, with old sign, showed evidence of a great deal of tortoise activity since mid-January - a much greater total area of this Eastern manga had been walked over, disturbed and eaten by tortoises than when I saw it in January. I can not demonstrate it, but I suspect most tortoises have left this rather open area because of the heat – there is adequate shade in the area in an absolute sense of merely being able to be covered and sheltered from the sun; but the shade is nearly all low shrubs and the tortoises seem to prefer and possibly require more dense, deep, open shade under trees. Some of the tortoises from this upper area of the manga have certainly moved down – e.g. #1072 ♂ - however, some have probably gone even higher up and others Eastward and Northeastward into the forested areas at the . . .

Pg. 65.
. . . lower end of Remigio Barrera's and Juan Guererro's tracts of land. When returned to Caseta went down to Pond #1 with P. Villa to look for an old trail to El Chato from this area. Saw 3 more tortoises around the pond which did not see on previous samples –
#1022 ♂ -
#1060 ♂ - CL 96.5; CW 106.3.
#1006 – (painted #15).
Caseta Weather – 1900 hrs. – hot and clear all day today and yesterday also. Rainfall 0.0 mm; Evap. 9.5 ml, since 17th at this time; reading 24.5 ml); Max 96.0 ˚F; Min 65.0˚F.
Has been hot, clear and sunny from 1 February, 1970 through today save for only a few days of rain. The weather records for the Caseta reflect this; i.e. 2 days with a low maximum temperature and rain in March and about 3 of the same in February. The rest of the time it has been hot and dry and the drying of the ponds by the 34d week of February, 1970 and the drying of the vegetation reflect this.

Pg. 66.

20 March 1970. – To Zone 3 Nesting Area to check last nest (#5 and 8) and to retrieve eggs from nest 14 or 15 and 17.
Region 4 – 0830 hrs – Weather – Evap. Dry, refilled full; Rainfall 0.00; Max 92.0 ˚F; Min 645. ˚F.
Also took a few tortoise numbers on way down -
#782 and # 242 – mid Region 2.
#60 – Region 3 – 2 border area.
#390 – Region 3 upper part – 450 feet altitude.
To Region 4 - #890 ♂ - #125 ♂ (perhaps #325) but I don't think so; 200 mark has an old hole in it from a previous ring marker).
Zone 3 NA – Weather – 0930 – Max 96.˚F; Min 66.5 ˚F, reset; Rain 0.00; Evap. Dry, refilled full.
Nests –
Nest 14 – discovered a small opening at one side, but in the hard . . .

Pg. 67.
. . . cap – small round hole of about 3-4 cm diameter; opened he nest. (First took 2 photos of it undisturbed – Roll 88, #34 and 35). Young cam up at an angle of about 75 - 80˚.
Inside found nest to be kidney shaped from top view:
[Sketch shows kidney shaped oval 26 cm in longest dimension with large rock causing depression in outline on one side and documenting an overhang along the 75% of the perimeter that was not influenced by the rock. Annotation says: "overhang – about 2 cm in almost all parts"]



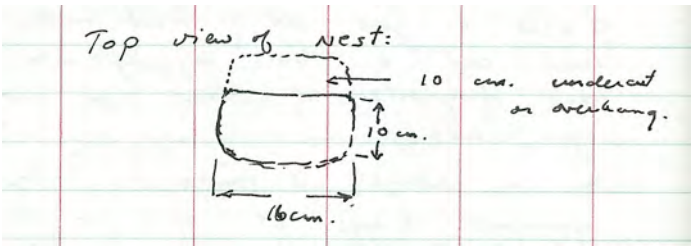
It was 20 cm deep, bottom being formed by numerous scattered small rocks. Therefore top of eggs was about 14 cm. Sort of flask shaped in that overhang was present around most of the nest. Most of the eggs fit in under this overhang at least in part. Hard cap was large and thick and fit down right on top of eggs. But whole nest is dry so young were able to crumble hard cap when digging out – abundant loose, crumbly soil at egg level from this activity. Eggs all in one level – 11 of them. The thoroughly filled the cavity at this one level – if there had been more eggs, they would have had to be stacked up toward the top of the nest.

Pg. 68.
Eight of the young had hatched and escaped - certainly close upon one anothers' heels if not as a group because was no hole in this nest on 16 March and now all 9 that hatched are gone. Also, they all clearly used this one small exit hole which is just about large enough for one young one to pass through – thus had to pas out single file for certain.

Loose soil below the hole was extensive and covered whole floor of nest as were probably digging as a general group at first and then one animal broke through to surface and others followed – at least this seems reasonable.
Two remaining eggs – 1 appears 0K and certainly has an embryo – will take to CDRS. Other is infertile. Interestingly, both of these were in central part of nest – 7 or 8 out of the hatched ones were around the sides partly covered by the overhang.

Pg. 69.
Measurements of these 2 eggs –
60.6 mm x 61.5 mm – appears OK; to CDRS.
62.1 mm x 62.2 mm – infertile.
Also note that the ♀ used feces in the hard cap!
Nest #17 – Another very interesting nest!
Opened it because was no hole anywhere on surface indicating that young had escaped. Hard cap large but not thick (about 8-10 cm at thickest part). Beneath the hard cap a bit of more loose crumbly soil- appears as if was wet when ♀ placed it in hole but it and entire nest are dry now and drying has resulted in it crumbling a bit. ♀ used a good bit of fecal matter in hard cap and on digging into nest found fragments of turds in around eggs also.
10 eggs in roughly 3 layers – top of uppermost 3 eggs at 10.5 cm below hard cap and ground surface. Bottom of these 3 at 16.5 – 17 cm below same. Then 4 eggs below them – bottom of these at 18.5 cm below hard cap surface. Then 3 more eggs – bottom of these at 21.5 cm below hard cap surface. The eggs were not really 3 distinct layers because of their shape resulting in them overlapping a great deal by fitting into one another's layers.

Pg. 70.
Bottom of nest at 21.5 cm has many rock; the nest could not have been any deeper here. Eggs filled cavity rather completely; but note that was essentially all air space around them and between them, <u>not soil</u>. Only material below the hard cap was a small amount of loose crumbled soil on top of the upper 3 eggs and here and there throughout the nest and some turd fragments. Most of space below hard cap and between eggs that was not filled by eggs themselves was simply empty.
Top View of nest:
[Diagram of roughly square nest (but with rounded corners) with 10 cm undercut extending beyond nest opening at surface. Nest is noted as 16 cm wide and 10 cm plus 10 cm undercut in perpendicular dimension.]

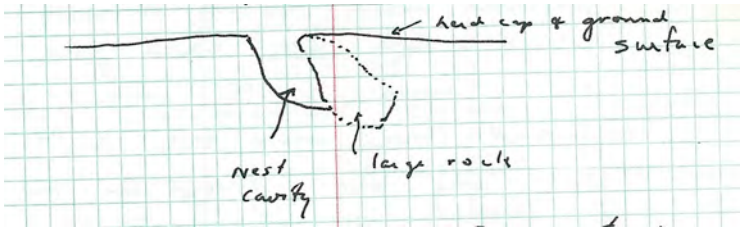


Two of the bottommost eggs and one on the 2nd level were well under this overhang – one of the upper layer was about ½ way covered by it. All the rest of the eggs were more or less in the central cavity below the hard cap proper.

Pg. 71.
It seems clear that the wet muddy hard cap when placed on top of the eggs by the female is cohesive enough to maintain itself as a unit and does not filter down around the eggs. This is the first nest in which I have actually found loose feces right down in the cavity with the eggs.
Certainly could not have gotten more eggs in this extremely small nest cavity without simply piling them on top of those already present.
Also seems clear that nest couldn't have been made much, if any bigger here because of rocks at its bottom and rock in sides and around the area on the surface.
Tok a number of photos of the nest just after removing hard cap and exposing the eggs a bit – Roll 89, #'s 1-9. Finally, I numbered eggs so could recognize by layer – will take to CDRS. #'s I-III – top layer; IV – VII – second layer; VIII – X – bottom layer.
Interestingly, #'six and VIII have just begun to hatch. VIII has only a pip in the egg but IX has one side rather well opened up and should be coming out very soon. It is . . .

Pg. 72.
. . . rather noteworthy that the bottommost eggs in the nest are hatching before the others – Why?
Nest 15 – No hole yet = however I think young may be trapped inside because there is a very hard durable cap on this nest and the solid final soil is intermixed with bent over herb stems making the whole meass solid and hard to move as a unit or to dig through. So opened the nest. – The nest is made in an incredibly small opening about 25-30 cm long by 15 cm wide between a bunch of large flat rocks. Part of the hard cap in addition wass a large plate sized rock. The female must have had one hell of atime digging this nest and its quite an accomplishment.
The main part of the nest was dug along side and down under a large rock which is sitting at an angle of about 60-65°. A side view of the . . .

Pg. 73.
. . . nest is as follows –
[Diagram of a sloping nest pocket that angles down under a large rock comprising nearly half of the nests horizontal area in relation to the hard cap and ground surface.]



Thus the only overhang to the nest was that formed naturally by the rock. The 10 eggs appear to have been o one level or at most in 2 layers which intermeshed in the bottom of

this cavity. The female certainly couldn't have gotten any deeper because the bottom of the nest and most of its side are rocks. Also her maneuverability must have been seriously hampered by the abundant surface rocks. The depth from the top of the hard cap to the bottom of the nest where the eggs were sitting is about 22 cm. Inside I found, 1 unhatched egg and 9 healthy un-deformed young. The young have certainly been in here for at least 2 weeks or so because there yolk sacs are all gone and their umbilical areas are closed up tight – even the dry umbilical area skin is gone. The appeared to have been trying to dig out some because there were crushed pieces of hard cap around them (the hard cap apparently was sitting right down on top of . . .

Pg. 74.
. . . the eggs). However, they had not progressed much and I seriously doubt they would have gotten out – much of the area around them was rocky and the only way out through the hard cap was blocked by unusually dry, hard, compact soil = more so than in any other nest I have examined. The 9 of them were all at the same level and in a bunch – one was even on his back. They were completely surrounded and enclosed in loose dry clods. Perhaps they might have gotten out by group effort but it is too difficult to really say.
The one unhatched egg was right in their midt so they had certainly not progressed far although they had dug upwards some because below them were their egg shell under a couple of cm of dry soil clods. The one egg measured 59.9 mm by 60.0 mm and was infertile.

Pg. 75.
I will mark, measure and release these 9 young – the measurements will follow in a few pages.
Nest 8: We could not relocate it – so will have to use Villa's report – 4 young hatched and escaped; 3 eggs rotten; 1 egg appeared OK.
Nest 5: All 8 eggs appear rotten -
1- 64.7 x 62.0 mm infertile
2 - 63.2 x 62.0 mm infertile
3 - 64.3 x 63.5 mm infertile
4 – 62.7 x 62.6 mm infertile
5 – 63.7 x 63.0 mm infertile
6 – 65.0 x 63.6 mm infertile
7 – can't measure infertile
8 – can't measure infertile
Took last temps at nest 9 before dismantling the whole apparatus, just to see if there is much difference between today and 15 March. The past 4 days have been clear and hot all day whereas March 15 was a clear hot day which had been preceded by several semi-cloudy cooler days – 2 of them with brief rain showers; temps taken at 1200 hrs. After taking removed all the instruments and brought them to the Caseta, including West potentiometer and its accessories.

Pg. 76.
Nest #9

Probe 1 (Nest) - ˚C	Probe 2 (soil column) - ˚C
1 – 61.0	60.5
2 – 52.5	53.7
3 – 40.0	46.8
4 – 31.0	35.6
5 – 30.7	31.6
6 – 30.7	30.7
7 – 30.7	30.7
8 – 30.7	30.4

Data on 9 hatchling from nest #15 appear at right on page 77 – number referred to is a white, latex-base paint mark on rear of carapace. Released these 9 at the top of their nest at about 1400 hrs. The all immediately started scrambling off, with no coordination of movement between individuals. They struck out in all directions. It was very hot and sunny at this time. Very quickly most of them responded to the strong solar radiation and sought shade. However 2 of them continued to strike out for open ground and I finally had to rescue them and put them in shady places in rock crevices because there were showing clear signs of heat distress (i.e. frothing at mouth). Rechecked them all at 1530 as I was leaving – all in shade under rocks ; none far from the nest. See Roll 89, photos 10-11.

Pg. 77.
Data on Nest #15 hatchling (referred to on Pg. 76). All had Yolk sacs dry, closed and clean and Plastral folds gone completely.

No.	SL	SW	H	CL	CW	Comments
1	78.0	67.9	35.8	91.5	102.5	slight depression in one side plastron.
2	74.0	60.0	34.5	88.0	98.0	---
3	74.6	64.8	33.2	87.5	98.0	---
4	72.1	62.5	38.8	86.5	101.5	bulged out a bit ventrally
5	73.3	64.0	34.5	87.5	98.0	rather deep depression on one side plastron
6	72.0	56.4	39.8	88.0	98.0	bulged out markedly below and slightly pushed in on left side.
7	73.6	64.7	35.5	91.5	101.0	---
8	78.1	67.4	35.5	91.5	102.5	---
9	75.5	63.7	36.1	87.0	95.0	---

Pg. 78.
On my return saw #390, about 50 feet lower in altitude and about ½ km below where was this a.m. - this at 1615 hrs.
P. Villa took measurements at El Chato today at about 1000 hrs. – Rainfall – 0.05 inches, emptied; Evap. 13.0 ml , refilled full.
Caseta – 1900 hrs – Weather – Rainfall 0.0 mm; Evap. 5.2 ml, reading 29.7 ml; Max 93.0 ˚F; Min 69.0 ˚F. Clear and hot and sunny all day long. Evap. Refilled full today.

21 March, 1970 – To CDRS with eggs from nest #14.
28 March, 1970 - P. Villa checked weather instruments for me this past week-

[24 March 1970 – Region 4 – 0900 – Max 90; Min 68; Rain 0.0 inches; Evap. 28.5 ml, refilled full. Zone 3 NA – 1000 – Max 94; Min 68; Rain 0.0 mm; Evap 28.3 ml, refilled full.]

Pg. 79.
[25 March, 1970 – El Chato – 1000 hrs – Rain 0.0 mm; Evap. 17.7 ml, refilled full. In copulation - ♂ #11 and ♀ #57.]

31 March, 1970. –
Studies of nest #17 at CDRS – This experiment, which was designed to determine if the young animals escape from the nest depended on social facilitation turned out to be a grand failure for a number of reasons – The sum total I learned was very little concerning this aspect of escape from the nest and its theoretical relation to selection for minimum clutch size. It did however offer a bit of data on how closely together sibling hatch in Santa Cruz nests and provided another nest which was not opened soon after being laid to compare with those opened by Oswald Chappy in the fashion he learned from Miguel Castro.
First the hatching data: On March 20 when I opened the nest one egg (IX) had just begun hatching and probably had started the day before – This opening of the nest occurred at 1030 hrs. This egg was completely hatched out by 1630 on my return to the Caseta [Editorial note CGM returned from the nesting area to Caseta]– the hatchling emerged after the eggs had . . .

Pg. 80.
. . . been placed in the can and probably during transport to the Caseta. There was a second egg, #VIII, with just a tiny pip in it (with mucous being extruded) when I opened the nest also. None of the other 8 eggs showed any signs of hatching, but I could feel the hatchlings moving in some of them as I placed them in the can for transport.
The eggs were transported to the CDRS on 21 March. Then on 22 March at 1200 I checked all the eggs again. –
#'s II and III – small pip in sides; a bit of mucous leaking out of each.
#'s I, IV, V, VI – not yet hatching.
VII – small opening of 3 mm – a bit of head visible.
VIII – small opening of 5 mm – head visible.
#IX – already hatched.
#X – opening of 1 cm; can see head.
On 24 march at 0700 - #I has a small pip and is leaking mucous;
#'s IV, V, and VI – still not hatching; VI looks bad, as it did when I first opened nest – I doubt it is any good.
On 29 March – 1000 hrs. - #'s IX, VIII hatched out and escaped from artificial nest.

Pg. 81.
#'s VII and X all the way out.
#'s I, II, III about ½ way out.
#'s IV and V small openings; mucous leading out.
VI – not hatching yet.

By 31 March at 1800 when I discovered overheating accident #'s I, II, II were out of eggs; only IV, V still in hatching process; VI never began hatching – examined it – infertile.
Egg data – taken on 22 Marc at 1230 before putting in artificial nest.

Egg #	mm x mm	wgt. (grams)
I	59.7 x 58.9	102.00
II	60.2 x 60.1	107.40
III	60.9 x 61.5	118.60
IV	60.9 x 60.9	109.40
V	60.6 x 61.3	119.25
VI	61.6 x 62.3	123.65
VII	61.1 x 60.7	109.50
VIII	61.3 x 60.6	116.40
IX	hatched out	
X	opening in egg too bit to measure it or weight it accurately.	

Experiment: As noted above the eggs were transported in sawdust to the CDRS on 21 March 1970. I arrived late the same day, examined them and found that all were OK. On 22 March

Pg. 82. I took the above measurements and weights and on 24 March at 0700 I placed them in an artificial nest at the CDRS tortoise house. This nest was made of soil from the "pampas coloradas" just above the village of Puerto Ayora (this soil is not exactly the same as that in the natural nesting area where (Zone 3 NA) the nest was located, but it is very similar in structure, color; sandiness vs. clay content, etc. The bottom of the nest was 20 cm from the surface and the eggs were placed in it in roughly 3 layers just as they had been found in the natural nest (see pgs 69-75 of this volume0. They were placed in approximately the same individual positions which they had occupied in the natural nest. The nest at the front was a double thickness of glass with 2 layers of a deep . . .

Pg. 83.
Red gelatin filter paper in between. This allowed me to observe the eggs and hatchlings in the nest with only infrred wavelengths (using a "Detectirscope" infrared viewer). At first, I placeda 10 cm thick hard cap, which I made by hand with pampa colorada soil and water, over the top of the nest. However, sufficient time to dry this was not available and it seemed extremely hard; so on 26 March I removed it and simply covered the eggs up to the surface level with loose soil. This was done at 1700 hrs on that day. The next morning at 0700 I discovered that the animals from eggs #IX and VIII had escaped from the nest #IX had been placed in the nest with the other 9 eggs when the artificial nest was constructed on 24 March, even though he was already hatched out. There was no possibility of definitely determining if then 2 dug out singly or together as no hole was present above the nest; this would be expected given the loose, crumbly dry soil. Anyway, this is hardly a significant result given that the hard cap was not present on the artificial nest, whereas it is always present in naturally made nest on Santa Cruz.

Pg. 84.

Unfortunately the red gelatin was so effective at cutting out any visible light, that this further combined with the dark sol and dark tortoises made it very hard to see activity in the nest. I made observations with the scope twice to 3 times per day for about ½ hour each time but was unable to see anything more clearly than the egg shells and even these were not very clearly defined. I will have to simply devise a better observation technique.
Finally, on 31 March at 1800 I discovered that someone, probably Johnson, had closed the top of the incubator down flush so that no heat was escaping from the top f the incubator – as a result the 7 animals which were hatched out or hatching in the nest were cooked to death. Luckily I had removed the first 2 escapees so they were measured, weighed, (recorded elsewhere) marked and placed in CDRS tortoise house. The 7 cooked ones and the infertile egg were disposed of. This ended the experiment.

Pg. 85.
1 April, 1970., - Returned to Caseta today; enroute saw no tortoises, but plenty of sign all the way from abut ½ - 1 km E of Zone 6 turn-off to well on the other side of Zone 1 turn-off on the National Park – Reserve Border.
Things have obviously continued to be extremely dry and hot, and sunny since 22 march when I left. Almost no rain I would guess. On all side of the Reserve Border and all along it from Alda's corner, I saw scattered groups of goats – they were absolutely and totally absent from these area till February and it is clear that the heat and sunshine and drying out of the vegetation has forced them upwards to these higher more lush zones.
At Caseta- also has obviously been hot, dry, and sunny here also.
Weather at 1900 – Max 91.5 ˚F; Min 67.5 ˚F; Rain 3.0 ml; Evap. Dry, thus 35.8 ml plus.
Has been dry and hot here and throughout the Reserve for essentially 2 months, with only a few days of rain and/or clouds during the entire period. Another thing which reflects this dryness is that there is almost never any dew in the morning, whereas in the gaura season, in fact to the end of January, there was reasonably heavy dew <u>every morning</u>.

Pg. 86.
2 April, 1970. – To Region 4 to sample and Zone 3 NA for weather.
Enroute saw a number of tortoises in woods near Caseta Pond #1 and some in the dry pond – a total of 7.
#819 – on Region 1-2 border near pond.
#73 ♂ - middle of Region 2 in guayavillo forest.
#368 – in lower part of Region 3 in steep descent part – to side of trail in guayavillo forest.
Region 4 – sample for March-April – a bit late for rest of March sample, but I think it can be included now because conditions have not changed – still dry, hot, clear and almost no rain – nor has been since early February, 1970.
First Region 4 Weather - 0830 – Rain 0.045 inches, emptied; Evap. Dry, thus 35.8 ml plus, refilled full; Max 90 ˚F; Min 68 ˚F

Pg. 87.
Sample –
#1194 – well into shade at 0830; inactive.

#890 ♂ - well into shade at 0900, inactive.
#1103 – well into shade at 0900, inactive.
#756 ♀ - well into shade; can't reach to get measurements.
Repeat #919 (number hard to discern, 19 part OK, but in hundred series, is marked on 2nd marginal scutes and 5th scute – probably intended thus to be 900; has 12 marginals on right side and the person who marked it must have made a mistake. There is a 919 ♀ near Caseta (or at least was there in mid-March, 1970) – entirely different animal). CL 71.2; CW 72.3; 65.5; sex ♂, probably. No flaking disease, algae or lichens or smooth scutes., W.g.i.'s very intermittent and thin - not at all prominent. In shade inactive, at pond.
#1024 ♀, prob. – CL 58.4; CW 64.7, 59.5. No flaking disease, smooth scutes, algae, or lichens. W.g.i.'s present, but thin and missing here and there; in shade, inactive; at pond; Remarked.
#96 ♀ - cant get to in order to take measurements. In shade; inactive; at pond.
One more small one – can't reach at all.

Pg. 88.
#352 ♀ - can't reach to measure; fairly large – about 90 cm CL I would estimate; at pond.
The above 3 animals have very poorly defined, thin w.g.i.'s.
This sample was, in part, an exercise in futility – the animals are very widely dispersed, without exception in densely vegetated, shady locations, and thus very difficult to see. I was extremely careful and slow in taking the sample but undoubtedly missed some simply because they are all in the shade, in fact in heavy shade. There are clearly not as many animals in the sample area as there were when I passed through here on 14 and 15 March , 1970 while taking the normal monthly sample Therefore, I think the only justifiable way to include a sample from Region 4 in the March sample will be to use what I got on 14 and 16 March as a base and extrapolate for the total number for the normal area sampled. The . . .

Pg. 89.
Count of 14 March seems appropriate since I covered about 1/3 – ½ of the normal sampling area on that day. Since I saw 10 animals then a good estimate of the total number for the sample, had I covered the entire area, would have been 20 – 30, probably closer to the lower number since the portion of the area I walked over usually has animals a bit more densely concentrated than the part I did not examine.
This raises the question of why only 9 animals were seen today as a result of 2.5 hours of laborious careful searching, much of it on my hands and knees so that I could see into densely vegetated spots, e.g. under shrubs. Two factors are involved I think.
1 – The animalsl have literally dispersed more widely from the area as it has become even more dry, vegetation matted down, opened up and hot. A lot of them have probably moved upwards in altitude, also, to higher, cooler, more green areas. This is probably the primary reason. It was certainly already quite dry, hot, and desiccated vegetatively here in mid March (it had been becoming so through all of February and the first 2 weeks of march). The last two weeks have simply been a further extension of this . . .

Pg. 90.

. . . general trend. There has simply been almost no rain here, except for a few days, for 2 solid months!
2 – because it is so sunny and hot, the animals seek shade by 0830 and virtually even the last stragglers are in the shade by 0900; this results in simply not being able to see them as easily and probably thus biases the sample; however because I searched so carefully throughout the area today, I think this factor almost negligible.
I will say more about the condition of the vegetation and lack of water in some more general notes in a few pages hence.

Zone 3 NA – Weathere – 1230 – Rain 0.20 mm, emptied; Evap. Dry, thus 35.8 plus, refilled full; Max 92; Min 67.5.
Animals in this area - looked around for 15 minutes in immediate area of nest #15 hoping to see some of . . .

Pg. 91.
. . . the hatchlings from it which I recently marked with paint; however, saw none. This being predictable because they are certainly all well hidden in the rocks and shade at this hour – 1245 – it is hot as hell and bright sun is out. Then went to stomping grounds of #1193 and sure enough, the animal was there in his favorite shade site beneath a prone Pisonia branch.
On return to Caseta:
New #1247 ♀ - almost certain of sex – very short, stubby tail. No flaking disease, algae, lichens, or smooth scutes. W.g.i.'s very thin, intermittent, and very poorly discernable. CL 52.0 cm; CW 54.4; 50.0 cm. At nest #13 (1969/70) in Region 6.
New #1248 - impossible to sex – perhaps a ♂; tail longer than #1247. CL 52.6 cm; CW 58.4; 53.0 cm. No flaking disease, smooth scutes, algae or lichens; w.g.i.'s clear and well-developed. At big boulder area of Region 5-6 border.
New #1249 ♀, probably; a bit hard to se – tail intermediate in length; CL 68.7 cm; CW 69.8; 65.0 cm. No flaking disease [correction – a few hardly noticeable minor spots of flaking disease scattered here and there.], no algae, lichens, or smooth scutes; in middle of Region 5.
#51 ♂ - very large; about 125 m below Caseta Pond #1 (distance) in shade inactive.

Pg. 92.
#1125 – same area as #5; under manzanillos eating apples; in deep shade; note up from middle of Region 3 on 13-14 March 1970.

Caseta Weather – 1900 – Clear, hot, and sunny all day – max 93. ˚F; Min 66 ˚F; Rain 0.0 mm; Evap. 3.7 ml, reading 3.7.

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3 April 1970 – to areas above El Chato to NE toward Moreno's:
On way to Chato-
Saw only one animal on Reserve Border, #354 ♂ in shade at forest edge just above Caseta – no sun out ; prob. night burrow – now 0730.
Saw fresh definite sign of only 2 more animals in mora all the way to Chato turn-off. Why ? Probably because the area is so open and therefore exposed to solar radiation and extreme heating near ground, even in tall shrub's shade. The tortoise have clearly left

this area for higher elevation and also probably lower ones into guayavillo-Scalesia forest.

Pg. 93.
Near pond at El Chato turn off;
#854 ♂ - CL 112.4; CW 120.5; 113.0. Substantially severe flaking disease all over shell No algae or lichens; w.g.i.'s present but thin. Scutes smooth in central 1/8-1/4.
Came on up to and through large open Passiflora – Commelina covered care above Reserve Border and pond – This is the area where I always found at least 4-5 animals in garua season samples – absolutely none here now- a lot of old dry turds of 2-5 months age, probably from animals here in November – January period. Much of Passiflora – the vast majority – is dry and shriveled up to almost nothing; Commelina also is very dry, much of it brownish and not nearly as lush as it was even in late January; it is also matted down very badly. Tortoises seem to have completely moved away from these open fields.
Continued on Northwards toward base of Mirador – At 920 –930 feet found #189 ♂ basking in an open area; just near a forested area – he has clearly been living here awhile because of much matted and grazed vegetation and numerous turds of all ages and stages of decomposition up to even 1.5 – 2 months old; has been using nearby trees for shade. Saw him a bit lower than this in December or January sample – need to check on this to be certain.

Pg. 94
CL 134.7; CW 151.5; 140.0. Has green algae on upper rear of carapace, bits of flaking disease scattered all over and a lichen species on upper rear carapace also; entirely smooth scutes; w.g.i.'s clear and moderately well-developed.
Wandered all through this area at 900 – 1000 feet where thre were many (but scattered) tortoises in Nov. – Jan . Nothing there now but old sign – mostly matted down vegetation, old trail, and dried up turds of 1-3 months age and more. One might guess that the animals had moved out of these =small openings and patches of herbs (grass, Commelina, Passiflora) into the nearby and surrounding, more dominant (in terms of total area cover) Xanthoxylum forests – threes forest have extremely dense shade, and still fairly abundant grasses and a few other herbs. However, they do not have Passiflora or Commelina or the most predominant grasses of the open patches. And, then tortoises are not here either! So, I suspect some of the animals have moved higher up. . .

Pg. 95.
. . . in altitude, others (perhaps the majority) have retreated down toward El Chato to wait for rain in the more dense guayavillo forest and a scattering of individuals remains through these altitudes from the Reserve Border (800-870 feet) to 1000-1100 feet. The animals were never dense at these higher altitudes above El Chato and above the Guayavillo – Scalesia forests – they seem even less dense now that the dry, hot, sunny weather is here. It is logical that they might desert these areas because they are rather open on the whole except for the Xanthoxylum forests. Perhaps the latter just do not offer the right types of food.

At about 1000 feet went off of trail to W a bit to look through another area of mixed Xanthoxylum forest and open grassy patches. Quickly found a fresh trail and followed it to the tortoise - #30 ♂ (could be #430, but 400 mark look like a gouge of natural origin and not a cut); CL 126.5; CW 139.1; 125.0. Flaking disease scattered all over rear of carapace; w.g.i.'s well developerd and clear but not thick or wide; in Xanthoxylum forest.

Pg. 96.
Wandered around in this are for another 20 minutes or so, but saw nothing in the way of tortoise sign. Then continued toward Moreno's house. Just on side of Los Hermanos found a great deal of tortoise droppings and about ¼ of an acre of smashed down Commelina, now dried up.
[Marginal note: ** 1 more]
Tortoise turds were everywhere, including some from abut 1-2 months ago or even earlier and some very fresh. One must be from this morning early as it is very fresh. Looked around for the tortoise in question but couldn't locate – however, certainly is here somewhere. Altitude here about 1100 feet.
On other side of Mirador and Los Hermanos saw some scattered sign, but old. This is the are where P. Villa saw 3 in 34d week of February, 1970. No fresh sign here now. Altitude is 1150 feet. From last area on up saw no more sign of tortoises.
The interesting thing about the 2 tortoises seen below and the other sign at these altitudes is that these areas are at the same . . .

Pg 97.
. . . altitudinal ranges as the fires set last month by Chappy and Ramos (and possibly Garcia). This make it very likely that there were tortoises in this large area which were burned because before the occurrence of the firs these areas contained similar vegetation to those where tortoises now are a bit further E; i.e. a lot of Mora-covered area with Xanthoxylum stand and fairly large Passiflora – Commelina areas scattered throughout. Also, as mention in notes of 12 March, there were scattered tortoise droppings throughout much of the burned area and near it.
Went to visit Moreno and talked with he and his sons – the one son, Henry, saw 2 tortoises above Segundo Herrera's house, but just below the Bellavista – Santa Rosa trail about 2-3 weeks ago. However, Herrera recently told him that theses animals had gone back down below the house and he has not seen them for several weeks. None of these statements should be taken too seriously – however, at least the 2 animals were seen – these 2 probably include the one seen by Gallo Torres about 2 weeks ago in the same area, and the one seen in the area in mid February and late January by the Herreras.

Pg. 98.
Henry also saw 2 over to W on Chappy's land just below Paredes' a bit to this side of Ramos. These are probably not the same 2 seen by Ramos's wife in mid February. We went over there and found one animal just below where Henry had seen the 2 in early March ("first days of March " he says).
#533 ♂ - CL 125.8; CW 128.6; 117.0. Near banana patches, but in an open grass covered are; altitude about 1380 feet! Scattered flaking disease all over; scutes smooth in central ¼-1/2; no lichens, algae, w.g.i.'s thin and fine and not well developed.

Morenos say they have seen none up high anywhere on their land yet this year. Last year in the dry period in February they had one near their house.
Saw Sr. Paredes on the trail – he says he has seen none on his land on the other side of the trail (N) above Ramos' . . .

Pg. 99.
. . . and Chappy's land.
Also stopped in and saw Sr. Segundo Herrera and Sr. Chappy. Each claims to have seen no tortoises up high near their houses or Bellavista – Santa Rosa trail – I believe Chappy as he seemed open and honest. But Herrera was lying directly as it was he who told Julio San Miguel about one tortoise near his house (only 200 m distance below it) in late January. He probably is afraid I am investigating him in some stupid fashion. Chappy did say that there was one animal (#533?) that " always" lived in his banana patch?!
Anyway – how to piece all these reports and my observations together:
Only one thing is certain – that is that a number of animals have moved Northward and upward from the Caseta and El Chato areas and in between since the extreme drying began in early February; there were animals high up above Chato and also above the Caseta on Devine's land in November, December, and January, but none were as high as these are (some animals) now – they are limited to about 1000-1050 feet on Devine's land, and below and to about the same altitude N and NE of Chato, although a few were as high as 1100 feet in January in this latter area. But during February as the extreme drying out of the ponds and vegetation began and progressed . . .

Pg. 100.
. . . rapidly, a few animals went much higher up, almost reaching the Santa Rosa – Bellavista trail which lies at about 1380-1400 feet. Most of the reports of animas at these altitudes date to about mid-February to early March; a total of about 10 different animals reached these altitudes of about 1300 – 1400 feet (4 at Devine's, 2 near Segundo Herrera', 2 on Chappy's land, 2 near Ramos' house). Others were at nearly the same altitudes, but a bit lower down – e.g. DeVries' report of 2 at about 1275 feet altitude near Devine's "Maternidad" pond.
It is also clear however, that there has been no mass shift upwards in altitude; many tortoises appear instead to have moved downwards around the pond, as if waiting for rain- e.g. #97, 98, 73 from mora area are near Pond #1 below the Caseta.
A more though analysis will have a await the rest of this period's sample and a close examination. . .

Pg. 101.
. . .of the movements of marked animals. A few thing seem obvious now however:
1 – Tortoises have deserted extremely open areas in favor of open areas with nearby woods and tforests which offer shade; many are also in the guayavillo forests, around the Caseta and Chato for example; as support for this witness the lack of animals in the mora area between El Chato and the Caseta, their absence in the open Passiflora – Commelina covered area NE of El Chato where I was today.
2 – They are "concentrated" in the pond areas, at least around Caseta Pond #1 and the Region 4 pond (at least they were so in the latter case in mid-March; by early April they

seem to have scattered in this lower area). They are concentrated in the sense that a sample of the whole area around the ponds usually sampled results in a greater total number seen than usual; but they are actually individually more dispersed. In the garua and early hot season when there was still H20 here, most animals wwere either in the pond or very close around its edges. Not many were in the immediately surrounding forests. Now the reverse . . .

Pg. 102.
. . .is true. However, given the number seen wallowing in the pond (#1) in mid February by DeVries, it may be that the large number I found in mid-March dispersed around the pond and in the surrounding forest was the left over remnant of a fairly dense concentration which must have collected around this pond in mid February as it was rapidly drying up. Thus, animals were fairly well dispersed when H20 was abundant and (from August till mid and late January) and then became very concentrated as drying out began in first 2-3 weeks of February; now they are dispersing out again because there is no standing H20 anywhere and the vegetation is drying out badly.
3 – Many tortoises have also moved upwards from lower dry regions like Region 4 and below, into more lush forests at altitudes near the Caseta; only a scattering have moved above . . .

Pg. 103.
. . . Caseta altitudes out of Reserve.
4 – However, many tortoises seem to simply wander in many directions, probably searching for H20; this has involved quite a few moving down in altitude – e.g. mora and Caseta upper ponds and Devine's land down to Caseta Pond #1; others from latter location down to Region 4 area (and back again rapidly in some cases).
5 – The majority seem to be at the higher altitudes in the Reserve- i.e. 450 –670 feet or so in region below the Caseta.
6 – Many in lower areas seem to be moving little at all – e.g. see sample fore March of Zone 3 Nesting Area – i.e. Region 7 of Caseta – La Fe Trail. However, many at higher altitudes, e.g. Caseta Pond #1 area, have clearly moved somewhere because has been a large turn-over in numbers of marked animals!
So four trends –
I. Dispersed in garua season and cool cloudy, occasionally rainy part of early hot season (=all of January); this followed by extreme concentration around ponds as extreme drying began in clear, hot, sunny dry season (early February – present); re-dispersal after drying out of ponds completed, . . .

Pg. 104.
. . . as drying of vegetation continued along with hot, clear weather and lack of rain.
II. General upward movement of population considered as a whole, but with many , perhaps majority of animals staying at same altitude and even locations. This correlated with drying and hot, clear weather.
III. Increase in sharp movements by certain individual animals over fairly long distance in only a few days – often followed by rapid return to original location.

IV. Great decrease in total activity period and feeding by individual tortoises in any give 4 hr period as compared to cool garua season; corresponding avoidance of open areas except on rare cloudy days during the hot season.
Will comment more on this and conditions of ponds and vegetation after Chato – Cerro Gallina sample.
Caseta Weather – 1900 – cloudy all morning; hot afternoon. Max 89; Min 67; Rain 0.0 mm; Evap. 3.0, reading 6.7.

Pg. 105.
4 April 1970. – To El Chato to begin sample toward Cerrro Gallina. None seen all the way in mora area –
Region 1 – (guayavillo forest above ponds and Chato) – will sample later.
Region 2 – Chato area –
Near pond #1 –
#1077 ♂ - CL 124.3; CW 132.2; 121.0. Scattered flaking disease on rear ¼ of carapace and front marginal area; scutes smooth in central ¼ -1/2. No algae or lichens; w.g.i.'s discernible but thin.
#68 ♂ - can't reach to be sure, but think this # is correct.
#372 ♂ -
#63 ♂ -
#563 ♂ - CL 88.9; CW 94.2; 88.0. Severe flaking disease all over, especially on rear 1/3 of carapace; scutes smooth only in very central position; no algae or lichens; w.g.i.'s extremely thin and intermittent.
** In between Pond #1 and #2 – fresh turds (this a.m.) of one animal .

Near Pond #2 –
New #1250 ♀ - large old girl. CL 104.8; CW 113.1; 105.0. Severe flaking disease on rear marginal scutes and front marginal; also some scattered along scute borders elsewhere; scutes smooth except for very outer border and it is along these border that the flaking disease is worst. No algae or lichen. W.g.i.'s fairly well developed and clear.
#192 ♂ -

Pg. 106.
Pond # 3 and 4 area:
#204 ♂ -
#1208 –
#326 ♂ - large.
#384 ♂ - CL 117.4; CW 128l.5; 119.5. Flaking disease severe on rear 1/5 of shell, front marginals; no alae or lichens w.g.i.'s clear and well developed; scutes smooth in central ¼ -1/2.
#1036 ♀ - CL 96.0 CW; CW101.3; 89.5. No flaking disease, algae or lichens; scutes smooth in central ¼- ¾. W.g.i.'s intermittent, but mostly clear and moderately well-developed.
#151 ♀ -
Weather data – 1000 – El Chato – Evap. 29.2, refilled full; Rain 0.05 inches, emptied.
Stayed at Chato for the night -will complete sampling tomorrow morning.

5 April, 1970 –
Continuing sample at El Chato – on S side; lost tape measure so can't get measures.
#946 ♀ - medium – large size. No flaking disease, algae, lichens or smooth scutes.
W.g.i.'s clear but very thin.

Pg. 107.
3711 ♀ - medium – large size; about 85 CL.
One unmarked ♀ - same size as above 2 animals.
One unmarked ♂ - medium sized – about 90 –95 CL.
#147 ♀ - large; about 95 cm CL.
#1178 –
#164 ♂ -
#11 ♂ -
#159 ♂ - [note – not in sample – beyond sample area]
Two more – burrowed in under a thick Clerodendron molle. Both in exact same location; can not reach to get #'s of either one - both marked.
#1224 – at beginning of trail where it leaves the open Chato sampling area nd starts toward Region 5.

Starting down to Zone 5.
#685 ♂ - very large; in large open grassy area just a few hundred meters distance below Chato. Was in this same area in January sample!
One more animal – medium-large ♂ in same area – marked; tightly burrowed in.
#1225 – 70 feet lower down (i.e. 70 feet in latitude down the trail from S side of El Chato) Much drier here than at El Chato region.
Two more animals in this area – saw fresh droppings but could not locate – one small, one medium-large on ♂ scale.
#315 ♀ - at 120 feet below S side of Chato. Not far above Zone 5 now; very dry here.

Pg. 108.
At El Chato there were signs (fresh ones) of goats; all the way down to Zone 5 saw dozens of goats – very abundant and their trampling down and grazing effects are obvious all through these regions.
Zone 5 (or Region 4 of the trail – Chato – Cerro Gallina) –
First – straight line trail sample through the area –
#992 ♂ - huge fellow.
One unmarked ♀ - about 80 cm CL (medium – small in size) Mating with #996 – see notes p. 129 and ff.
#1227 – near dry pond near campsite.
#826♀ - large (all smooth scutes). Together (with #684 ♂ under a Pisonia at lower end of Zone where Region 4-5 meet.
#684 ♂ - huge. ♂ at rear of ♀. Perhaps an attempted copulation.
#1181 ♂. – huge one.

6 April, 1970.
Zone 5 – enlarged sample.

6 above animals then –
#225 ♂ - a very large completely smooth shelled old one. SW of small dry pond.
#655 ♂ - very large; south of dry pond (small one).
One unmarked large ♀, very near #655. all smooth scutes.

Pg. 109.
In open park like area to E of dry pond and campsite.
#143 ♂ - medium–large
#1180 -
Area around large dry pond –
#194 ♂ - very large; all smooth carapace.
#339 ♂ - very large; all smooth carapace. At pond.
#8l56 ♀ - very large; all smooth carapace. At pond.
One unmarked medium-mall ♀ - about 70 cm CL. At pond.
One marked animal about 75-80 cm CL; but can't reach to get number or sex because is under dense shrubbery. At pond.
#87 ♀ - large, all smooth carapace.
#895 ♂ - very large; all smooth carapace.
I wanted to continue on to Cerrito and nesting area below, but my ankle is injured and the Achilles tendon area is dangerously swollen. The walk back to the Caseta is going to be enough of a strain, so I should probably not push the strength of the ankle too much. Therefore will return to the Caseta and will have to complete this sample in a week or so.
El Chato Weather – 1100 hrs. – Rain 0.0 mm; Evap. 7.3 ml, refilled full. Sampled Region 1 of trail (guayavillo forest just above El Chato) on way out – not much fresh sign – animals in it very scattered.
#163 ♀ - small-medium; about 75-80 cm CL.
One more – saw fresh droppings only – definitely not made by #136 ♀.

Pg. 110.
On return to Caseta saw fresh droppings scattered along the last 75 m of the Reserve Border before entering forest just above Caseta - thus definitely an animal out in Mora since I last passed by here on Saturday. This is not surprising perhaps because has been cloudy about ½ of the daylight hours since sunrise Saturday morning (now 1200, Monday).
Caseta Weather – 1900 hrs – Max 93.5 ºF; Min 69.0; Rainfall 0.0 mm; Evap 14.7 (since 1900 on 3rd), reading 21.43. cloudy all day since 1100, till then clear and sunny.

8 April, 1970 –To Zone 3 NA to check weather instruments.
Tortoises seen enroute –
#246 – just below Caseta; eating manzanillo apples.
#1013 – near Pond #1.
#242 – Region 2 – 100 m below Pond #1.
#1135 – Region 2 – 100 m below Pond #1 – eating manzanillo apples.

Pg. 111.

#368 – lower part of Region 3, flattened area just a few hundred meters above Region 3-4 border.
Region 4 Weather – 0830 – Evap. 29.7 ml, refilled full; Rain 0.0 inches; Max 90.0 ºF; Min 68 ºF. Replaced Tru-check with Clear-vu rain gauge.
Zone 3 NA – Weather – 0900 – Evap. 28.0 ml, refilled full; Rain 0.0 mm; Max 93.5 ºF; Min 69.0 ºF.
Caseta Weather – 1200 hrs – clear and hot all morning since sunrise and looks as if will be a hot day all day long with no clouds. Max (for today!) 89.0 ºF; Min 69.0; Evap. 2.6 ml, reading 24.0, refilled full; Rain 0.0 mm.
Then went down to Playa and CDRS – will return in 5-7 days.

12 April , 1970 – Returned to Caseta with Bobbie Mayer. Enroute saw only one tortoise, #919 ♀ at Caseta Pond #4, same area where has been through the dry season.
**Stopped at zone 6 to fill evaporimeter and check rain gauge – of course evaporimeter dry and gauge empty – This is an accurate representation of the rain situation but will have estimate evaporation because has not been checked.

Pg. 112.
And filled since 21 March when was no rain and evaporimeter tube was replaced, having been broken a few days before by J. San Miguel.
Little change in tortoise sign along trail since mid-March (see notes of 11 March, 1970). No sign any further E since then and amount of crossing of Reserve Border by tortoises about the same. Most trails and turds old – 1-2 months, indicating a few animals have moved along and across border in past month but very few.
In afternoon went down to Caseta Pond #1 to watch sun set and show Bobbie birds and a few tortoises. All animas seen were in forested areas around pond. None in pond and a cursory check under some Clerodendron molle around the pond edges did not show any animals; but did not sample enough to really see if relative abundance and dispersion have changed since sample in March.
Animals seen –
#1265, #1245, #526 large ♂, . . .

Pg. 113.
#40 ♂ - medium-large.
#41 – large ♂.
#305 – from Caseta upper pond area.
#1068
#1070 ♀ - painted #10
Saw #10 painted first about 100 m SW of pond moving along drainage out of pond; was walking very determinably toward pond, sometimes crashing through Clerodendron bushes in the process. Arrived at the pond 25-30 minutes later. Immediately began munching on herbs in the pond floor and did not appear to be looking for H20 because did not even look at or head toward the area (low dried up mud holes in cent) where water would be if there were any now, thus probably has been here before in this hot season since the pond dried up.

Food species – saw #10 (painted) eating several things on floor of the pond. Two most abundant plants are now Cassia and Heliotropium. After first entering ate some leaves and upper leaf stems of Cassia, but after stripping about 3 or 4 compound leaves off of one plant moved away and began eating small herbs. The wander out of pond and retired for the night (1800 hrs). clearly avoided plants not apparent – did not continue on same Cassia or go to any of others of this; did not eat Heliotropium at all; this may have all been chance; however . . .

Pg. 114.
. . .no sign of grazing on cassia or Heliotropium in the pond although both form an abundant carpet. Apparently even goats do not eat these two.

13 April, 1970 – To Caseta Pond #1 again to show Bobbie more things. Simply recorded some animals I saw – not a sample.
#246 – at small pond along tail just below the Caseta.
New # 1251 – too small to sex; CL 61.5; CW 66.0, 60.5. No flaking disease, smooth scutes, algae or lichens; 75 m above pond.
#247 ♂ - edge of pond; CL 120.4; CW 134.7; 124.5. Scattered flaking disease all over; scutes smooth only in very centers; w.g.i.'s clear but thin. No algae or lichens.
#1215 – W side of pond.
Also wandered beyond sampling area – Results.
NW side of pond –
#701 ♀ - #8 painted – not far beyond area where originally marked.
#53 ♂ - CL 122.3; CW 132.3; 119.5.
SW of sampling are – along drainage –
#351 ♀ - #14 painted.
One unmarked ♂ - about 80 cm CL.
#40 ♂ - CL 125.0; CW 136.2; 123.5. bad flaking disease over much of shell; no algae or lichens; scutes smooth in central 1/10 – 1/5 only.
#41 ♂ - CL 137.3; CW 149.0; 139.5; all smooth scutes; scattered flaking disease, bad in places; no algae or lichens; w.g.i.'s clear and well developed.

Pg. 115.
3904 ♀ - CL 80.6; CW 84.2; 78.5. W.g.i.'s almost non-existent; scattered minor flaking diseas on rear of carapace; no algae, lichens, or smooth scutes.
Also went down a bit into Region 2 of the trail.
#103 and #450 – (from above areas – Caseta and above before). Both about 100 m below pond.
One notable thing – almost every one of these animals was in either fairly dense forest proper, or if near an open "pampa" of herbs and or grasses, was at its border only being in fact in the dense shade of trees, usually manzanillo.
Also, animals are extremely widely dispersed; rare saw 2 anywhere near each other – in dense manzanillo covered grassy areas and forest alike, animals all well dispersed.
Judging from hundreds of droppings seen, the main food now is manzanillo apples and it is common each day to find that 1/3 – ½ of the animals one sees are actually in the shade

of these trees actively eating apples. The only other recognizable foods in the droppings are some scattered grasses.

Pg. 116.
. . . and herbs. It is no wonder that the animas are concentrating on the apples because they are most and green whereas nearly all else is dry and very devoid of moisture. (all else = herbs and grasses, i.e. garua season food species). I can not detect anything in the cloacal region of tortoises or in the droppings to indicate that the apples cause inflammation of their gastrointestinal tract lining or sloughing off and bleeding of the same. Of course an autopsy – like exam would be the only way to really determine this matter.
As to the digestion of the apples – Bobbie says she saw one fresh dropping in which the animal had obviously only barely digested, if at all, the fleshy outer part of the apples. However, after looking at about 40 fresh droppings today, I found that in very one of them the apples' fleshy outer parts had been thoroughly digested; the only remaining parts were the inner hard almost woody core which contains the seeds. This inner part is the hard . . .

Pg. 117.
. . .knotty portion which remains for months after the apples rot naturally on the ground when not consumed by tortoises. So the tortoises generally seem to be digesting away all the fleshy part which certainly contains the water (and most of the nutrients probably). How ell they digest the apples may depend on whether they break the skin open in eating them. In most cases the animals seem to cut into the flesh of the apple sometimes severely, just in picking it up and getting into the mouth before swallowing it. However, I have also seen them swallow the apple whole, without ever breaking them open. Since most droppings contain at least 10 and as many as 20 –30 apple "cores" I doubt that all of them are crushed open in eating – and yet in all the turds I have examined, every single apple has been digest down to the woody core.
Will examine more instances of eating and the droppings also. It is intriguing to thin that many of the animals at the higher altitudes – 300 feet and up are existing now mainly on a fruit which is so toxic to humans and . . .

Pg. 118.
. . .other animals.

Weather – Caseta – 1900 hrs – 13 April 1970 – Clear and hot nearly all morning; cloudy most of remained of day. Max 90.0; Min 73.0; Rain 0.0; Evap. 4.0, reading 9.3.

14 April – cloudy all day till about 1500, then clear and sunny till sunset. Max. 87; min 73.0; Evap. 2.8, reading 12.1; Rain 0.3 mm.

12 April – clear and hot and sunny all day. Max 89.5; Min 67.5; Rain 0.0 mm; Evap 5.3, reading 5.3.

14 April, 1970 – To Cerrito nesting area for entire day – will complete sample from Zone 5 to this point. This will complete the entire sample from Moreno's to below Cerrito for the March – April period.

Pg. 119.
Enroute to Chato –
#354 ♂ - 400 m W of forest – Mora borderline just N of the Caseta; has thus moved considerably W – eating new growth of passionflower; using half smothered trees for shade.
#58 ♀ - on Reserve Border just leaving "forest" where it junctures with Mora E of El Chato turnoff; moving Eastward.
#1630 – as last week, at Mora – forest border just above Chato where enter Region 1 of sampling line.
Tortoise concentration about as in period last week when I did sample here. Noted down #'s of about 1/3 of those I saw as was walking through rapidly –
#609 – in Region 1 forest.
#192 ♂, #562 ♂, #1250 ♀ - near weather instruments.
Weather at El Chato – 0900 hrs – Rain 0.06 inches, emptied; Evap. 30.8 ml, refilled full.
Enroute to Zone 5 from Chato –
#320 ♂ - medium sized.
#449 ♀ - medium sized. Both about 100 m distance below El Chato S side pampas (sampling area).
#87 ♀ - about 1/3 of way between Zone 5 and Chato – still in reasonably dense guayavillo forest.

Pg. 120.
Copulation ! – At 1930 came upon a pair of tortoises, male attempting to copulate with the ♀. This was in very dry guayavillo dominated forest about 2/3's of the way down to Zone 5 from El Chato.
#310 ♀ - CL 93.2; CW 102.6; smooth in central ¼ -1/2 of carapace scutes. Bad flaking disease all over the carapace.
#?2 (marked in 1, 2, 7 of 10's scutes, 1 and 7 marks being most fresh, but 2 mark clearly a cut). CL 139.2; CW 155.0; all smooth scutes completely.
Some general observations about this attempted copulation:
The animals were in the open in a dry herb covered area; they probably would not have been able to withstand the solar radiation in such a location on any other hot, clear days so typical of this season, but it was sloudy and drizzly today form sunrise till now – 1200 and is still so.
I do not know if the copulation was ever successful. As I first approached the animals, I could hear . . .

Pg. 121.
. . . the ♂ giving short rhythmic groans before I could see them and while I was still about 40 – 50 m away form them through dense brush. When I first arrived the male was mounted on the female, thrusting regularly and briefly giving a groan with each thrust; but the ♀ was turned a bit under him so that his cloacal area was in contact with her rear

right leg pocket area and not her cloacal area – thus this was obviously not a successful attempt. What could have occurred before this I do not know. Soon after I arrived he dismounted and lay flush against her side, both facing in the same direction. Then, of and on, for the next 1.5 hrs (till 1100) he attempted to mate with her by 4 separate mountings. All of these failed. Each mounting lasted from about 5-10 minutes; each time the male in frustration would finally dismount, sit beside the female for 10-15 minutes and then remount.
Through all of this save for movements described below the ♀ remained flat on the ground resting on her plastron, with head and all legs withdrawn fully. She never extended the head at all and the legs only for some twisting and turning movements. She never actually attempted to walk away form the male. She also never attempted to avoid his attempts at coupling . . .

Pg. 122.
. . . by lowering the plastron in the rear; however she never raised the plastron in the rear (if that would even be possible while supporting the ♂'s weight is debatable – probably not) or in any obvious way trying to aid the ♂ in this attempts. She was, in other words, entirely withdrawn and passive, and perhaps literally harassed and afraid because of this very aggressive behavior of the male.
Her one active behavior during each mounting was to turn slightly under the male after he had mounted – usually within a few minutes or even seconds after he began thrusting or groaning. Three times this resulted in her presenting the side of her shell to his cloacla area. In the 4th mounting, the last one before I left, she actually pivoted 180 º after he mounted, and this resulted in his trying to copulate with her . . .

Pg. 123.
. . . head region.
In each case when she pivoted under him the male seemed to be aware that something was amiss because he moved even more violently and extended his head even further down (or his extended neck) near her head region. This never prevented her from continuing to pivot under him by using her 4 partially extended legs. In each case as she pivoted he eventually stopped thrusting and groaning while she was active; then he started again in each case, but more weakly and he soon stopped altogether and dismounted.
The ♂'s behavior was much more active and difficult to describe. In 3 of the 4 cases, and in the case of the mounting which had already occurred before I arrived he mounted from the rear of the female. In the other case he mounted over her rear leg pocket and then slid and moved around till he was over her cloaca in the proper position. It was generally clear however, that if she pivoted out of the proper receptive position under him he could not prevent her from doing so and could not readjust his position once she turned so that his cloacal region . . .

Pg. 124.
. . . was facing her carapace anywhere from the rear leg pocket forward. In each case he gave up the mounting once she accomplished such a movement.

It thus appears that the ♀ was not receptive and was able to prevent a successful copulation by this pivoting, turning movement; not by lowering the plastron and carapace in the rear cloacal area. The ♂ never showed any significant pre-mounting courtship behavior. However since, he was already mounted when I arrived I may have missed this. It would not be at all surprising if such behavior usually occurs, that it occurs only at the beginning of the entire mating sequence, even if the sequence involves several to many mountings. Between the original mounting and the 1st one I saw start to finish, he did sniff around her cloacal area for about 1-2 minutes before remounting (after dismounting from the first mounting). For all 3 other mountings I saw he did not sniff her, but just climbed on with no further. . .

Pg. 125.
. . . ado.
In mounting the male extends his neck and simply slides it over the top of her carapace, immediately following with this plastron; he fully extends his forelegs thus getting the plastron up onto the side-top area of her carapace; he then pushes with his rear legs as he pulls his forelegs in and starts climbing up onto her shell with them. He ends up with this forelegs resting on her front marginal scutes and extended; his concave plastron fits onto the upper rear and rear portions of her carapace; his rear legs are fully extended and support his body off of the soil in the rear. This is the resting position.
In thrusting he performs a number of interesting things at once: he quickly and simultaneously draws his rear legs up, pushes down on her marginals with his forelegs and as a result rocks backward, using his concave plastral portion as a pivot point or fulcrum. This brings his cloacal area and tail under the rear of her carapace (supracaudal scute area), in a sharp thrusting movement. It does not result in him touching the ground at all. As he does this he emits a sharp groan of about 1–1.5 seconds in length. The entire thrust movements lasts about 1-2 seconds.

Pg. 126.
At the end of the thrust he simply reverses all these movements simultaneously. It appeared to me that in the resting position his tail stayed close to hers. So it is likely that in a successful copulation the penis stays in the cloaca throughout the mating. However, I do not know this yet because have not seen a successful intromission and mating.
Other interesting facts:
1 – groans were emitted only during the thrusts, i.e. when mounted.
2 – the male held his head down over the ♀'s head area by arching his neck out as fully as possible in a long curve; it is probably a useful behavior for keeping her head retracted and her entire body withdrawn – he appeared to be trying to keep her petrified and completely passive. He could probably use his mouth to bite at here head or forelegs if she extended them.
3 – I wonder if the pushing down on her front marginals with his forelegs does not also serve the . . .

Pg. 127.
. . .purpose of slightly elevating her plastron in the rear in some copulations. I did not see this occur in this case, but could not see well enough to say whether it occurs or not.

It is perhaps logical however, that physically, any effect which this pushing down on the plastron would have in raising the latter, would be counteracted by the fact that the animal raises his rear legs and rocks backward a bit in thrusting his cloacal area up against hers. This seems to shift the center of gravity of the combined mass of the animas even ore to her rear and thus seems to result in preventing the weight and thrusts of his forelegs from raising her rear. In stead she appeared to just sit flat on the ground, flush, on her plastron. Perhaps this latter position is normal for copulation, because there is some question that the much smaller female could support the entire weight of the large ♂ (which she is doing during the thrust, and rests between thrusts) by raising her plastron in the rear; i.e. by extending only her back legs to . . .

Pg. 128.
. . .tip her body upwards. I doubt she could support all this weight for very long with only her 2 rear legs – perhaps she could not even lift this weight off the ground at all. This remains to be seen.
4 – When the female pivoted under the entire or almost entire weight of the male (on the upper rear of her carapace – center of his weight) she did not lift herself off of the ground, so that she was not supporting all this weight on only here 4 legs. Instead she simply partly extended her 4 legs onto the soil and then by lifting slightly, but mostly scarping sideways and digging in with here feet she was able to pivot beneath him. Her carapace was flush with his plastron, and her plastron flush with the soil during this movement.
5- if the ♀ were able to lift the ♂ at all with her legs, it could be easier with the . . .

Pg. 129.
. . . forelegs because most of his weight is over the center and rear of her body. Thus she might be able to extend only her forelegs and lower her plastron in the rear were she unreceptive; however, perhaps (as noted under #2) he uses his head to threaten and bite at her forelegs. I saw none of these sots of movements so will have to look at them later if they occur. Took a few photos of all this – Roll 91, #'s 20-30.
All these things, regarding movements of the ♀ especially, may vary depending on the relative sizes of the ♂ and ♀. For example if the ♂ is a good bit smaller (as some which are probably sexually mature are), then perhaps the female can extend here legs to support his weight and either assist the mating or prevent it depending on her receptivity. Or if the ♂ is extremely large and the ♀ quite small in a relative sense, then perhaps in thrusting the ♂ need not draw in his rear legs and rock backwards so much.
On trip to Zone 5 last week (5-6 April, 1970) saw #992 ♂ and an unmarked ♀ of about 80 cm CL in an attempted copulation in Zone 5 – 5 April, about 0900-1000 hrs. The attempt was written up at that time but in my cheap temporary notebook. This is a transcription of those . . .

Pg. 130.
. . . notes but with the modification that I have since seen this more clear attempt today. Most movements were the same, the female's being exactly as in the case seen today. However, twice she took off within a few moments of the ♂'s dismounting, trying to get away from him. She headed to brushy areas and began crashing through them. He took

off after her immediately, and overtook her easily each time. Without sniffing about her at all, he immediately started mounting her, head and neck stretched out; this caused her to completely and rapidly withdraw her legs and head and stop moving.
Other than this, her movements were similar – she tried pivoting under the male during each of the 4 mountings I saw (1 in progress when I arrived, 3 after I was there). She successfully turned 3 times and twice he was finally facing here side, once here rear leg pocket, when he finally gave up and dismounted. He tried readjusting himself to the . . .

Pg. 131.
. . .proper position in each of these mountings but she just continued to pivot under him as he tried to realign himself. The one time she seemed unable to move under him and was just scraping the soil hopelessly, they were jammed up under some Clerodendron and Pisonia branches. This resulted in both having trouble moving and the ♂ finally dismounted, she took off and he chased her, caught her in the open and remounted. Again, saw no pre-mating courtship. Again, he arched his head out over her thus threatening her front end – he kept it there all through the attempted copulation. He groaned while thrusting, but also emitted some random similar groans each time while chasing and mounting here – thus a threat sound to aid in stopping her movement?
The male did not show the pulling in of the rear legs completely off of the ground when thrusting. Instead he simply relaxed and bent them a bit, pushed with forelegs and thus rocked in attempting intromission. Perhaps this was due to her smaller size relative to his as compared to the previously described pair. Although he cam closer to actually achieving intromission than in the previous case, the copulation was not successful while I was there. In. . .

Pg. 132.
. . . both this case and the previous one I finally left because the male finally dismounted and id nothing for 20-30 minutes after that. In the present case, the usn came out and it was clear the animals would soon have to give the attempt up and head for the shade. In this first described case (today), when I passed by again at 1500 the 2 animals had moved away (sun came out between 1300-1330). So I have not yet seen a definitely clear successful copulation; however, those seen in October, November, and December may have been successful because in each case there were not multiple mountings and the ♂ did not repeatedly chase the ♀.
Finally, the question still remains as to whether copulations would b more common (or at least more commonly witness) if the animals were concentrated around the ponds following a large, heavy, rain?

Pg. 133.
Following this, continued toward Zone 5 –
Just a short distance down the trail saw 2 animals in shade of a guayavillo. Male was sniffing at rear of ♀ and disturbed soil in area indicated a probable attempted copulation; ♀ was jammed up against a prone tree trunk and completely drawn in – typical ♀ posture when ♂ is “attacking” them.

Copulation - #385 ♀ - CL 96.1; CW 105.4; smooth all over; scattered very minor flaking disease. #549 ♂ - CL 141.2; CW 156.4; scutes smooth in central ½ - 2/3's; bad flaking disease all over; very dome-shaped.
In passing through Zone 5 along tail –
#507 – huge ♂ - flaking disease horribly bad; 50 m N of dry pond – campsite area.
#143 ♂ - (saw here last week); CL 119.7; CW 128.6; bad flaking disease all over rear ¼ of shell and front marginals area; no algae, or lichens; W.g.i.'s very then but detectable.
#225 ♂ - (saw here last week) CL 143.5; CW 153.2; scattered bad flaking disease especially in 2 common areas. W.g.i.'s there but thin; no algae or lichens; scutes smooth – ¾'s of them in centers.
#684 ♂ - same exact spot where saw last week. CL 144.2; CW 155.2; Scattered flaking disease all over, bad in 2 common places; light green algae and at least 2 lichen species, confined to lower ½ of 4th vertebral and all over 5th. . . .

Pg. 134.
. . . vertebral, supracaudal and last costal on each side. Big eaten out hole (8 x 4 x 1 cm) in 7th marginal on right side.
Sample – Region 5 (Zone 5 to Caseta) –
#567 ♂ - very large and smooth all over CL 139.9.
#826 ♀ - smooth all over; no lichens or algae; w.g.i.'s there but very thin; scattered minor, old flaking disease pits. [Marginal note: copulation] Probably has or will soon attempt a copulation - ♀ is totally withdrawn; males is sniffing about her rear. Both in shade; Region 4-5 Border.
A bit further down trail –
#545 ♂ - very large; in position such that can not measure.
Region 6 –
Region 5-6 border – on side of Cerrito -
#653 ♂ - large, all smooth shell.
Lower down on side of Cerrito – Region 6 –
#903 ♂ - CL 108.0; CW 121.8; bad flaking disease all over rear 1/3 of carapace and front marginals; w.g.i.'s present but very thin; scutes smooth in central 1/5 or less only. No algae or lichens. In shell.

Pg. 135.
#1229 ♀ - a bit lower down – only 20 m distance from #903; in shade.
3198 ♂ - low down; on side of Cerrito just before beginning of flat, dry rocky level area (Region 7) In dense shrubs in shade.
Region 7 – no animals seen.
Region 8 – Cerrito Nesting Area –
One small unmarked animals seen in shade of pega –pegas; can not reach to mark and measure.
On return –
[Copulation] - Found #903 sniffing at rear of #1229 – he had moved from his resting spot to here – she was all drawn in and looked hassled. I watched them for about 10 minutes but nothing happened except the sniffing so I left.
15 April, 1970.

To Naranjo area – am interested in determining if many animals have moved into the densely forested regions around the Reserve Border from Naranjo and el Chato areas – i.e. away from more open areas.
#774 – in dense Mora along Reserve Border just N of El Chato.
In beautiful dense forest along Reserve Border between El Chato and Naranjo saw very little sign of animals. Some old turds and old trails, but very widely scattered. Saw no burrows, no animals. My general impression was that the . . .

Pg. 136.
. . . tortoises certainly have not moved into the forests in any significant numbers at these altitudes.
I suspect they are largely in and around the pond areas where they are normally concentrated – just being more dispersed and more in the forests than open areas 0 i.e. the reverse of the garua season.
In Naranjo area – open area – partially forested, near dry pond and the caves.
#676 ♂ - CL 91.0; CW 96.5.
#224 ♂ - 100 m N of open area, more in forest of guayavillo.
In Zone 4 –
#254 ♂ - CL 126.3. (duplicate # at El Chato?).
New #1252 ♀ - CL 80.7; CW 87.9. No flaking disease, algae, lichens or smooth scutes; w.g.i.'s clear and well-developed.
#675 ♂ - very large.
New # 1253 ♂ - CL 82.7; CW 91.9. Scattered flaking disease on rear marginals and front marginal area. No algae or lichens; scutes smooth only in very centers; w.g.i.'s very thin and nearly undetectable.

Pg. 137.
#495 ♂ - CL 139.0; CW 151.3. Scattered flaking disease on rear ¼ of shell and front marginals; scutes all smooth; no lichens or algae; w.g.i.'s clear and moderately thick.
New # 1254 ♀ - CL 78.3; CW 82.7. No alge, lichens, flaking disease or smooth scutes; w.g.i.'s very thin but visible.
One more animal – marked, but can not read number or get measurements because so well burrowed into brush; about a medium – large sized animal, ♀ scale (couldn't sex either).
Most animals in these areas are either in the forested areas or near the open pampas, but only at their borders where there is plenty of dense shade from trees and shrubs. Only one animal was in the pampa proper and was moving along during a cloudy period. They are also eating manzanillo apples here, but they are generally less available because of a shortage of the trees as compared to the Caseta area and Region 4 of Caseta trail and El Chato Zone 5 areas.
But comparatively, this area, though very dry, has certainly had much more rain this rainy season than Eastwards of here. The guayavillo forest between El Chato and Naranjo and the whole Naranjo – Zone 4 area, shows a surprisingly good growth of green herbs and shrubs, and in the forest the trees, lianas. . .

Pg. 138.

. . . and epiphytes are quite green. The area is not greener than others such as El Chato, Caseta, Zone 1, but relatively speaking must have had more rain because it is as green as the latter areas which [whereas] these areas are usually considerably drier than them. The goats are also lower here, being in Zone 4 and below mostly and not up in the Naranjo area or the luxurious guayavillo forest E of Naranjo.
Clearly there has not been any great movement of animals from El Chato to Zone 4 – Naranjo or out of any of these 3 areas into the dense guayavillo forest along the border. Animals are Naranjo and Zone 4 seem about as concentrated in the garua season or a bit less – This is not surprising because have seen these areas only since October 1969 when the ponds here were already dry and had been so for quite awhile, so I do not know if animals would . . .

Pg. 139.
. . .be more concentrated here if pond shad H20 – i.e. didn't get to the change from wet to dry season as markedly in Zone 5 – Naranjo as it did at Caseta, Chato, Zone 1, Zone 6, etc.
Caseta Weather – 1900 hrs – Rain 0.0 mm; Evap. 4.2 ml, reading 16.3; Max 89.0; Min 70.0.
16 April 1970 – Wrote notes and relaxed all day long. Rain 0.0 mm; Evap 5.0, reading 21.3; Max 92.0; Min 72.0; clear, hot and sunny most of day, save fore 1600 till sunset (1815).
17 April, 1970 – To La Fe to complete sample from Region 7 through there.
Enroute –
#62 ♀ - small, but low #; about 80 cm CL – mid Region 2.
#136 ♀ - mid Region #3, steep ascent part. CL 104, CW 106.7
#53 ♂ - lower and mid Region 3 – dry part. CL 122.2; CW 132.4.
#314 ♂ - Region 4 – just below Region 3-4 border and just above open area near weather instruments.

Pg. 140.
Region 4 – Weather – 0830 hrs. Rain 0.0 mm; Max 89.5; Min 69.0; Evap. Dry, refilled full.
Zone 3 NA – Weather – 0930 hrs. Rain 0.0 mm; Max 92.0; Min 69.0; Evap. Dry, refilled full.
Region 7 sample –
#220 ♂ - CL 121.6; CW 144.4. In open area part of nesting zone – down from Caseta area.
#1144 – Central Nesting Area.
No more animals from here to Region 8.
Region 8 – very, very dry – no tortoises seen at all.
Region 9 – Also quite dry.
#1200, #325 ♂ - both under same tree in area where I always see 2-4 animals – upper part of Region 9. The 200 scutes mark on #325 used to be a ring tag hole but surely looks to have been cut afterwards. Think this is same animal I saw in Region 7 (central Zone 3 NA) in November, 1969.

Pg. 141.
One unmarked small (♂ scale) tortoise seen in lower part of Region 9, about ½ way between right turn and La Fe NA; well burrowed in so could not mark, measure or determine sex.
At La Fe NA (Region 10) – no time to measure, mark, etc. so simply counted animals – saw a total of two – one quite small, i.e. 6-10 yrs old at most, one larger, about 70-75 cm CL.
Very many less goats throughout the entire region below zone 3 NA than in garua season – this would be expected because they have generally moved northward a great deal.
On return –
#1249 – midpoint of Region 5.
Shot 12 goats (7 ♀♀, 5 ♂♂) today on return to Caseta and trip down – all in between Region 4 and Caseta pond #1; missed one shot at a goat in lower end of Region 8; this disparity truly reflects the difference in the relative and absolute numbers of goats at the various altitudes and zones.
Caseta Weather – 1900 – Rain 0.0 mm; Evap. 3.7, reading 25.0, refilled full at 1900; Max 87.5; Min 70. Very cloudy today most of the time save for about 1200-1400 and 1700 till sunset. Clear night.

Pg. 142.
18 April – To CDRS to prepare for long trip (mostly vacation).
1130 hrs – Zone 6 – Weather – Rain 0.0 mm; Evap. 25.2 ml, refilled full.
#797 ♂ - at Pond #2 in shade of manzanillos.

Pg. 143.
Photographs –
Roll 87 #'s 31-35 – burned over areas above El Chato, March 12.
Roll 88 #'s 1-17 – Ditto – see notes of 12 March.
18-19 – Large male moving down hill in transition zone – (middle of Region 3 of Caseta – La Fe trail).
21-23 – Caseta Pond #1 in dried up condition – 16 March.
24-25 – same – 17 March.
26-33 – around Caseta – sunny with nearly full moon.
34-35 – Nest 14 in Zone 3 NA – new hole in it where young just previously escaped - 20 March.
Roll 89 - #'s 1-9 – Nest #17 in Zone 3 NA – just after removing hard cap – positioning of eggs – 20 March.
#10-11 – Hatchlings from Nest #15 just after painting them – released in a group on top of the nest - 20 March.
Roll 91 – KX – 12-14 April –
Approximately -#'s 1-10 – Caseta Pond #1 and surrounding scenery; with Bobbie Mayer.
Approximately - #'s 11-19 – young Galapagos owls in nest (Lechusa negra) also adult owls.
#'s 20-30 – tortoises – attempted mating #82 ♂ and #310 ♀.

Pg. 144.

#'s 31 – end – scenes showing dryness of area now at El Chato – "pampas".
Roll #92 – KX – 14-15 April, 1970.
#'s 1-6 – Galapagos owl (Lechusa Negra), with half moon; hard to set up because of evening light.
#'s 7-end – Bobbie Mayer and C. MacFarland photographing and gathering wild growing hot peppers. The exploring caves at Naranjo; also ferns in cave entrances.
Roll # 93 – HSE – 15-16 April, 1970.
#'s 1-2 – ruined – wrong ASA setting.
#'s 4-6 – white barn owl at cave entrance, Naranjo; shows daytime behavior – i.e. sleeping and sitting doing nothing.
#'s 7-end – Many shots of short-eared owl; Bobbie and I goofing around, reading, etc. at Caseta; shots of Caseta in late afternoon (with man urinating in background).
Roll 94 – April 16, 1970.
Total of barn owls (mostly) and short-ears [owls] around the Caseta – with Honeywell flash unit; experimentation.

Pg. 145.Roll 95 – KII – April 16, 1970.
#'s 1-12 – Barn owls around Caseta; also with Honeywell flash.
13 – Bobbie coming up stairs into Caseta at night.
#'s 14-18 – Various small birds in transition and cactus zone - ♀ vermilion flycatcher; endemic flycatcher; G. scandens.
#'s 19-20 – Effects of goats on Opuntia in lower zones.
#'s 21-23 – Short-eared owl guarding nest in setting sun; ♀ I think(?).

End of notes – Volume 7 – Santa Cruz; transcription completed 19 January, 2005, T. H. Fritts. See addendum below.

Addendum
Loose page included in notebook probably representing rough notes with information as follows.

Nest #	# Eggs inside
12	11 (one bad)
9	7+
1	14 (minus 1 or 2)
2	8
3	15
4	8
5	8
6	10
7	9(minus 1 or 2)
8	11
13	unknown
14	unknown
15	unknown

Data on nest temperatures and photographs on opposite side of the loose page is unintelligible to the transcriber. thf

End of notebook.

Isla Santa Cruz Volume #8.
Field Notebook of Craig MacFarland

Pg. 1.
20 May 1970
Returning to Caseta today. Enroute to Zone 6 saw no new sign of tortoises anywhere along Reserve Border that was not present in April or last trip by here.
To Zone 6 - searched through normal sample area in this zone - only saw one animal #419 ♂ - up under a Clerodendron in shade (hot and sunny) - cannot reach to measure. No others found - very little sign throughout the area of any tortoise activity. Just old dry turds, old matted down trails, old burrows.
To Zone 1 - likewise thoroughly covered normal sample area. One unmarked ♀, about 80 cm CL, only 15 m distance below Reserve Border on trail.
Pond 1 area - none
Pond 2 - #1170 ♀ - up under a Clerodendron in shade - inactive.
Pond 3's large surrounding pampa Manzanillo groves area - nothing.

Pg. 2.
Then to large pond by Reserve Border just west of Zone 1 - again little sign as in two zones previously examined.
#94 ♀ (probably; tail intermediate in length). CL 97.7; CW 105.4.
These zones are extremely dry, all ponds have been dry since early March and are still so. The areas have certainly been becoming (as with rest of Reserve) more and more dry each week since early, first days of February. The mass of the herbs which were so luxurious before are all dead and dry. The only place there is much green vegetation (especially herbs) is in shade of dense foliage, e.g. especially under manzanillos. On the whole, tortoises seem to be very definitely widely dispersed in these areas and not at all concentrated in them (especially Zone 1 I am thinking of) as in October - January samples.
Weather at Zone 6 - 1030 hours. Evap. dry, refilled full; Rain - 0.30 inches.

Pg. 3.
21 May 1970 -
To Caseta pond #1 area to sample. #246 ♀ at Caseta, active by 0800, walking around campfire area at 0915 still; very cloudy, cool and windy now. - CL 97.8; CW 105.3; Splotches of bad flaking disease on rear and front marginals area; no algae or lichens; scutes smooth in central 1/8 -1/4 only.
#1251 - about 25 m to west of trail, 75-100 m distance above pond #1 -= basking in open at 0930 - still cloudy.
Made a circuit inside pond looking carefully up under Clerodendron bushes also for tortoises.
#626 ♀ (up from Reg. 4) - in center of pond grazing ; still cloudy. CL 86.1; CW 95.5. No more seen on inside circuit.
On S. side of Pond:
#1189 (painted #4) - in open 15 m S of pond ; active a bit.
#1022, resting in open near pond border; inactive; still cloudy.

#1070 ♀; (painted #10) - same as #1022. Both in semi-open area, lots of Manzanillos and dense patches of Clerodendron nearby.
Pg. 4.
On SW side of pond.
New #1255 ♀; CL 62.0; CW 64.1; almost certainly a ♀, very small , short tail. No flaking disease on top, but plenty on underside of rear marginals; no algae or lichens; scutes smooth only in very centers. Along drainage to SW, burrowed in under some shrubs; still cool and cloudy. Completely inactive. Near dense Clerodendron area.
#570 ♀; CL 97.9; CW 110.8; Scutes smooth only in very centers; only a few very minor spots of flaking disease on rear of carapace; no algae or lichens. Very interesting that is definitely a ♀, yet is large but not smooth all over. I say definitely a ♀ on basis of tail length and size; shape and plastral concavity indicate ♀ also. In open moving along, but near dense Clerodendron area.
On west side of pond:
#1215 - in forested area- (Guayavillos, Manzanillo) about 40 m west. Active a bit.
Pg. 5.
On north and east sides - none seen and only a few scattered, old, dry droppings.
I decided to expand may are of counting a bit as in April to see what I could find in the forests to the south and north-northwest areas from the pond. So I covered extra areas of about 1 hectare each in these 2 directions; these are the same areas which I searched in the mid - April period. They are guayavillo dominated areas with a heavy canopy closure and with lots of Manzanillo shaded areas. The herbs are much more numerous, green, and lush in these areas (though they are still quite dry) than in the open and semi-open areas around the pond and the Caseta.
To N-West and north sides- saw only one animal, #933 ♀, (painted #12) - under a Manzanillo, sitting; still cool and cloudy.
To south -
#73 ♂ and #1072 ♂; it looks as if the latter may have been aggressing #73, because he is behind him, close by, with
Pg. 6.
. . . his head out and above the rear of the carapace of #73. The latter is inactive and all drown in. Both are just sitting however. In forested area.
#305 ♀; moving upwards along drainage toward pond, but well below 300 (m) pond in distance; also in forested area.
To small pond just below Caseta; will sample as usual up to altitude of Caseta and over to it:
#891 in forest just S and on borderline of small pond. Sitting inactive; looking around a bit.
At same altitude as tent and Caseta - but to west in forested area in tall dry grasses near Manzanillo groves: #408 and #1125; active, but only slightly.
Near tent in open active a bit #598, down from Caseta upper pond area.
Pg. 7.
So a total of 2 near Caseta, 8 at pond and around it (normal sample area) and 3 in small pond and area above (also normal sample area). Four (4) more seen in expanded areas beyond normal sampling area.
In afternoon - to Caseta upper pond area:

#174 ♀ (painted #2) and #852 ♀ - both in fairly dense semi-forested area just below the pond; #852 is just behind #274 - both sitting still now -perhaps a recent aggression ?
#695 ♂ - below ponds a short way on border of open plant #1 covered fields and semi-forested area; burrowed into loose dry soil and partly covered by tall dry grasses.
#885 - in semi-forested area just below the Caseta; burrowed in like #695; inactive also.
In pond #2 area:
#123 ♀ - was burrowed into soil under loose dead grass but has just turned outward, so will probably be active soon. Nearly open area - only low shrubs and sapling for shade.
Pg. 8.
#120 ♀ - CL 85.3; CW 89.5. Same area as #123; also burrowed into loose, dry soil, under a semi-prone guayavillo stem.
#450 - near pond #3 in shade of a large guayavillo.
#1190 (painted #13) - near Devine's eastern manga just up hill from ponds.
No others seen in usual sample area.
To Devine's by central manga.
#403 ♂ - CL 96.9; CW 98.8. About 150 m distance above upper ponds (Caseta) area. Grazing in open on small herbs to side of pangola grass strip.
#909 ♀ - just 15 m north of last animal, burrowed into loose dry soil - only slightly covered by vegetation - but has been a very cool day. Both animals right on mora border.
[Marginal note: Fresh turds with Manzanillo apples - see 29 May notes]
Clear sign about ½ way to first fence (i.e. now at about 830 - 850 feet alt.) of at least 2 more
Pg. 9.
. . . . tortoises- have been eating all along mora - manga border (herbs); clear out into mora for about 15-20 m are clear signs of disturbance where tortoise have been clearing herbs out and grinding mora and other "shrubs" (e.g. Solanaceous thing) down - only in this one area however.
Rest of way to fence not much sign of any activity - possibly a few small paths, but not clearly tortoise.
In upper half of bananas as I was walking along east of this first patch of them, saw #304 ♂ (was here on March 19, 1970 too) walking along into patch coming from grassy areas to east across 1 fence. It's measurements: CW 112.9; CL 124.2 [Editorial note: note order of CW and CL transposed from normal pattern and that CW is reported (erroneously ?) as less than CL - this is not normal measurement and I suspect CGM transposed labels for these two measurements - thf] Original saw this beast in Reg. 4 of Caseta - La Fe trail!
22 May 1970 -
Will search over Devine's land today for tortoises - same areas in large part as on 19 March 1970.
In banana patch area - lowest ones -
Pg. 10.
3782 ♀ - at about 950-1000 ft. elevation, just W of bananas, in open grazing on dry, but fairly lush grass.
#304 ♂ - same area as yesterday grazing on grass and herbs.
#1 ♂ (could be 101 but very doubtful mark in 100's place - almost certainly only 1) - CL 128.5; CW 145.0; carapace scratched up so has been traveling through mora. W.g.i.'s

well-developed and clear. Scutes not yet smooth anywhere save for small central areas; but all are well worn. No algae or lichens; a few minor spots of flaking disease on rear of carapace only. Feeding just west of banana patch (lower end) in an area of fairly lush Commelina. From matting -down of the area and scattered fresh turds looks as if has been here for at least 1-2 weeks. There is a clear trail from banana patch to the area, probably made by this animal.
Pg. 11.
Altitude here is about 880-900 feet.
** Saw sign of probably 2-3 animals in same banana patch. Searched all over same areas in central and eastern parts of Devine's land where searched on 18 March. Except for the animals seen above, saw no more and outside of the banana patch saw no sign that is any more fresh than in March search.
Then returned to Devine's house - discussed with Bulmare possibility of tortoises above the house, i.e. between it and the S. Rosa - Bellavista trail. There is a lot of Scalesia pedunculata forest in this area (cattle are also in these areas). Bulmare says he has seen no animals in these areas and none higher than 4 that were in house area in February. However, Bulmare may be a bit afraid to tell me if there are in fact any tortoises in the area in question because of the death of one (killed by some unknown persons) about half way between Devine's house and the Santa Rosa - Bella Vista. trail. I do not yet have the necessary information on this animal but will obtain it from Bud Devine as soon as possible. Anyway, Bulmare is an honest fellow, but the fear of being accused of or thought to be involved in
Pg. 12.
. . . . the death of this tortoise may have resulted in him not being completely open - he averted his eyes a lot (unusual for him) when I questioned him and seemed a bit wary.
Then came down Devine's eastern - most manga as usual and found all sign to be in same condition as in March - absolutely no new sign. Saw only 1 tortoise, just above Caseta upper pond area a few dozen meters distance. In manga /forest border sitting in shade (sunny off and on today, in morning; sunny all afternoon).
#788 ♂; CL 116.0; CW 124.4; no algae or lichens; flaking disease in large bad blotches on rear of carapace and in center of 4th vertebral scutes.
Late afternoon (1630-1730): searched Caseta pond #4 area and north of it to altitude of Caseta and then
Pg. 13.
. . . . back over to the Caseta. Since most of this area is covered with rather dense guayavillo-Scalesia forest, I wanted to see if animals were at all concentrated in these shadier, somewhat greener areas. Search over about 1 hectare and discovered that animals had been moving through here very much in past few dry months - many dry droppings, old burrow sites in loose, dry soil to lots of matted down vegetation and paths all over; of course, could be mainly the result of activity over this time period of only a small # of animals - in fact this is likely because few times I have been through here during the hot season have only seen a few if any animals.
#220 - near pond #4, burrowed in, inactive, in young Scalesia stand near open area of pond.
#444 ♂ (#11 painted) - same area along open trail as on 20 May . Active and looking about for food.

#96 ♂ - in guayavillo forest; near a dry pond; inactive and resting up under a Clerodendron bush.
Pg. 14.
Some notes from Julio and Galo -
1. The failed to take weather from 18 April to 20 May except at Caseta - god damn!
2. Took rain at Chato and emptied gauge once - 8 May 1970, 1.0 inches; emptied.
3. **Same day (8 May) at Chato they saw on pair copulating, ♂ #18 (very large) and ♀ #618.
4. #1102 (from Chato!) is about 200 -300 m distance above Reserve Border in Segundo Herrera's manga which almost reaches R. B. Galo says he has been there for about 1 month and he sees the animal every time he goes by.
5 Galo spent ½ day hunting for the tortoise reported (by whom?) - Henry Moreno? - Ramos?) to have been killed on Ramos' land by fire of 10 -11 March, 1970. This was to no avail as he found no sign
Pg. 15.
. . . . at all.
I sent Galo down to check weather instruments at Reg. 4 and Zone 3 NA. Somehow he got himself completely lost and ended up taking the old trail east to Zone 1. Anyway, the dumb ass returned with only the Reg. 4 (weather) data l- to wit - 11 May 1970 - 0700 hrs; Max temp. 88.0 ° F; Min 64.0; Evap. dry; refilled full; Rain 5.0 mm - emptied.

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23 May 1970 - To El Chato to change weather instruments - w.71 (not clear) sample in mora.
#187 ♂ - CL 113.5; CW 114.5; halfway between first hill and rt. Turn. Deformed; bad flaking disease on rear and front marginal; only central 1/10 of scutes smooth; no algae or lichens; w.g.i.'s clear and easily visible. Grazing on grass in trail.
A bit further on - to left of trail 15 m. #1044 ♀; CL 89.7; CW 95.3. Scattered flaking disease on both front and rear of carapace; no algae or lichens. W.g.i.'s present but very thin. Grazing in open passion flower field.
Pg. 16.
Just before Rt. Turn - 20 m north of R. B. - grazing in open passion flower field
#452 ♀ - CL 91.5 ; CW 97.8; w.g.i.'s thin but clear. No algae, lichens; only a few minor spots of flaking disease on front marginals. And rear of carapace. Scutes smooth only in central 1/10-1/5.
#58 ♀; CL 104.7; CW 113.2. At rt. Turn; also grazing on passion flower and Commelina in open. Bad flaking disease in usual places on rear ¼ of carapace and front marginals; no algae or lichens. Scutes smooth in central 1/8 -1/2 of their area.
#98 - about 200 m east of R. B. - El Chato turn off. Moving west very deliberately along trail - from fresh turds can see that has been moving from Camote patch area (at least 300-400 meters away) for past few days. To Chato ponds?
Pg. 17.
Near El Chato turn - off -
#632 ♂ ; great masses of turds filled with manzanillos behind this fellow - thus probably from Chato ponds area because no manzanillos in this area around the small pond and R. B.

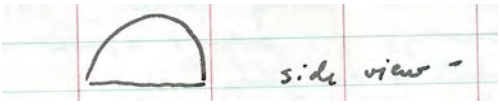
#441 ♀ - just inside guayavillo forest as starting down to El Chato - CL 89.8; CW 99.4; F. d. on rear 1/5 and front marginals area of carapace. W.g.i.'s very thin and almost non-existent. No algae or lichens. Central 1/8 - ½ of scutes of carapace smooth.
At El Chato l- weather 1100; Rain 0.36 inches; emptied; Evaporimeter - dry; refilled full.
Saw #609 ♂, very large, in guayavillo forest above El Chato on way in; on way out he had moved out of forest and was ambulating directly and determinedly toward R. B. and pond near it.
On return saw #256 ♂ (might be 216 but doubt it; if so, a duplicate as 216 has been painted as #7 and is definitely a different one). CL 118.5; CW 126.4
Pg. 18.
Bad flaking disease on rear ¼ of carapace, front marginals and scattered elsewhere. Scutes smooth only in very centers; w.g.i.'s virtually non-existent; no algae or lichens.
24 May 1970.
Had 4 guests (3 British and 1 German) and was working at Caseta today on instruments anyway so did not do any sampling.
Did go down to pond #1 area and even below it. Saw about 8 animals - all same but one, as seen on 21 May. New one was #368 ♀, large. She was down beside #1072 about 200 - 300 m distance below the pond along the trail.
Caseta weather - has been cloudy mostly since came up to Caseta - usually cloudy all mornings an till about 1200-1500 - then clears some in afternoon, but only for
Pg. 19.
. . . . intermittent periods.
Weather tonight -1900 ; Max 84 ° F; Min 66° F; Rain - 0.0; Evap. 6.1 (reads 6.1), filled on 22 May at 1900.
25 May 1970. Working on weather data and notes all day long at the Caseta.
Caseta weather - 1900 hrs - Max 83.0; Min 66.0; Rain 0.0; Evap. 4.2 (reading 10.3)
26 May 1970 - To La FE - Zone 3 etc. for monthly sampling
At Caseta - #246 ♀ - still hanging about and eating all pineapple and banana leavings.

#1189 (painted #4) - just south of Caseta pond #1 in open area ; in shade inactive (Region 1-2 border).
Reg. 2: #1072 ♂ - near trail, only 30 m further south than where saw on 21 and 24 May 1970.
#117 ♂ ; lower - middle Reg. 2 - moving along in dry guayavillo forest, up drainage toward pond #1. Pond about 250-300 m away. Moving determinedly like coming from below; only 15-20 m off of trail at most.
Pg. 20.
Reg. 3; #1021 - In shade of a large leafless Clerodendron in very upper part of Reg..3 in guayavillo forest.
#416 ♂ (prob.); CL 83.5; CW 90.4; found in steep ascent - descent part of region; inactive in shade in very dry guayavillo - matasarno forest. In lower part of this ascent - descent portion, about 350 feet altitude. Same animal I think as was near Caseta pond #1 area previously.
#827 ♀ - just 30 m further down trail from #416; also inactive in shade; same vegetative conditions. Are these 2 moving up again after moving downward??

#1026 ♀ - In trail, about 75-100 m lower down than previous animal. Altitude about 25-30 feet lower. Sitting, inactive in semi-open; perhaps foraging. CL 70.3; CW 78.9..
Pg. 21.
. . . .w.g.i.'s visible, but very thin; this is contrast to above 3 animals all of which had no detectable growth increments. No. flaking disease, algae, or lichens. Scutes smooth only in very centers.
#216 ♂ (#7 painted) - in "open" area just above Reg. 3-4 border - very dry guayavillo - matasarno forest. Has moved up from central Reg. 4 area where I last saw him. Now at a definitely slightly higher altitude.
Reg. 4. - weather - 1030 hrs.; Max 81.0; Min 65.5; Rainfall 0.0; Evap. - 23.9 ml. (refilled full).
Reg. 4 sample - first line through it and western half. Main area.
#718 ♀; CL 88.6; CW 94.6. Just off of trail along sample line; no flaking disease, algae, or lichens.; w.g.i.'s visible but very thin. Scutes smooth only in very centers. In shade, inactive.
#95 ♀; CL 81.9; CW 89.5. Same area as previous animal; In shade, inactive. Scutes smooth only in very centers; no algae or lichens; flaking disease only in a few minor spots on last vertebral and rear marginal scutes. W.g.i.'s non-existent. Carapace very worn.
Pg. 22.
To west of sample line; but beyond straight line sample.
#1192 and #1103 -♀ (prob.) - hard to tell because tail int. in length. CL 76.6; CW 81.9. w.g.i.'s clear and moderately well developed; no f.d, algae, or lichens; carapace worn but no smooth areas on scutes yet. [Marginal note: both a bit beyond normal sample area- #1192, probably would be seen on straight line sample - Region 4-5 border.] Both animals in guayavillo forest in shade.
#? 19 ♀ - am fairly sure have seen this animal before - question of hundred's numeral arises because has mark in 2nd, and 5th scutes k- so 800 or 900 ? k- happened probably because has an extra marginal on right side. CL 71.0; CW 72.0; w.g.i.'s clear but rather thin; no flaking disease, algae or lichens. Scutes not smooth anywhere yet. In openish guayavillo forest, inactive in shade.
Pg. 23.
New # 1256 - ♀? - too small to be sure CL 58.6; CW 61.6. Well to west of trail, in open guayavillo forest, inactive in shade; no flaking disease, algae, lichens; w.g.i.'s visible but very thin.
#384 ♂ - same general area; foraging but in shade; CL 117.2; CW 128. No algae or lichens; bad flaking disease on front marginals area and rear ¼ of carapace. W.g.i.'s clear and well developed. Scutes smooth in central 1/6 -1/3 of their area.
#908 ♀ - same general area as above 2 - in semi-shaded area; well burrowed into cool, loose, dry soil up under some sparse Tournefortia stems; inactive.
Eastern half:
New # 1257 ♀ (prob.) - CL 67.8; CW 69.9. No flaking disease, algae lichens, or smooth scutes. W.g.i.'s very fine and incomplete mostly. Not active; in shade of a large Pisonia. Near weather instruments.
#1194 - - pond edge - in shade.
1 more - can't reach to sex or determine #, about 80 cm. CL but also in pond edge shade.

1 more ♀ - in pond - also in shade- about 80 cm CL.
#501 ♂ - near pond; in shade; about 110 - 115 cm CL.
[Marginal note: all inactive]
Pg. 24.
Areas south of the weather instruments:
#404 ♀ - under manzanillo; inactive. Very big, clear w.g.i.'s !
#1034 ♀ - CL 76.7; CW 81.2 - same areas; in shade; am fairly sure I have seen her in this area before and recorded such.
Reg. 5 -
Big boulder area -
#128 ♂ - in shade inactive - on sample line.
Searched around a bit extra [marginal note: out of sample line] in this area to see if I could find any other animals. -
#112 ♀ - large, all smooth all over carapace- no algae or lichens; several very deep patches of flaking disease on rear ¼ of carapace - an especially deep area (about 1/3 -1/2 of surface area) of 4th vertebral so afflicted. In shade of a manzanillo; inactive. CL 98.6; CW 113.5.
Pg. 25.
Reg. 6 - none seen.
Reg. 7 - Zone 3 NA.
Weather - 1600 hrs. ; Rain 3.2 mm; Evap. of course dry, refilled full; Max 92 ° F; Min 62 ° F. Evap. here since 22 May (if Galo Torres had arrived) must have been about 6.0 ml/ day based on Reg. 4 for same period - therefore a very good estimate for 0800 22 May to 1600 26 May would be 26.0 ml on this basis.
27 May 1970. Sampling continued.
Reg. 7 - straight line sample -
#1144 - in central nesting area portion; eating cactus pads which are only semi-green and moist - fallen on ground from a trunked, but youngish Opuntia.
No others seen.
Reg. 8 - none seen - no fresh sign or anything different since January.
Reg. 9 -
#961 ♀; CL 66.4; CW 68.2. In open rocky area covered with many large, beautiful Opuntia trees; in most upper part of Reg. 9, just above area where I usually find 2-5 animals. Eating
Pg. 26.
. . . . . a very green, moist, nearly spineless Opuntia pad (underneath a large Opuntia tree) where it had fallen to the ground. No algae, lichens, or smooth scutes; w.g.i.'s visible but very, very thin. Some minor spots of flaking disease confined to rear marginals.
In the area of Reg. 9 where there are always several.
#1238 - CL 89.8; CW 95.7 - to check growth
#1200 - CL 63.6; CW 68.3 - to check growth
#1199 - CL 62.9; CW 64.9 - to check growth
The two small ones have fine white, visible w.g.i.'s; the large one has visible and moderately thick ones; when I saw them the 2 small ones were resting in the shade; the large one was moving along.

Another 75-100 m south of this area - at "Rt. Turn point - still an area of flat rocks and tall Opuntias.
New #1258 ♀ prob.!- very stubby tail - too small to sex accurately; CL ------; CW -------.
Pg. 27.
No flaking disease, algae, lichens, or smooth scutes; w.g.i.'s present and visible but extremely thin. In shade, inactive. Had been eating cactus because fresh leavings of pup and spines around mouth and on jaws.
#1076 ♂ (prob.) CL 57.7; CW 63.9; eating fresh, green, moist fallen Opuntia pads; in same area as #1258; no flaking disease, algae, lichens, or smooth scutes. W.g.i.'s clear and very well developed and moderately thick. Worth noting that it is 0930 on hot morning and yet he is out feeding in only a partially shaded area; however there is a strongish, cool, constant sea breeze. He has small spines all over his jaws and face and the pad he is attacking is quite spiny around its edges - he is eating all of it, edges included. Remarked because notches are fading fast.
#236 ♂; CL 107.5; CW 120.5. About 2/3's of way to La Fe NA. From Rt. Turn - in an area with a lot of flat rocks, tall Opuntias and a few dirt patches - have seen a tortoise or 2 here before. This animal has a very strange shape - he is squished up
Pg. 28.
.. . . . short in the ant- posterior line so that he is excessively or super-domed in shape –



As a result, although he has the correct # of marginal scutes on each side (=11), several of them on each side are much narrower (ant-post dimension) than usual and elongated dorso-ventrally. No flaking disease, algae, or lichens; scutes smooth only in very centers but carapace very worn in general; w.g.i.'s thick and clear; lots of fallen cactus pads in this area.
At La Fe nesting area - Reg. 10.
New # 1259 ♀; CL 64.3; CW 71.9; in shade resting; inactive; w.g.i.'s clear , but thin; no flaking disease, algae, lichens, or smooth scutes. In main nesting area.
Pg. 29.
#388 ♀; CL 85.8; CW 95.6. Scutes smooth only in central 1/10-1/8 of their area; no flaking disease, algae or lichens; w.g.i.'s present and complete, but very thin; inactive in shade in central part of nesting zone.
On return -
In same area where saw #'s 1199, 1200, and 1238 this morning.
#433 ♀; CL 75.3; CW 77.7; no flaking disease, algae or lichens; only very centers of scutes smooth. W.g.i.'s clear, but fine - well -developed however. It and #1199 are nosing about each other under a tree - cloudy and cool now.
Zone 3 NA - weather - 1800; Rain 0.0; Evap. 6.0 ml., not refilled now ; Max 84.0; Min 63.5.
28 May 1970 -
Zone 3 NA; enlarged sample -
Eastern loop -

#787 ♀; CL 89.3; CW 104.3. Large, all smooth female; no lichens or algae; flaking disease in only one place - 2 deep dried up pits on first vertebral where it meets first marginals.
Pg. 30.
w.g.i.'s present, complete, and moderately thick. In shade inactive (0830). Some question about # - only 10 notch is clear - all the 7 notches (700, 70, 7) are very , very faint at best. But they all seem real. The biggest doubt is the 700 notch which is extremely faint. Did not remark her.
Central area:
#1144; near 1969/70 nest #2, same place seen yesterday; in shade, inactive.
#53 ♀; large; hard place to measure - only obtained CL 121.5. Spots of minor flaking disease scattered over front marginals and real 1/5 of carapace; no algae or lichens; scutes smooth in central 1/8-1/5 of their surface area; w.g.i.'s clear and complete but very thin. In shade, inactive.
New #1260 ♀; CL 60.2; CW 65.2; Prob. A ♀; tail very short and stubby; in shade, inactive.
Pg. 31.
w.g.i.'s mostly non-existent; where present extremely thin; no algae, lichens, smooth scutes, or flaking disease
#918 - just NE of 1969/70 nest #1, in one of his usual haunts - in shade, inactive.
Western loop:
New #1261 ♂ maybe; too small to sex. CL 55.6; CW 60.1; no algae, lichens, flaking disease, smooth scutes; w.g.i.'s very, very thin - almost invisible; moving along near dilapidated Clerodendron covered pond site just NW of main nesting area.
1000 hrs l- leaving the area for the Caseta - weather here - Min last night 66.5; Temp now 80 ° F; Rain 0.0; Evap. 8.0; refilled full at this time.
1045 - Reg. 4 weather; rain 0.0; Evap. 10.3, refilled; Min. 63.5; Max 83.0.
Pg. 32.
On return saw a few more animals: Region 3-4 border area - #216 ♂ (painted #7) in same spot exactly as on 26 May 1970.
2 seen in steep ascent part of Reg. 3 - about 380-390 ft altitude - #835 ♀; another small - medium sized ♀; failed to get #.
Another, medium - large ♂ in dense brush moving upward along drainage in lowest part of Reg. 2.
#351 ♀ (#14 painted) - moving down trail in middle of Reg. 2, in an open area.
#1189 (painted #4) in exactly same location as saw on 26 May and 23 May 1970.
#421 ♂ in trail about 100 -125 m distance above Caseta pond #1.
Caseta weather l- 1900 hours. 28 May - Max 82.5; Min 70.0; Rain 0.0; Evap. 3.7 (reading 21.2) Clear most of day; clouds off and on in afternoon.
Pg. 33.
Weather at Caseta yesterday - 27 May 1900 hrs; Max 84.0; Min 60.0; Rain 0.0; Evap. 7.2 (reading 17.5) Clear all day
29 May 1970 - Working at Caseta all day on equipment. To Devine's in late afternoon. On way up saw 3 tortoises -
#96 ♂ and 445 ♀ (#1 painted) at forest - mora border on Reserve Border just above Caseta. [Marginal note: #96 could be #76 because 20 mark is poor; also saw a clear #96

just east of Caseta a few days ago - but could be same animals l- probably so because their 20 is a mark just worn].
#403 - in same place where saw this one and #909 on 21 May 1970- in Devine's central manga.
Noted again today fairly fresh droppings with manzanillo apples in them near here - were really fresh on 21 May, so one or both of them (2 separate droppings) must have come up here from Caseta region just before saw on 21 May.
Caseta weather - 1900 hours - taken by Galo Torres - clear almost all day Max 84.0; Min 70.0; Rain 0.0; Evap. 3.3 (reading 24.5)
30 May 1970
Asked Bud Devine about his observations of tortoises throughout the hot season.
Pg. 34.
He did not remember much but his comments essentially confirmed Bulmare's as recorded on 18 March 1970. Since the 4-6 animals seen by Bulmare, Bud and DeVries in Feb. 1970 period have not seen any around or above house. One thing Bud did mention which others did not is that 2 of these animals were using the Maternidad pond just 100 m SW (distance) from his house as a drinking hole in February. He also saw another tortoise go by the house and move off in ENE direction toward Remigio Barrera's lands in same period; hasn't seen this animal since.
A slaughtered animal was found on his land at about 1200 feet altitude between the S. Rosa - Bellavista trail and Bulmare's house on about 15 April 1970 by some tourists visiting Devine's. It had been
Pg. 35.
. . . . opened below and the plastron and legs were missing. Whoever killed it attempted to hide the animal in tall grass and brush. In fat reason it was found now is that drying of brush has opened things up enough that it could be seen. Animal was #2 (found all scutes on it), apparently a large rather smooth-shelled adult ♀. Probably dead 2-3 months because all rotted away and most scutes were falling off even though not in direct open sunlight.
Returned to Caseta in afternoon (1300-1400) by central manga seeing fresh tortoise sign in all same places as on 21 May and yesterday, but nothing else. Saw no tortoises but not surprising because was hot and clear since about 1030-1100 k- thus they must have moved off of manga border into shade in mora.
#96 and #445 were in same locality as yesterday afternoon - in shade, inactive.
Caseta weather 1900 hours- clear since 1030 hrs. Max 84; Min 66; Rain 0.0; Evap. 3.8 (reading 28.3), refilled full.
Pg. 36.
31 May 1970. To area above El Chato (up to NNE and NE toward Moreno's to sample)
On way over sampled through he Mora between 0745-1845 - all animals encountered were already active and moving about.
#445 ♀ - same area as yesterday, has moved about 20 m further to east on R.B. toward Caseta turn off.
#96 ♂ - has move dup from Caseta pond #1 area and is now back on R. B. - about 2/3 of way to top of first hill (*i.e. about 150-175 meters distance to west of Caseta trail - R. B. intersection). Clearly did this by moving up drainage, along series of "hanging ponds"

then through mora (about 50 meters of it) or small woods, probably former, to R. B. and then now moving westward. Am sure did this because I have been
Pg. 37.
Around the Caseta and the tent a lot the past few days and the animal did not pass by that area; but certainly did so a bit to the east.
#106 ♂ l- on R. B. trail, just before Camote patch. I.e. at Rt. Turn area; paths through passion flower and mora near him show that he just came up to R.
B. from the south, probably through the 150-300 m of mora l- p. flower area from the guayavillo - Scalesia forest below. I would not be surprised if this is where he has spent the past few hot months (i.e. the forest)l.
There is fresh sign of the other animals I saw in the passion flower pampas on 23 May 1970, so they are still in this area although I did not see them this a.m.
#'s 452 ♀, 58 ♀.

#98 ♂ - moving along R.B. to east, just beyond Camote patch by about 125l-150 meters, at Segundo Herrera's manga - does not seem to have gone much further west than where I saw him on 23 May; and has clearly started back toward old Camote patch stomping grounds.
Pg. 38.
Am going to search around the Reserve Border area where there is a bit of Xanthoxylum forest and a lot of passion - flower l- Commelina fields, along R.B. for about 75-100 m before the small pond and El Chato turn off. The depth on either sides of the R.B. to which this area runs before hitting mora is somewhat variable but averages about 50-75 m. There is evidence of heavy use (many trails and eaten vegetation and turds) by tortoises for past few months and I want to see if a significant# of El Chato refugees might be here where it is a bit greener. --
#1361 - grazing in p. flower field about 40 m north of R.B.
#176 ♂ l- CL 112; CW 126.0; in same areas as 1361, basking near last night's burrow (0900).
#958 ♂ - CL 016.7; CW 118.5; also grazing; another 30 m north of last 2 near mora edge.
Pg. 39.
The mora edge with the passion flower fields is not clearly defined in some areas and I'm sure tortoises make excursions out into the mora, as the trails indicate; also, there are scattered little patches of Commelina - p. flower - other herbs throughout the big mora fields, especially along its edges.
Regular sample above El Chato and R.B.:
#609 ♂ - near small pond (dry) near El Chato turnoff. - CL 112.0; CW 118.3. Bad flaking disease in usual areas; have recorded him before at Chato; remarkable feature is extremely hart almost vertical drop-off and downward slops of his carapace from middle of 4th vertebral and backwards.. He has fairly well-developed w.g.i.'s now.
#853 ♀ - burrowed into shade in an open P. flower - Commelina field, about 75 m north of small pond; area has been well used for past few months; saw an animal here in same area in March - April sampling. About 860-70 feet altitude.

#154 ♀ - have seen before at Chato. Could be #54 because 100 mark is obscured a bit, but I think it is a cut. CL 95.9; CW 107.6. About 870 feet alt. - just east about 50 m from where saw #853. This one also in shade in Xanthoxylum.
Pg. 40.
. . . . . forest edge which border on a field of low growing young, green passion flower; inactive.
*83 ♂ - med -large (can't reach to measure) in area about ½ km above El Chato turn off - big passion flower l- Commelina field where I usually encounter a few animals. He is in the shade of one of the scattered Xanthoxylum trees which occur in this area; inactive. The area is still quite dry but both these two prominent herbs are starting to come back a bit and the area is greener than it was in March and April. He has clearly been using this area as a feeding ground, probably for 10 days to 2 weeks at least because there are abundant turds scattered about all over the ground and large eaten -over patches.
#18 ♂ - CL 146.2 - hard to measure so could get CW. Very near previous animal; also in shade inactive; interesting because Julio and Galo reported seeing this
Pg 41.
. . . . on mating at base of El Chato near ponds on 8 May 1970. Anyway, he is a hug bastard with no algae or lichens, but flaking disease on rear ¼ of carapace and also all over front marginals area. Scutes all smooth except for most outer borders (however most his size have no growth rings visible at all and he has some on each scutes along the outer borders.
Went on up to about 1200 feet on trail toward Moreno's and also searched over much area to west of the trail at various locations between 830 and 1000 feet. Except for one area (see below) saw no fresh sign - nothing different from what I saw in these areas in March - April sample.
One area where there had been notable activity in January sample (but not in March-April sample) is at about 880-900 feet and just east of the trail - it is a natural continuation of lower -pampas near Reserve Border as well as those to the west. Apparently there has been a lot of activity in it in the past 6 weeks or so because there is abundant sign - droppings of a few days to many
Pg. 42.
. . . . weeks age, a number of fresh burrows and lots of matted down eaten vegetation. The area is mostly open Commelina and Passiflora covered pampas with scattered vine covered Xanthoxylum and Tournefortia shrubs which offer shade. Also mora plants scattered here and there, of course increasing as one approaches the mora dominated fields to the NE and East. There were fresh turds (a few days old) and burrows of 3 different sizes in the area so at least 3 animals there. One large male, one medium and one small one (all ♂ scale); but I couldn't find them. Not strange that they are hard to locate because it was hot and sunny and animals are all in dense shady burrows now. In sum, there, as always are no real concentrations of animals in any of these areas; instead the areas have a thin scattering of
Pg. 43.
Tortoises though out it. Am also sure that there are a few animals up even higher toward farms - above 1100-1200 in other words. Areas I want to really look over are those to NW and North toward Cabolla, Lechoso, and Salasaca mountains. Then came east and went up Segundo Herrera's big manga to see if I could note any live or dead tortoises - he

burned a huge area at about 900-1050 or 1100 feet in late April and early may and I want to see if # 1102 or any other tortoises which may have been in that area were harmed. Found #1102 ; CL 91.2 cm (burrowed in tightly; can't sex or get CW) about 150 m up the manga from Reserve Border - at about 900 feet altitude. Was in an area where there was a huge amount of old and new turds and matted down mora - the animal has been working along the manga over a distance of about 100 m L(from where I saw it today and upwards) eating almost exclusively Commelina which is growing in under the mora and in the process mowing some of the mora down. This is another interesting and clear example

Pg. 44.

. . . . of the fact (also time and (time) clearly seen on Devine's central manga) that they are eating Commelina, Passiflora, and other herbs in sharp preference over the farmer's planted pangola grasses.

Two other things of note:

1. No sign below the animal indicating it came up from R. B. Instead am pretty sure it went NE of Chato and then over to east along about 900 -1000 feet through passion flower fields and mora to this manga; then finding manga easy going has settled down here. Galo says has been seeing it here all throughout last month approximately in this same area.

2. Above 1102 about 150 meters saw another fresh turd - thus am pretty sure there is at least one more animal up this manga; since I went only to about

Pg. 45.

. . . . 1000-1-5- feet (i.e. first hill) there may even be more sign above. May well be that some animals were killed by this fire - didn't have time to search the areas, but walked along one side of it and saw no tortoises; but 1102 and other turds are very close to fire's Border and of course if 1102 came to manga by route suggested above then others could have been on this route when fire occurred; the rout goes right through he burn.

On return to Caseta:

#98 back at Camote patch - thus about 125 meters traveled today. #1044- same area as other day - eating fresh growth of Commelina and Passiflora.

#97 - moving along briskly - only about 75 m from rt. Turn and Camote patch ! thus about 350 -375 meters from where I saw this morning - moving along and eating.

All these 3 seem to be fully active at 1700 hrs - still warm season in a way - or rather an in between period.

Pg. 46.

Caseta weather - 1900 hrs - Max 85.0; Min 70.0; Rain 0.0; Evap. 4.7 (reading 4.7).

June 1, 1970.

To El Chato and below to sample. On way over between 0700 and 0745 saw a number of animals from yesterday - all in the same areas where last seen - #'s 97, 98, 96, 445 (painted #1), 1044.

Also saw 2 new ones - #627 ♂ - just heading up trail from Caseta (at 0655 hrs) toward upper pond area.

#450 coming east out of forest between mora and trail from Caseta u to R. B. l- just reaching trail at 0705. Of all 7 of these animals all were seen between 0655 and 0730 and all were active already but #1044 - she was still in last night's burrow.

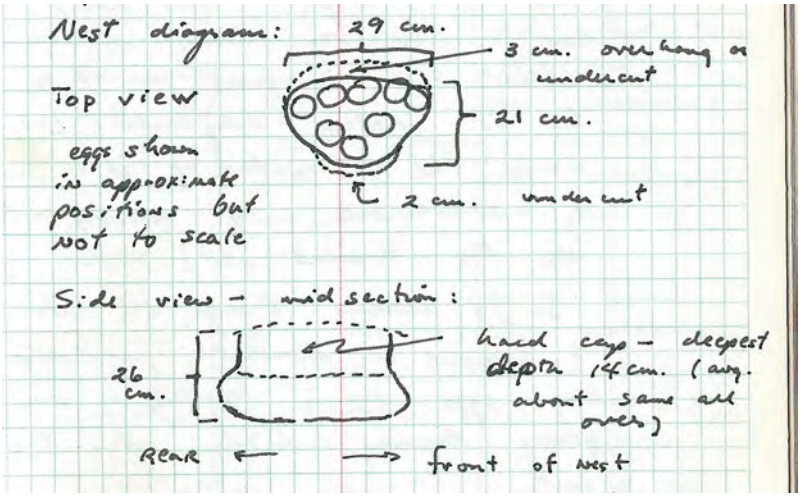
Pg. 47.

Sample:
Reg. 1: Guayavillo - Scalesia forest above El Chato
#59 ♂; CL 131.3; CW 145.8; saw him in virtually this same exact location under a guayavillo tree in fairly dense forest on 23 May 1970. Bad flaking disease in usual places; no algae or lichens; scutes smooth in central ¼ -2/3's of their area. W.g.i.'s clear and moderately thick! Inactive, sitting.
#632 ♂ - very near last animal; burrowed well into loose dry soil of forest floor; sitting and inactive.
#75 ♂ - about 2/3's of way down to ponds; off to left of trail about 50 feet - very lucky to see him - if sun were out and he in shade I never would have spotted this animal. Sitting inactive in an open spot in the forest; CL 129.8; CW 146.1. Bad flaking disease all over front marginals area, rear 1/3 of carapace elsewhere. Scutes smooth in central 1/10-1/5 of there area only, but hose areas with growth rings are very worn - it is along these growth ring liens where scattered flaking disease is mostly concentrated. W.g.i.'s mostly thin and not well - developed. (Could be #175 but 100 mark is more like a natural chip and is far toward one edge of the scutes instead of being centrally cut.
Pg. 48.
1 more animal definitely in this area- fresh (1-3 days old) droppings in the same area as saw #'s 59 and 632 indicate a small animal (♂ scale) in the immediate vicinity.
At pond #1 area - Chato - #192 ♂ - about 25 m W of pond in semi-dense forest and shrubby; sitting in open inactive - burrows near here last night; sleeping now (0930).
Special note[Eating manzanillos]: Saw lots of manzanillo apple cores in dry turds around El Chato turn -off, small pond there, along R.B. for about 100 m east of turn off and at various locations where there were tortoises fro a few hundred meters north of the R. B. and small pond - since there are no manzanillos in this area can conclude animals came up from El Chato ponds (closest manzanillos trees) where animals had been eating great quantities of apples all through last half
Pg. 49.
. . . . of March and all of April - this phenomenon also seen in many droppings along trail through Reg. 1 down to base of Chato and ponds area - shows route of movement to R. Border and above. This is analogous to manzanillo apples in dropping around Caseta upper ponds and up onto Devine's central manga to altitudes of 850-870 feet - shows they came up from Caseta pond #1 and surrounding areas with small ponds near Caseta (nearest manzanillos again) notably, no manzanillo apples in turds on Segundo Herrera's manga where #1102 was l- this adds to notion that animal (s) took its time getting there and didn't come by R. B. route.
Also many apples in turds for several hundred meters west through R. B. mora trail - again animals moving up from Caseta area and westward along this part of R. B.
Pond 1 area cont:
#172 ♂(male); sitting, inactive asleep just east of pond but in semi-closed guayavillo forest. W.g.i.'s clear but thin; no algae or lichens.
Pg. 50.
#781 ♂; same area and habitat and inactive behavior as previous animal; in semi-shade under a guayavillo. CL 121.5; CW 133.0. No algae or lichens; scutes smooth only in central 1/10 - 1/5 of their areas. Scattered minor flaking disease in usual areas; w.g.i.'s clear but rather thin - however, complete.

(Just now is clearing for first time today (0950) - looks as if will be hot and sunny for awhile_
Between pond #1 and #2: no animals seen but 2 very fresh (this a.m.) turds with manzanillo apples in them - from a medium -small (♂ scale) animal I would guess - thus 1 certainly in this area - definitely not one of the 3 above.
Pond #2 area:
#1223 - near weather instruments, at forest - grassland border - inactive and sleeping.
No others seen - a lot of old sign from pre - March-April sample and
Pg. 51.
. . . some sign of March - April - turds and burrows. But otherwise deserted.
**Weather - 1030 hours - Rain 0.0; Evap. - dry - thus 35.8 plus ml., refilled evaporimeter full at this time.
Pond 3-4 area and beyond a bit to where grasslands end and guayavillo forest starts to cover trail.
#162 ♂ - very large - have seen many times before here in last 2 months - just west of pond #2 - on grassland edge - inactive, resting under a guayavillo tree. CL 140.2; CW 147.7.
Sun only out for 20 minutes awhile ago - now (1100) just out again but lots of big cumulus clouds, so doubt it will stay out but less than ½ of the time.
No others seen, even though I searched out into forested areas in many places around and beyond normal sampling area, as in March - April sample.
Awhile later - 1130 - back at weather instrument area - #781 which was at pond 1 at 0950, inactive in shade is now walking along trail and is just abreast of pond #2 - that means he traveled about 125-150 m in last 100 minutes - rather rapid I would guess - of course open trail (which is in fact a tortoise highway, the man -made structure being constructed
Pg. 52.
. . . . after the tortoise use of the area) makes travel in these pampas easier than in most vegetation around here.
On toward south side of Chato.
#194 ♂ - inactive and in dense shade of brush under a manzanillo just at turn to south side pampas.
South side sample:
#207 ♂ (?) - can't see well enough to sex - in shade of brush in semi-open guayavillo forest.
#11 ♂ - about 50 m south of where last seen - sleeping in Clerodendron brush in a manzanillo grove.
1 more smallish one (♂ scale) - fresh dropping present but could not locate.
To Zone 5 -
Reg. 3 of sample:
#685 ♂ - about 40 m south of last grassy pampa where was in April. - inactive, sleeping in brush; guayavillo forest.
#13 ♀; inactive sleeping in brush; about 50 m south of #685 - in guayavillo forest. CL 93.5; CW 100.0; w.g.i.'s present but thin; no algae or lichens; flaking disease in usual places.
Pg. 53.

Scutes smooth only in central 1/10 - ½ of their surface area. Fresh turds by her rear end are full of grasses, plant #1, and other herbs - not well digested stuff. No manzanillo apples.
Another 150 m south:
#549 ♂ CL 142.0; CW 155.7. Beside drainage bed 15 m west of trail; inactive and in loose dry soil in shade; guayavillo forest; manzanillo grove nearby. Scutes smooth in central ½-3/4; flaking disease scattered all over, heaviest in usual places and especially concentrated along growth ring lines; w.g.i.'s present but thin. No algae or lichens. Has a notable respiratory ailment - wheezing and gurgling when inhales.
Reg. 4 sample - straight line through (Zone 5)
#507 ♂ - just a bit north of camp area; inactive resting (saw here at 1435 hours; again at 1800 - had not moved an inch).
#296 ♂ near dry pond - camp area inactive resting in shade of Pisonia.
#684 ♂ - 50 m south of pond and camp area - inactive; sleeping under a big Pisonia.
#225 ♂ - moving along in general area near #684.
#57 ♀ - burrowed in; same area as above 2; down from El Chato area.
Pg. 54.
June 2, 1970 - Starting sample down to Cerrito -
Reg. 5 of trail -
#12 ?? - can't read last 2 digits, too well, burrowed in; about 100 m below the Region 4/5 border l- inactive; still early (0700)
#63 ♂ - beside trail, burrowed in ; another 100 m S of last animal.
#545 ♂ - same location as #63, but 20 m to west of trail; sitting in a rather open spot where has been churning up the loose, dry soil. CL 136.5 cm; CW 151.8 cm; w.g.i.'s present but very, very thin; non -existent in some locations. Scutes all smooth; bad flaking disease scattered on rear 1/3 of carapace and front marginals area. No algae or lichens. A notable depression in latter ½ of 4th vertebral and the adjacent (last pair) of costal scutes.
#655 ♂ - heard moving along in forest well west of trail (about 100 feet) and thus (not really in sample) [Marginal note: yes, is in sample - when headed down trail found him to be within 50 feet and easily seen. CL 148.5; CW 163.0; w.g.i.'s present and moderately thick.
Pg. 55.
. . . . scutes all smooth; no algae or lichens; flaking disease bad all over rear 1/5 of carapace and on front marginals- also scattered along scute junctures and outer scutes borders elsewhere.
#683 ♂ - not far above side of Cerrito - nearly there. CL -----; CW -----. Sitting in dense forest, inactive. Scutes all smooth; no lichens or algae. Flaking disease severe in 2 usual places but only in scattered splotches; also scattered pits and splotches all over rest of carapace. W.g.i.'s present and quite thin. [Marginal note: Reg. 5/6 border]
Reg. 7 - Dry rocky - Pisonia covered zone to Cerrito nesting area.
#156 ♀ - about 200 m distance into this region toward nesting area. CL 95.9; CW 111.5. Resting in shade, inactive Scutes smooth in central ¼ - ½. Some flaking disease on front marginals area; a few very tiny spots of it on rear part of carapace. None of it severe. No algae or lichens; w.g.i.'s present but extremely thin.

#1181 ♂ - Eureka! - about 1/10's of way down to nesting area below Cerrito. Can't perhaps include in sample because is about 25 m to east of trail. In shade, inactive, of a Pisonia. Perhaps should include in sample? But note distance moved.!
Pg. 56.
At nesting area - no tortoises in immediate vicinity but will search about for some shortly. Examined nest #16 which must have had young leave it in latter 2 weeks of February or early March. As I expected the young had hatched and left. There was a nice baby tortoise - sized, circular hole through one side of the hard cap - hole about 3.5 cm in diameter. Inside I found clear evidence of what I estimate to have been 8 eggs which hatched, although am less certain of the number in this nest than in the others I have examined because of the greater age and hence lessened degree of recentness since they hatched. Anyway the # of eggs was at least 7 and perhaps as many as 12 - but 8 seems the best estimate - I could find 7 clear separate egg shells and an eighth position where I think an egg was lying. There were also some scattered inner membranes of eggs which may bring the number up to a dozen, but I think most of these membranes were drug part-way up toward
Pg. 57.
. . . . . the surface above the eggs by the hatchlings.
There was clear evidence that all the eggs had been in one layer at the bottom of the nest. The bottom was made up of very hard soil with scattered half-fist - to fist -sized rocks in it and am sure ♀ dug as deep here (typical "pampa colorada" red soil) as she could; The bottom averaged about 265 cm depth from the soil surface.
[Nest diagram shows greatest breadth of nest hole to be 29 cm x 21 cm (with latter dimension consisting of 3 cm overhang and 2 cm undercut on opposite side; eggs shown in curved line of 5 eggs along one margin and three other eggs in approximate triangle on other side; side view shows nest to be 26 cm deep; and hard cap - deepest depth 14 cm (avg. about same all over) with nest expanded at front and rear at bottom.]



Side view shows nest to be 26 cm deep; and hard cap - deepest depth 14 cm (avg. about same all over) with nest expanded at front and rear at bottom]
This means that the tops of the eggs were at about 19020 cm below the ground surface level, given average eggs of 6 cm diameter. There was a few cm of loose soil on the eggs

between them and the hard cap bottom, but his may have been due to the bottom several cm of the hard cap being ground up by the digging
Pg. 58.
. . . . activity of the small beasties. Certainly some of this occurred. Most fantastic thing - there was a live hatchling inside partly under the front overhang, wedge in by hardened soil clods and rocks. He was obviously trapped and doomed to die had I not released him. The soil in the nest, as expected was completely dried out , though cool (he was about 20 cm below the surface) so I expect he is rather dehydrated. (I am using "he" instead of "it" out of convenience; of course, can't sex the animal yet).
So, if assume 8 eggs, all hatched and 7 escaped -absolutely no sign of any eggs having rotted or any young having died within the nest. The little guy had been in here for a long period because his egg tooth is almost completely worn away, his plastral fold is gone, and his umbilical areas is completely closed up, dry and almost clean (some dry mud still adhering to it.)
Pg. 59.
Even assuming the hatchlings did not exit till early March, this one has been trapped within for 3 months longer than the others and is still alive - fantastic ability to survive.
Measurements: SL 65.0; SW 58.1; H 40.0 mm; CL 80.0; CW 86.5 mm.
I did two brief experiments with him:
1. filled a little depression in a lava rock with H20 and set him at the edge of it - twice he started to turn away, so I stuck his head into the H20. He then proceeded to drink rather steadily for 10 minutes until he was choking, probably from being brim full of water.
2. offered him some small green leaves of the sticky malvaceous plant of these altitudes and my unidentified plant #2 (field #2 i.e.). He did not attempt to eat either when placed directly in front of them - he is much more intent on wandering about.
Then I released him in the nesting area - hopefully he will survive if he can find some small green herbs to eat because his tank full of water is considerably more than most small hatchling start life with - however, most don't sit and wither away for 3 months extra under
Pg. 60.
. . . . ground. One notable thing - he appears a bit swollen out in the plastral region (note height measurement of 40.0 mm) - much more so than normal after the yolk sac regresses - could this be a protein deficiency sign - i.e. equivalent to human symptoms of (word unclear).
Nesting zone enlarge sample -
#1046 ♂ CL 129.9; CW 148.5; quite large - a duplication of the one seen near Lechoso mtn. On new park border? Scutes all smooth; quite raised in front end - like S. Cristobal tortoise (G. e. chathamensis). No others seen - scattered old, dry turds here and there all over.
June 3 1970 -
Zone 5 (Reg. 4) enlarged sample: #507 ♂; 296 ♂; 225 ♂, 684 ♂, 57 ♀: all in about same positions as on 1 June (date not clear due to cross outs) All near or just south of small dry pond - campsite area. Searched all around dry pond - campsite area as usual - no
Pg. 61.
. . . . more animals seen - not any fresher sign than what I saw here in late March - early April. But vegetation (herb layer especially) really dried out and beaten and mashed

down all to hell - due to goats and tortoises. Tortoises certainly have definitely scattered out somewhat.
To pond area to NE - second half of expanded sample:
1 ♀, large, smooth shelled; burrowed well under Clerodendron shrubs in pond - can not reach so can't get # l- is marked; I can see a notch in 100 scute.
#?2 - ♂ - very large and smooth shelled l- has marks in 10, 20, and 70 scutes l- thus supposed to be 30, 80, 90?? - Ok Castro! - Who knows?
No others seen - conditions here as at campsite pond area - dry as hell and all herbs brown and smashed down Plenty of goats. Tortoises must be extremely dispersed.
Found a ♀ dead in a cave like area near small pond - campsite - it is a long lava tunnel with a number of open roof holes - but at one end tunnel is collapsed for about 40 meters or so and sides gradually shorten - looks as if wandered too close to edge and fell in where sides low and then
Pg. 62.
. . . . could not get out. Definitely not murdered as plastron - carapace juncture not cut and no sign of humans ever being in this cave. Shell is old l- 15-20 years? Female about 85 cm CL. Has been here awhile because rain dripping and seeping in from roof has made several dozen water depressions on the carapace - in fact almost worn through in a few places. Looks as if she wandered about in here for some time and then expired.
[Marginal note: took photos KII - Roll # 144; #'s 4-7]
Also forgot to write up something about small one from nest #16 yesterday - after my "experiments" were completed I released him and watched for about 1 hour - he never either sought shade permanently or tried to eat anything. He passed many small green leaves (herbs) on his level but never even attempted to eat one. He was alternately in and out of shady
Pg. 63.
. . . . spots in his wanderings, and even occasionally stopped for a few seconds to a few minutes while in the shade, after having come from a 4-5 minute excursion in the hot sun. But even though he went under several dark deeply shaded places under lava blocks, ideal also for hiding; he never stayed there for more than a few minutes - he seemed very intent on moving about and "exploring" the area. His progress was agonizingly slow l- perhaps as covered about 15-20 meters distance in all this time. He was continually getting hung up in small dry herb braches which are prevalent on his level. But he showed a positively helpful reaction to these by turning sideways, retracting head and pulling it around a branch that was caught between his head and foreleg., etc. when he needed to do so. They are so slow and vulnerable (to hawks, snakes, pgs) but they gradually do move along.
On return to El Chato:
#549 - just above Reg. 4 (zone 5) border - thus has moved down since June 1.
Pg. 64.
#685 back up trail a bit - very close to grassy pampa where normally resides - only 20 -25 m movement since June 1.
#781 ♂ - at turn off to south side Chato pampas - probably one I saw here on June 1 - **no - that was #194 ♂;** so has moved a lot - was at Chato pond #1 on 1 June and same morning saw moving past pond #2 heading SW. Total movement, straight-line since June

1 at 0935 to today at 1000 about 250 -300 meters [thf note - presumably note by CGM no that was #194 nullifies this last conclusion]
Chato Weather - 1000 hours. ; Evap. 8.2 ml; refilled full; rain a trace only; not measurable, emptied.
#632 ♂; about ½ way between pond #1 and entrance to forest above El Chato
#17 ♂ l- medium large - just a bit higher on trail than #632 ♂
Then went out a different way (on Guerrero's hunting trail) l- saw #'s 75 ♂ (or 175) which
Pg. 65.
. . . . saw in Reg. 1 sample of June 1 and #164 - both on Guayavillo forest mora border just east of sample trail - actually both slightly into mora.
On way to Caseta l- saw # 106, 97, 445, and 96 in same areas where seen on 31 May and or June 1, 1970.
Julio San Miguel checked weather at Zone 6 for me on 30 May 1970 - Rain 0.0 mm; Evap. - dry - thus 35.8 plus ml.
Caseta weather - 1400 hours - rain 0.0 mm; Evap. -----(reading 18.0), refilled full; Max 85.0; Min 62.0.
Left Caseta at this time for CDRS.
** Enroute saw fresh tortoise trails and droppings about 1 km east of Zone 6 turn-off on the Caseta - Coast Reserve Border trail - this is important because it is the furthest east I have yet seen tortoise sign to this date.
June 8, 1970
Julio San Miguel took some measurements for me at the end of last week:
Pg. 66.
June 5, 1970 -
Reg. 4 - 0800 hours; Max 82.0 ° F; Min 63 °F; Evap. dry; refilled full. Rainfall 0.0 mm.
Zone 3 nesting area - 0900 hours. Max 84.0 ° F; Min 62.0 ° F; Evap. dry; refilled full; Rainfall 0.0 mm.
June 6, 1970 -
Zone 6 - 100 hours - Rainfall 0.0 mm; Evap. dry; refilled full.
Julio San Miguel checked weather instruments for me again 12 June 1970
Reg. 4 l- 0800; Max 83.0; Min 62.0; Evap. 35.0, refilled full; Rain 0.0 mm.
Zone 3 NA - 0900 - Max 84.0; Min 62.0; Evap. 35.7, refilled full; Rain 0.0.
Pg. 67.
[thf note: top half blank]
June 16, 1970.
Returned to Caseta with Jan and Baby Bennett. Bob Nansen from the "Lina A" (Metropolitan Touring Co.'s tourist vessel - Greek boat) came along with his friendly rented burro. Enroute saw nothing new - garua finally began the night of the 11-12th of June and has been rather cloudy for at least ½ to all of each day since then - but not enough yet to change the dryness of the vegetation from what it has been through April and May to now.
**Still fresh tortoise sign about 1 km east of Zone 6 turn off on Reserve Border. Also noted many fresh trail and turds along Reserve Border all along area by Zone 6
Pg. 68.
. . . . and zone 1 turn off.

Saw #1168 about 300 m east of Zone 1 turn off - on Reserve Border. From here to Caseta area saw virtually no tortoise sign which is fresh at all.
At Caseta saw a number of animals at about 1600 hours- all out ambulating around in open areas, grazing, walking etc., taking advantage of the cooler weather and cloudiness #'s 598, 450, 695, and 246.
Caseta weather 1900 hours - Rainfall 0.0 mm; Evap. 3.7 ml; (reading 11.4 ml) Max 81.5; Min 68.0.
June 17, 1970 -
Jan and I worked around Caseta all day setting up camp, hopefully in fine enough condition to last till November.
Again had #'s 598, 450, 695, 246 and also #267
Pg. 69.
. . . . . all around Caseta in open areas - bumping into tent, looking around new kitchen at the Caseta, etc. Was cloudy most of the day so enhanced their activity. Bob Nansen went to El Chato and Caseta pond #1 today and checked #'s of animals for me - however it became obvious that he was making many mistakes being brand new at this game - so I feel it is safest to take only the #'s of the painted ones he saw - he saw -
#1 (painted) - just above Caseta on Reserve Border - same area where I saw her frequently in late May and early June 1970.
#4, #12, and #10 (all 3 painted) at Caseta pond #1.
He did not check weather at El Chato so I will have to do so soon.
Caseta weather l- 1900 hours - Cloudy all but about 1.5 hours this afternoon.
Pg. 70.
Rain 0.0 mm; Evap. 3.1 (reading 14.5); Max 80.0; Min 67.0.
June 18, 1970.
Jan and I still engaged in same - saw same 5 animals around the Caseta in the open nearly all day - all moving about quite actively nearly all day long.
Caseta [weather] 1900 hours -Rainfall 1.0 mm; Evap. 1.7 ml (reading 16.2 ml) ; Max 78.0; Min 64.0. Cloudy almost all day except for about 1 hr in afternoon; mild garua all morning.
June 19, 1970. Final day of setting up camp. Again saw all 5 same animals about Caseta and tent areas - again very active most of the day. Two very notable things.
1. #'s 450, 598, and 246 have all become notably "domesticated". By this I really mean that over the past 3 days I have noticed that each day they
Pg. 71
. . . . all 3 systematically search all around the Caseta, the new kitchen which is about 15-20 m west of the Caseta, and all around our tent - this is a new thing for #'s 450 and 598 but I noted #246 doing so at the Caseta each day for virtually the entire period of 20 May - 3 June 1970 when I was here last. It is interesting that #246 at that time spent all her time, almost, at the Caseta proper where we were at that time living and cooking because the new kitchen was not yet completed and I was not living in our tent (only one tent standing at that time). During that period she was eating any raw fruit peelings (lemons, organs, bananas, platanos) which we discarded. She was probably attempting to eat other things but I did not take particular note at the time. Now she and the others 2 have already learned to check
Pg. 72.

. . . . around not only the Caseta, but also and in fact, particularly the Caseta kitchen building. The proceed very first thing after rising in the morning to the Caseta kitchen area and check around it for discarded items. Have seen #598 deliberately approach the same white wash basin near the kitchen for 3 mornings in a row before 0800 and check it for water - twice there was some and the animal drank it all down (despite the filthy H20 in it in one instance). They also eat any banana, orange, or platanos (plantain) peels they can find. Also they check any object which is different from the normal vegetation - paper, plastic cups, cans, bottles l- Have seen #598 eat toilet
Pg. 73.
. . . . paper with great gusto - also saw this same animal approach a plastic bag on the ground but I didn't let him have it - however it was clear he would have eaten it. This is interesting am sure plastic would or could cause easily an intestinal blockage and perhaps death if enough of it were eaten. The says something about future problems of tourists and their litter in areas inhabited by tortoises (and land iguanas probably also).
It is notable that the kitchen has only been in operation for about 1 week (built 3-4 weeks ago) and already the 3 of them have learned to check around it for food and water. Prior to its actual operation they did not check around it often - or at least #246 didn't I know while it was under construction and even after construction as complete but before we started cooking and eating there.
Pg. 74.
It is also of note that we set up a second tent and a tarp with tables under it (for cooking) just on the 17th of June 1970 in the afternoon. Already, yesterday and today these 3 animals are checking around these 2 new structures as well as our old green tent (which has been set up since last October). [Marginal note: Note: they seem to be checking the green tent even more after the past few days tan normal since we have re-occupied it and begun to be active around it again - Can't say if drawn by us and or our things - i.e. cans, food scraps, toilet paper scraps. Etc.] It is not uncommon for animals to occasionally check around the green tent for potential food, but this rapid inclusion of the new areas in our camp indicates a real inquisitiveness and an association of human habitation with potential food. It also shows that the animals are hardly bothered at all by human presence (perhaps they would be if molested but we never do more than turn them in a different
Pg. 75.
. . . . direction if they are getting too close to the tent and are in danger of disrupting guy lines, stakes etc.). It appears that tortoises could be very easily domesticated and taught to feed from one's hand with little effort. These still hiss and withdraw if we approach them, but they do not particularly avoid us and if disturbed or moved a bit they simply crawl away within a few minutes, thence to return usually within a few minutes to a few hours to explore the same areas again.
It seems that tortoises quickly spot and investigate anything new in their environment which is obviously different from the normal vegetation, soil, rocks, etc. The crunch into and knock over all kinds and color of bottles, cans, tables, etc. However, it seems as if they particularly are attracted by small (relative) objects with bright orange, red, or yellow colors l- I have seen them pass by
Pg. 76.

. . . . . cans with white, black, gray, and dark green paint on them in order to try to bite into a portion of a can with red or orange paint on it. In one case lost gear an animal specifically bit. Repeatedly at the red stripe on a Texaco oil can which was mostly white with green and black lettering on it also. Today I threw a fresh orange half near a tortoise but to his side where he at first did not see it. In his normal looking about he quickly spotted it after sticking out his head and ate it down. (He had withdrawn into his shell when I approached but did not see me place the orange). He very specifically and rapidly picked
Pg. 77.
The orange out of the low brown and green herbaceous vegetation. He looked at it and proceeded to (eat) it quickly with in 10 seconds after sticking his head back out of his shell after I had left his side. None of this of course demonstrates anything about color vision, but it is suggestive.
**Noted #598 this morning at 0600 (cool, wet, and raining!) already prowling around under the tarp we set up just the day before yesterday. This was very extraordinary and early activity for the garua season =- the other 4 animals around the Caseta did not become active till various times between 0700 and 0800.
The problem with most of these observation is that one does not really have any control population and therefore no real experiment; but the several points made above about 1 inquisitiveness, 2 rapid association between human habitation and the potentiality
Pg. 78.
. . . . of food and water sources and 3 ability to quickly pick out foreign objects are all probably valid.
It is also notable that all 3 of them made at least 2-3 round trips by all these areas (tents, and tarp, kitchen, Caseta) yesterday and today and not just one examination in the morning hours.
It should be interesting to see how long these 3 maintain this behavior and if others (e.g. 267 or 695?) begin this behavior.
2. Also today saw #450 approach the new pit (5' x 5" x 4 feet deep) for tin cans and such unburnable waste- this pit lies along a clear path about 20 m northwest of the kitchen building. This animal cam up to the edge; stopped, stretched its neck out about to ½ full length looked over the edge into the pit, then turned and went around
Pg. 79.
. . . . the pit to one side. This is of interest in relation to the finding on this island, Floreana, Pinta, and V. Alcedo of tortoises which had obviously fallen into deep lava cracks, tunnels, or pits and died due to inability to escape (most cases) or injury (fewer cases). This animal clearly could detect the danger of this hole and avoided it. Of course many (perhaps all, certainly all I have seen have been so) of the natural crevices, holes, and tunnels have moderate to thick vegetation in them and often some all around their edges. Tortoises could thus fall in because they edge of the pit was not easily visible as in the case of this garbage pit or because they were leaning out to feed on the vegetation in or along the edge of the given hole.
Finally, Galo Tores says that #1102 has retreated down S. Herrera's manga and is moving west along the Reserve Border toward El Chato; also that there is another tortoise (he "thinks" #702 - should check on this #) on S. Herrera's manga
Pg. 80.

. . . . at about the same position where #1102 was when I checked on the latter in late May 1970. All this is as of Monday, 15 June 1970.
Caseta weather 1900 hours. - Rainfall 4.0; Evap. 1.2 (reading 17.4) Max 77.0; Min 67.0; cloudy all day but for 30 minutes before sunset. Garua all morning, none in afternoon. June 20, 1970.
#598 was up and active at 0545 hours and to our cooking tarp looking about by 0600. Later this tortoise wandered over around the Caseta for about 1.5 hours (0700-830) and at 0900 arrived at Caseta kitchen and immediately checked white wash basin for water and drank the garua present in this location. He is certainly fixed in his wanderings and very humorous to see checking around the various pots and pans in the human inhabited areas.
Pg. 81.
** attempted mating - I forgot to note that Bob Nansen saw a large smooth ♂ and a large smooth ♀ in an attempted copulation at El Chato on June 17, 1970. He did not get their #'s nor could he tell if the copulation was ever successful. He disturbed them while the ♂ was still attempting to effect intromission and then he went away, took some photographs in another area and when he returned both of the tortoises were gone. He said the ♂ was groaning loudly while thrusting and he heard it for many meters (100's) before he first found the animals.
Caseta weather - 1900 hours - rained all day, most of last night and is till going strong - a very heavy mist, but no real rainfall - very wet. Rainfall 3.0 ml.; Evap. 0.0 (reading 17.4 still); Max 73.0; Min 67.0.
Pg. 82.
For the rest (or at least most of the rest) of this volume I want to summarize a great deal of information which has been accumulating over the entire period of the past severe dry season from February 1st to the beginning of the garua during the past few days (June 18-20, 1970, more or less). These notes have been kept in my small notebook and various other places with this summary as my ultimate attempt and intention to give the whole season and its occurrences some coherence. A complete and accurate summary including an analysis of animal censuses and individual movement is not possible now, but will have to wait till I have enough time (i.e. 1 month plus) **--thf note - its now nearly 31 years later.** To do such; it is also not profitable to do so now but to wait till the first year's data is complete in November. However, these comments are worth recording now in a general way because some of the ideas do not lend
Pg. 83.
Themselves to daily recordings while censuses and activity studies are being conducted. Much of this information is already recorded in piecemeal fashion in the day to day notes kept for the entire period. Also, the more complete analysis will certainly add some information t that set down below and probably will change some of the statements and ideas quantitatively. However, qualitatively I consider all the below to be a good and true impression of what has occurred over the past 4.5 months.
The zones, regions, areas, etc. referred to in the following comments have all been recorded as to altitude and location and their general vegetation described in previous volumes. After completing these notes, I will make a summary list of these giving the altitudes (by Thommens altimeter) which I consider correct for each area. I will be re-describing my two main sample lines (1. El Chato and above to Cerro Gallina and 2. Devine's to La Fe) in the future months to more clearly define the vegetation, soil, and

Pg. 84.
General geological conditions of the various zones and regions. This will be done also for other areas I usually visit (e.g. Zones 1, 4, 6; Naranjo, etc.)
Summary:

I. Periods I was at the Caseta and tortoise reserve conducting regular samples, activity studies, examining nests, etc.

January 3-18 and 26-40, 1970
March 11-20, 1970
April 1 –7 and 12 –18, 1970
May 20 –31, 1970
June 1 – 3 and 16 – present (20th), 1970
At virtually all other times through this period except for parts of April, Pepe Villa (G. Parque Nacional Oficial) and or 1 or 2 wardens (Julio San Miguel and later Galo Torres also) were in the tortoise reserve. I asked them many questions about tortoises and their distribution, mating, activity, about goats and their movements,

Pg. 85.
About weather, ponds, vegetation conditions, about nest and miscellaneous other things. This was mainly useful in filling in these gaps in time, especially all of February and a few other 10-14 day periods. Their observations included nothing I did not observe myself save for specific sorts of observations on tortoise (individuals) at certain locations on certain dates and regarding instances of breeding between certain marked individuals. One type of information was particularly useful – they recorded weather for me at the Caseta and my other stations on a number of occasions and gave some useful data on the drying up of the ponds in Zones 1 and 6 and near the Caseta in February and very early March.

II. Weather –

From just about exactly Feb 1, 1970 through about mid June, 1970 the weather changed very considerably from the garua of all the preceding months and also considerably from the previous month and ½ (Dec. 15- Jan 31) . . .

Pg. 86.
. . .which was not really a garua period but this year was characterized by a lot of light rain at nights and during the days, mostly cloudy days if not in fact rain, notably frequent breezes in the day, little sunshine and relatively low evaporation (these comments apply mainly to the Caseta but the general trend held at all altitudes in large part being more cloudy and rainy as one ascended in altitude from the coast to the highlands.).
For the 1 February to 15 June period there was greatly increased solar radiation and total hours of sunshine, notably increased daytime maximum temperature, increased nighttime low temperature (i.e. higher than in garua season), much decreased rainfall, and greatly increased evaporation. In other words, in short, it became much hotter and drier than in the previous garua season. The rainfall was not only decreased in total amount

Pg. 87.
But was not dispersed over nearly as many days as in the garua season. Most days during the entire period were at least partly sunny and in fact the majority of them were clear

and sunny for nearly the entire daylight period. Cloud cover was reasonably common at night (perhaps ½ of the nights?) but it usually lifted before dawn or within one hour or two after sunrise. Rainfall, when it did rarely occur was most often during the night, the following day being bright and sunny often, thus evaporating all the surface and superficial water very rapidly. This rainfall pattern tended to reinforce the dryness and decrease the wetting effect the rain might have had on the vegetation had it occurred in the daytime or been followed (if it occurred at night) by a cloudy day or 2. Also, on many of the days when the rain did occur during daylight hours, it was common for all the rain to fall fast and hard for only about a 1 to several hour period – then the sun would com out soon after. Virtually all the rain of this period, when it rarely occurred was of the sort . . .

Pg. 88.
. . . I would call the "normal" rain - it fell fast and hard and for a brief time, rather than as a fine rainy mist for many hours or days as in the garua season. This pattern again contributes to a low wetting affect because of quick run – off.
The above comments apply to all vegetation zones and altitudes. In general it was hotter, drier, with more solar radiation, less cloudiness, higher daytime temperatures, lower night time temperatures, less rainfall, and greater evaporation as one decreases in altitude from the upper limit of the tortoise population (or the top of the island for that matter) to the coast. These conditions of course are reflected generally in the vegetative zonation over this range of altitudes. The summarized weather records for all my stations show these trends to have held true this year; but since the records are most . . .

Pg. 89.
. . . complete for the Caseta, my observations above are made mainly on this station as a base. The records below reflect some of these trends briefly. They speak largely for themselves – the garua months (Oct., Nov., December (in part)) and January (as described above) are included for comparison to the hot months of the dry period (Feb. – May).
Caseta Records –

Month	# days with rain	Rainfall	Evaporation	P/E ratio
Oct. 1969	13-16	17.95	74.0 ml	0.243
Nov. 1969	21	42.66	57.3	0.743
Dec. 1969	18-24	67.1	35.7	1.88
Jan. 1970	20-24	66.15	65.0	1.02
Feb. 1970	4-6	3.3	115.21	0.029
Mar. 1970	3	15.1	143.03	0.105
Apr. 1970	3	4.05	112.70	0.036
May 1970	10-11	14.8	97.0	0.153

Some of the "# of days with rain" are given as ranges to estimate the maximum and minimum # of days – this because I was not here all the time nor were other observers and rainfall was occasionally taken . . .

Pg. 90.

. . . only every several days.
These remarkable changes in weather patterns were of course largely predictable and expected from what I already knew about the Galapagos weather patterns based both on empirical evidence of previous records and on what little theory and causative explanation that exists in the literature. The changes were most notable and most extreme in the higher regions from about 300 feet altitude (beginning of guayavillo forest or forest predominated by that species) and upwards. It was especially notable from about 450 to 850 feet altitude, this region including most of the tortoises population and the regions I know best such as the Caseta area, El Chato, Region 1, Region 6, Devine's land and the areas N and NE of El Chato. In the coastal and lower transition zones (0 – 300 or 400 feet altitude more or less) the changes and their results . . .

Pg. 91.
. . .seemed less prominent large because these areas receive a good deal of solar radiation (and thus relatively high evaporation) and much less rainfall than the higher altitudes even in the garua season. In other words, the lower altitudes are dry year round unless there are heavy rains in the hot season. Actually the changes in the lower zones were also rather great, even if quantitatively less than the higher areas – more on this below in sections on tortoises and vegetation.
There were some differences of course in the weather of the months of the hot season itself l- again this is based on analysis of the Caseta records mainly, but my stations at other altitudes bear this out. The CDRS coastal records have not been examined yet but should fit in well. Mainly, the really hottest, sunniest months were February and March; almost every day in February was clear and sunny, with strong solar radiation, high temperatures, and high evaporation. This trend continued in march, the days in general being even hotter and again almost all of them clear and cloudless. April had a lot of clear, hot, cloudless, sunny days also, but . . .

Pg. 92.
. . . temperatures were not generally as high as the tow previous months, or at least they were cooler than in March. It was also a very dry month but for a different reason than in February and March – the P/E ration shows in fact that April was drier by this measure than March. April days were often cloudy at least in part and very commonly for about 1/3 – ½ of the day. Several periods of cloudy days for 2-3 days in a row occurred in fact. However, this almost never occurred in March or February. The low P/E ratio for April resulted, however, from almost no rain and the fact that these cloudy days (and many sunny ones) had some very strong accompanying breezes. This resulted in high evaporation on days even which were largely or partly cloudy for a significant portion of the time. In March and February breezes were of course also a regular . . .

Pg. 93.
. . . feature but not generally as notable and strong as they were on a number of days in April. Finally in may and the first half of June, the temperatures continued to drop off a bit , evaporation dropped off a bit from what it was in the previous months, and rainfall picked up again (though not much and scattered over many days) over what it had been in

April. Days were often partly cloudy in May and the second week of June, but on the whole most of the days for this 45 day period were sunny entirely or at least in part. In sum, the entire period of Feb. 1 to Jun. 15 was one of continued and increasing dryness for the soil, vegetation and fauna. Rain was very little in total and very seldom and hot, clear days very frequent. This was in act one of the hottest and driest "hot" or "rainy" seasons in the memory of some of the oldest inhabitants here – this being true at virtually all altitudes – Andres Rambeck mention such to me and he has been here almost every year since the late 1920's. It was notably drier than the . . .

Pg. 94.
. . . same period in 1968 which was considered to be a very dry year by everyone.

III. Ponds and available H20

End of notebook (with exception of a note written to Craig by his wife Jan concerning her efforts in Quito regarding the adoption and visa for their son Chili.

Isla Santa Cruz Volume #9.
Field Notebook of Craig MacFarland

Pg. 1.
June 21, 1970 -
Again very early activity observed in the case of 2 tortoises - #598 ♂ and #1072 ♂ both seen moving into our camp near the newly set up tent and cooking tarp (=fly) at 0545 hours. The were alternately walking a few dozen feet at a time and then sitting and observing their surroundings. At about 0600 they happened upon each other face to face and both raised their heads up and stretched their necks out fully. The much smaller #598 very quickly withdrew his head after only a few seconds of confrontation and then turned and began moving off quickly; #1072 began slowly following behind the smaller ♂ but not very rapidly or concertedly. #1072 then appeared to see us moving about in the tent and therefore stopped and began watching us. This effectively ended the encounter.
#598 came over to the green tent and tried to eat several pieces of toilet paper which Jan rescued from him - we are a bit afraid they will harm him.
31072 looked around under our tarp a bit, but since he broke 1 tent rope in the process we went out and turned him aside. This resulted in his immediately leaving the area to the SSW toward the big pond below.

Pg. 2.
By 0800 #598 had made his normal rounds, examining the kitchen building (and drinking garua water from wash basin there), the Caseta and its fireplace (where I caught him trying to eat a plastic disposable diaper and took it away from him), and the garbage pit.
#450 which is also in the area did not become active till about 0800, so can not say that all or even most are becoming active very early. #450 had stayed in the open for the entire night so perhaps was colder than the above 2 animals which were burrowed into vegetation.
Going to nesting areas below to check weather instruments. Will record any tortoise I see enroute along the trail.
At Caseta - #'s 450, 598, 1072.
At Caseta pond #1 south side - could see 2 - #12 painted and another. (also 4 in pond bed feeding; no water). Did not take #'s because

Pg. 3.
. . . . will sample here soon.
About 200 m distance below pond #1 - in an open spot on trail - (Reg. 2 upper part)
#217 ♀; #408 ♂; facing each other in trail but both drawn in - as if had a very recent confrontation.
#217 has no evidence of any algae on her, but #408 has a fairly extensive growth of the black-green type already after only a few days of real garua mist and rain. It is all over the last ½ of 4th vertebral, all of 5th vertebral, and all of last costal scutes on each side. On this animal there is virtually no f.d. so the algae is not associated with it.
#827 ♀; a bit further down trail and off to left 10 meters - still Reg. 2 - mid portion.
#13 ♀; in lowest part of Reg. 2 in last open area - could see marks where she had been moving south down trail for last 35 meters before encountered here - last saw her quite

awhile ago in mora above Caseta and before that (September) at El Chato - CL 102.4; CW 113.9. A bit of black-green algae starting to appear on her shell.
#119.♀; moving south in same area - CL 78.0; CW 84.9; ♀ probably, tail a bit intermediate.

Pg. 4.
Reg. 3 - heard 2 animals in upper part but failed to see them.
#62 in lowest part only 50 m above Reg. ¾ border.
In Reg. 4 - Weather - 1100 hours - Max 83.0 °; Min 60.0 °; Rainfall 10.5 mm; Evap 27.0, refilled full.
Tortoises in Reg. 4 along trail - # 416 ♂, #1135 ♀, #718 ♀; all near weather instruments.
#s 95 ♀
#1073 ♀ - CL 70.0; CW 73.4
#1194
#1026 ♀ - CL 70.6; CW 79.5
#423 ♀
#890 ♂
#709 ♀
#1192
#908 ♀
[Marginal note: all right around area of flat rocks]
Small pools of H20 there and several drinking from these little pockets in the lava. Very interesting that many of these (most in fact) animals were here through the end of January but during hot season I could not find some of them and those I did encounter were scattered in the

Pg. 5.
. . . . surrounding forest and semi-forest and around the edge of the nearby pond, very inactive most of the time and in the shade- clearly now have moved back into open areas of Reg. 4 and to only available standing H20 source (of course, a very , very ephemeral source). Shows nicely that they did not really (or at least probably did not) ever leave the general area but were forced by clear, hot weather and dry vegetation to scatter more widely than they had been in the previous garua season and to find more shady areas and to become largely inactive.
Region 4/5 border just below above flat rocky drinking area -
#404 ♀
#351 ♀ - (painted #14) in same area as #404
Reg. 5 - lower part - 100 m above big boulder area (distance) - #794 ♂ - huge old guy; still has old pink paint from earliest marking system (reads #424); scutes smooth all over; scattered f.d. all over rear ¼ of shell, front marginals area and elsewhere; has on very deep pocket eaten into side about 1-2 cm deep (variable depth) and about 6 x 6 cm in surface dimensions. - f.d. in the pocket and probably its cause.

Pg. 6.
No algae or lichens; no w.g.i.'s; bone not visible in pocket in side - covered inside also with external laminae material. CL 147.8; CW 154.9 cm

Zone 3 nesting area - 1230 hours – Weather - Rainfall 6.4 mm; Evaporation 31.5, refilled full; Max 84.5 ° F; Min 60.0 ° F.
In Zone 3 NA there are already both signs of nesting and at least 1 nest. Am going to check over all the main area and see how much sign I can find.
#384 ♂ - CL 117.0; CW 128.3; at southern end of large open part of nesting area. Fairly severe f.d. on rear ¼ of shell and front marginals area; no algae or lichens; scutes smooth in central 1/6 - 1/3 of their surface area. W.g.i.'s moderate to thin but clear and complete. Active in open - almost 1300; mostly cloudy but warm radiation coming through; sun may break out off and on but only for a few minutes.
#917 ♂ - in nesting zone large central area- under a tall *Opuntia* tree eating fallen, semi-dry but

Pg. 7.
. . . . green cactus pads. All smooth scutes; a nice ring of red - brownish mud around lower carapace indicating has been in mud or at least wet soil recently. Flaking disease scattered in spots on rear of carapace, front marginals area and a few spots elsewhere. One bad, large deep patch of it on 3rd right costal scutes and another on 9th right marginal. W.g.i.'s present but very thin; no algae or lichens clearly visible. CL 140.2: CW 151.5
#127 ♀ - Eureka! - Note that she was observed digging and attempting to nest in this area last November, then was later encountered, I think, at Caseta pond #1 (will have to check on this). Anyway she is now back at this nesting area and certainly has not been here in my normal sampling area for the entire hot season (Feb. - mid June) I can be sure of this because if she had been I surely would have found her during at least 1 of my many samples of this area - found many other animals regularly which live here but never this female.
She is probably also the ♀ responsible for all the holes dug in the main north part of the nesting area and the first nest (#1) of the year here (see below). Anyway, she has certainly been digging because here rear feet, nails, and legs, as well as

Pg. 8.
. . . . the rear edge and its upper and under surfaces. Here tail and the skin all around this area and the rear of the plastron are all covered with the typical red soil of the nesting area - the soil is adhered and was clearly of a muddy consistency when she got it all over these parts. It is mostly dry now but not completely. Plus, she does not have red soil anywhere else on her carapace, forelegs, etc. - this excludes the possibility that the mud is simply from her having burrowed into the soil for the night during some of the recent garua. <u>She has definitely been digging.</u> Also, I think from the looks of the nest that it was made last night; she is here close by to the nesting area where the nest is located. Her location as of 1300 hours today is only about 40-50 meters to the NW of the nest and unfinished holes; she is near the small "pond bed" area resting in the open. (now cloudy).

Pg. 9.
Her measurements are: CL 101.0; CW 115.2. She has that very notable depression in here 4th vertebral (its latter half) and the borders between her last and next to last costal scutes on each side k- I remember this depression as a very identifying mark from when Jan and I watched her dig 14 holes in November 1969 in exactly the same area where she

has just dug more and made a successful nest. Her w.g.i.'s are virtually non-existent. It is also noteworthy that after searching all over the main nesting area and its outlying zones and my entire normal sample area, of about 2 hectares that I can find no other ♀♀ and no other digging which is clearly of the nesting attempt type (save for 2 locations) other than in the immediate area of the new nest and the holes around it. I searched, as I said above, these areas carefully and saw only one definite hole on the trail just above last year's nest #1. - also close by is another hole (in fact made we think by #127 last year - November) which looks as if a ♀ had dug in it just a bit and then quickly moved on. These 2 digging attempts near 1969/70 nest #1 are very suggestive - perhaps #127 made them on her way into the red soil covered larger nesting area just 50 m.

Pg. 10.
. . . . further along the tail to the south. This is what it appeared she had done also in November 1969 - i. e. day one hole in the trail near last year's nest one and then proceeded on to the red soil area where she attempted to nest for several nights before going up and moving on to some other unknown place to nest. In the central area where the new nest #1's located there are 6 sites immediately around the completed nest where she attempted to nest. The 7 locations are all on open bare red soil with only scattered small dry herb stems and dead twigs and debris of an organic type. They are all in a total area (minimum home range calculation method) of about 300 square feet of the surface. At 3 of the sites she merely scratched the surface a bit and then hit surface rocks and apparently quickly gave up. At 3 others she actually made small holes before giving up. All of the sites are

Pg. 11.
. . . . . in very open areas; except 3 of them (including the nest) which are closely grouped and about 2, 5, and 5 feet respectively from the base of a muyuyu (*Cordia lutea*) tree. The completed nest is 5 feet away from this tree - the others 2 sites are just surface clearings and scratchings. This tree is now nearly completely barren of leaves but will provide some shade for probably about 1 - 1.5 hours a day (late morning hours) when it is leafed out, because its canopy extends out over the nest very slightly. It is interesting to note that the uncompleted nesting attempt which is only 2" from the base of this tree could probably have been partly shaded by its trunk and canopy for a total of 1.5-4 hours a day had it been completed and the tree leafed out later. 'Even if the tree did not get a covering of leaves the trunk could shade it for about an hour in the early morning (0630 - 0730 or so).
The new nest #1 will not be shaded by the *Cordia* trunk at all. Even if the tree leaves out, the shade will be scattered and only partial for the projected time period because the Cordia tree is not a densely canopied species.

Pg. 12.
Finally the 3 holes (attempts) in this area - in once she hit rocks in the sides and one very large rock was in the ay at the rear surface of the hole- this one she abandoned at about 9.5 cm depth. One other was abandoned at 16 cm depth and its entire bottom is a plate of rock - this was the deepest attempt made and the most extensive digging attempt which she abandoned. The third was about only 5 cm deep when she ran into trouble from

rocks in the sides and only large rock in the side and at the surface forming the entire rear and part of the one side of the nest. I am going to leave the first and second ones above to see if other tortoises might try to use them.
The hole up on the trail just north of this area is hard to estimate the depth of because the much finer brown loose soil there is crumbly and has caved into the digging a lot. She had clearly at the one dug quite awhile and then encountered problems from a

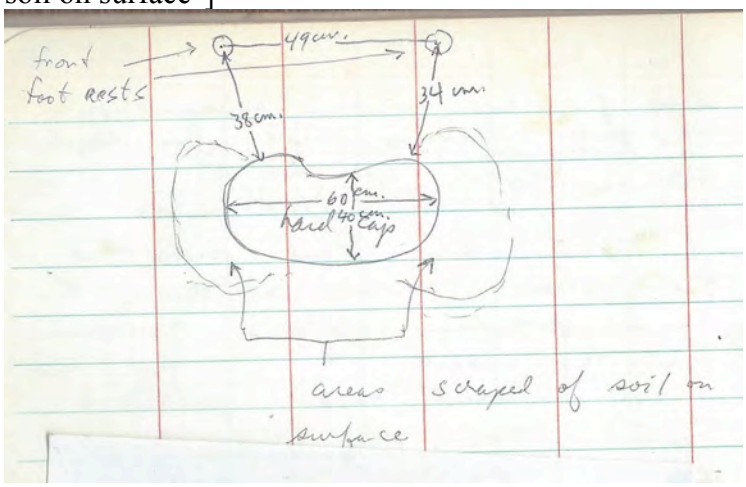
Pg. 13.
. . . . large fist-sized rock in each side of the hole and possibly also from the loose dry soil falling back into her excavation. She clearly used some cloacal fluid here because there is a bit of mud (but partly dried) on a pile of soil at the rear of the nest. **[Marginal note: <u>But not much fluid! Only a tiny bit of mud.</u>]** The hole does not have many rocks in its bottom and from the point where the loose soil stops and hard bottom begins again (presumably the level to which she dug before giving up) the depth to the surface is about 19.5 cm The clearly had a lot of small rocks to dig out here because her slap piles where she dumped the excavated soil are full of small ¼-1/2 fist sized rocks. This nesting attempt seems to have gone about as far as the one most completed one of the 3 discussed above.
None of these holes, scrapings, or the nest was dug on a nest site from last year although they are very near some of last year's nest.
Another note- no mud was found at the deepest of the 3 holes near the completed nest - i.e. she did not use cloacal fluid in this attempt. All the diggings appear fresh, very fresh as the slag piles are made up of crumbly dirt and have not yet started to tumble and wash (garua action) back into the holes

Pg. 14.
. . . . very much.
The nest itself is very fresh and I am almost certain was made last night. The hard cap is large and consists of very wet mud which is in a very compact form and has not started to dry at all in the few places where it is exposed. Over this cap in all but a few exposed places is a thin layer of about ¼-1 cm of fine, dry, powdery loose red soil with an admixture of organic debris (twigs, roots, dead leaves) and some small rocks and pebbles. The female's front foot rests are still very clear and undisturbed and the scale imprints are visible. Even though it has been "garuing" here recently, I do not think this can account at all for the very fresh mud of the nest. In fact, since the garua stopped early last night (1830-1900 at the Caseta) and probably even sooner here, the fact that the loose powdery surface soil on top of the hard cap shows no

Pg. 15.
. . . . sign of having been "garued" on is good evidence that this layer was scraped up from the surrounding soil and put here last night. Had it been any time before that the strong garua all during the day yesterday which occurred from the coast to the top of the island would have pocked and marked this dry soil clearly - no such signs are present. Anyway the nest is almost certainly from last night and if not, no more than from the night before that.

I, of course, cannot prove definitely that this particular ♀ laid the nest and that it was made last night but all the circumstantial evidence points to these conclusions. She has probably been here and digging for at least 2 or 3 nights considering the # of holes and that the one attempted hole with moist mud near it is not as fresh as the nest - i.e. the bit of mud near it is probably 2-3 days old judging from the fact that it is more dried out than the fresh mud of the nest.
The nest is shaped as follows:

Pg. 16.
[Diagram drawn shows: front foot rests 38 and 34 cm respectively from the margins of the nest hard cap which is 60 cm wide and 40 cm front to back. The kidney-shaped hard cap is bounded laterally by oval and posteriorly by a squarish looking "areas scraped of soil on surface"]



Clearly was a large ♀ judging from these dimensions. I will return in a few days to implant thermocouple and soil moisture blacks in this nest. For now I am putting some large rocks close around the top of the nest to prevent the pigs from disturbing the nest.
On return saw most of the same animals in same places and general areas where noticed on way down. However saw a few new notable things:
#119♀ had progressed southwards a few hundred meters more along trail and is now (1630 hours) at upper, upper part of Region 3 in forest.
#10 (painted; #1070♀) was now

Pg. 17.
. . . . down just below the manzanillo grove about 200 m below Caseta pond #1; this morning this animal was at the pond.
#4 painted - still in pond bed (#1189 is permanent #)
#216 ♂ is along tail ½ way between Caseta and Caseta pond #1 (painted #7) - therefore still in this area as was in May 1970.
Very interesting to note today, that without even taking a careful accurate sample in Region 4 and all along trail from Caseta to nesting area, that it is obvious that animals are present in much greater numbers again in these areas (especially the open and semi-open areas) than they were all through the hot seas months of Feb. through May. This is good evidence for my supposition that most animal in the hot season had simply disperse

largely horizontally at the same altitudes where they had been living in the open areas in the previous garua season. The hot weather and constant solar radiation forced them to space themselves out more thinly because of the very limited amount

Pg. 18.
. . . . of green vegetation in the herb - shrub layer; also they had to seek cooler, shadier, resting spots which were very limited in the open areas. The best evidence for this suggestion is that many animals which had been in open places like Reg. 4 up till Feb. and the hot season beginning, have now after only a few days of garua came out of the surrounding forest close by and are back in the open spots now that the hot solar radiation is not a problem. Many of these animals were found living nearby to the open area, but in the forest or forest/open area border all through the hot season - but they were much less dense and much more scattered out than in the garua season.
Jan say she had to fight off #'s 598, 450, and 346 from around the tents all day long today while I was gone - they were biting

Pg. 19.
. . . . our shoes, plastic water jugs, cloths, etc. All around the tents and smashing into stake and guy ropes.
This morning was the worst, but the animals were active virtually all day till about 1600 when they went off into the bushes for the night.
Caseta Weather 1900 hours - Rainfall 1.9 mm; Evap 1.0 ml (reading 18.4); Max 76.0 ° F; Min 65 ° F; overcast all day - garua most of morning.
I checked on #127's previous sightings in old notes (not a complete check but found most important items) - On January 4, 1970, I found here at the Caseta pond #1 wallowing around in the mud and then saw here there several more times in January; I will have to check through all notebooks more carefully to see where else she has been seen - anyway, at least I know she was in Zone 3 NA trying to nest in early November 1969 then in January was near Caseta and again in Zone 3 NA now - so shows three things:
1. Long distance movements between nesting zone and watering/feeding locations.
2. Return to nest in exactly same small plot of ground she dug last Nov. and now in same small 10 x 30 ft area
3. Nesting 2 years in succession.

Pg. 20.
June 20, 1970.
This morning #598 ♂ was stomping around tents again at 0600 - He seems to do this whether it is raining or not.
#450 ♀ is also in the area - first saw her coming out of the bush at 0830 hours.
Also noted #1072 ♂ and #267 moving toward tents from Manzanillo grove and small pond to the west about 30-40 meters.
Going to Caseta pond #1 to sample this morning - will take measurements whenever possible to obtain information on growth.
Near Caseta
#598 ♀ (probably); CL 81.9; CW 89.1; no algae yet.
#450 ♀; #267 ♂; #1072 ♂ - all in deep brush ; will measure later when more accessible.

#314 ♂ - coming down drainage and onto trail just below Caseta and tents- from general direction of mora and Reserve border to Northwest. CL 123.1; CW 133.7; bad f.d. all over rear ¼ of carapace and front marginals area. No algae or lichens; scutes smooth.

Pg. 21.
. . . in central 1/10 -1/5 of their area. W.g.i.'s nonexistent.
#246 ♀ - just a short distance southwest of tent - recently measured so won't repeat it.
All these animals above are in generally open pampa - shrub areas - grazing and moving around.
Just located #267 ♂ again in open just west of tents. CL 109.1; CW 120.7. w.g.i.'s virtually non -existent; black -green algae on rear of carapace faintly present.

At pond #1 - circuit of pond inside -
#1013 ♀ - CL 76.8 cm; CW 81.7 cm k- w.g.i.'s virtually non existent save fro a few fine lines scattered here and there; no algae or lichens.
#919 ♀ - CL 100.0; CW 110.2; very bad f.d all over rear ¼ of carapace and scattered elsewhere; no algae or lichens; scutes smooth in central 1/10-1/5; w.g.i.'s nonexistent; noticeably upturned rear marginals.
#117 ♂ - CL 99.4; CW 106.2; w.g.i.'s almost undetectable for the most part - a few fine, very thin lines here and there; some scattered f.d. on rear costals and 5th vertebral and front marginals area and bits of it elsewhere - don't remember him having his before !? No algae or lichens.
#919 sitting with head end only a few cm from tail end of #117 - just sitting when I approached so I do not know what transpired earlier.
#475 ♀ CL 75.4; CW 80.8; no algae, lichens or smooth scutes; f.d. very minor and only a few tiny spots at

Pg. 22.
. . . . various scattered places on carapace - none on rear of it! W.g.i.'s nonexistent. CL 75.4; CW 80.8.
#1189 ♀ (painted #4) - CL 66.7; CW 68.7. No algae or lichens; w.g.i.'s nonexistent; shitting guayavillo apple cores - very compact, relatively dry turds - all of fleshy part of fruit is gone and only dryish inner part with seeds remains - turds are solid apple cores in a thick brown sticky matrix.
#421 ♂ - CL 84.0; CW 92.8 cm; w.g.i.'s nonexistent; no algae or lichens.
All of the above animals were in the pond open area walking about and occasionally grazing on the few and scattered small herbs there. No much in the way of edible plants - some small plant #1 (*Blechum* sp.?) and other herbs. Most of vegetation is made up of a fairly dense stand of *Cassia* sp. and *Heliotropium* sp. Mostly ½ -1 m tall plants. The Cassia is fruiting and flowering in profusion as it has been since later ½ of March. The *Heliotropium* is drying back a bit and the flowering

Pg. 23.
. . . . has past its peak - in April and March these plants were much greener, and more abundant and dense. The tortoises (and goats) seem to avoid eating these 2 from what I can see of the species here and at other ponds - no signs of grazing. I have seen (see later

period in April notes) a tortoise try *Cassia* leaves and stems once but it quickly gave up feeding on that species. Have never seen tortoise eat *Heliotropium* in spite of its abundance in and around dry pond begs where many tortoises frequently are active.
#933 ♀; CL 74.8; CW 81.2; (painted #12); w.g.i.'s nonexistent; no lichens; faint bits of black-green algae on rear of carapace but not much; south side of pond - in open area - basking.
#1215 ♀ - CL 68.7; CW 74.1; south side of pond in open area - basking; w.g.i.'s largely non-existent - a few very, very thin lines visible here and there. No lichens or algae.
#1022 ♂ - CL 87.9; CW 95.1. Moving along in open on south side of pond; no lichens, a few faint patches of black-green algae on rear of shell and front marginals area; w.g.i.'s nonexistent.
#835 ♀ - CL 83.7; CW 90.3; no lichens or algae; w.g.i.'s mostly nonexistent - a few extremely thin lines here and there. On west side of pond - to west 40 m.

Pg. 24.
. . . . in an open area near some manzanillo groves with small rocky, but still dry ponds.
#444 ♂ - (painted #11) - CL 102.3; CW 111.4. No lichens; a good covering of black - green algae on rear ¼ of and front marginals area of carapace. W.g.i.'s non-existent about 20 m west of previous animal, moving along in an open area out of forest and toward direction of pond #1.
#785 ♂ prob.- but rather small to sex accurately - tail seems "intermediate" in length. Moving along trail to SW of pond away from pond toward forest - about 70 m from pond now. CL 70.7; CW 75.4.; no lichens or algae; a few scattered minor spots of f.d. on rear of shell scutes smooth only in very centers, w.g.i.'s nonexistent. Has a notable deformity of the carapace - 3 costal only on left side, 4 on right. As a compensation 4th vertebral is elongated excessively in its left - rear "corner" and 5th vertebral is elongated way to left also; also third and last costal on left side extends further

Pg. 25.
. . . . back than is normal. These 3 scutes then have filled in the span which would have otherwise been occupied by the 4th left side costal scute.
On north side of pond -
#1245 - inactive, trying to bask in an open spot in a grove of *Clerodendron* bushes. No algae or lichens; w.g.i.'s nonexistent.
#1068 ♀; CL 75.5; CW 79.7; w.g.i.'s nonexistent; scutes smooth only in very centers; no f.d.; no lichens; black -green algae common on rear 1/5 of carapace. Re-marked because cuts, especially 7's getting faint - but still quite readable. Inactive, attempting to bask in a small open spots in densely shrubby area.
To small pond just southwest of Caseta - will sample as usual up to altitude of Caseta and camp and then over to them.
#891 ♀; CL 77.2; CW 83.3; w.g.i.'s nonexistent; no algae or lichens; remarked because 7's getting faint - rest of marks quite easily readable. Inactive, in open on edge of a small rocky pond (dry) just west of main small pond.
#538 ♂; CL 100.7; CW 111.9; Sitting in open - grazing - very near last animal; in area with large sedge clumps. No lichens or algae; a few very scattered, minor spots of f.d. on rear of carapace. W.g.i.'s largely not

Pg. 26.
. . . . present but a few extremely thin white lines here and there. Scutes smooth only in central 1/20 - 1/10 of their surface area.
#1125 ♂ (probably); CL 77.5; CW 83.3. Up at level of camp - sitting in open area. No algae or lichens and w.g.i.'s nonexistent.
#267 ♂ - same general area; moving in open.
#423 ♀; CL 82.0; CW 83.8; **[Marginal note: duplicate to one now in Region 4 of Caseta -La Fe trail]**; no algae or lichens; w.g.i.'s extremely fine and thin; sitting in a mud wallow in the open - a notable ovalish shaped elongated animal - looks like some G. e. chathamensis individuals. Also just west of tents in Caseta area.
Caseta Weather - 1900 hours - overcast all day; garua till about 1100 hours, then dry rest of day and still so. Max 74.5; Min 64.5; Rain 1.5 mm.; Evap. 1.2 (reading 19.6)
**Note - although I did not find a great many more animals in sample today than during some of the censuses in the hot

Pg. 27.
. . . . and dry season it is clear that:
1. There are in fact more animals concentrated in and around the Caseta pond #1 sampling area than there were in the dry season sample times - especially quite a few more than were there in April and May and first half of June, 1970.
2. the animals have started moving bock into open and semi-open pampa areas which are covered with grasses and plant #1; they are leaving the more shady forests - and all this after only about 1 week of garua - apparently increased moisture and cloudy cool weather and slight increase in greenness are already taking effect.
3. The are active almost all day off and on between about 0700 - 0800 and 1600-1900.
June 23, 1970.
To Caseta upper pond area and Devine's to sample -
#445 ♀ (painted #1) - in open basking below upper ponds a bit - on reserve border just where saw her for about 1 week in late May and early June 1970. CL 80.1; CW 86.8; no algae or lichens; w.g.i.'s nonexistent. Notes a deformity in carapace which am not sure I recorded before - she has exactly the same deformity as #785 from yesterdays sample - except she

Pg. 28.
. . . . has it on her right side - only 3 costal scutes with accompanying compensation of 4th and 5th vertebrals and 3rd right costal scute.
#256 ♂ - CL 118.7; CW 125.8. Bad f.d. all over rear ¼ of carapace and front marginals area; no lichens or algae; w.g.i.'s nonexistent; scutes smooth only in very centers - unusually large to have no smooth scutes yet. Re-marked 4 of 50 mark because chipped and hard to read.
#305 ♂ (probably) - called this animal a ♀ before but if so very uncharacteristic - large yet scutes smooth only in very centers - does not look at all like a large old ♀ such as #'s 131, 127, etc. Re-examined tail and although it is short the point is very, very abnormally wide and thick - as if it were at one time much longer but had been bobbed by an injury. Therefore will consider it a ♂, probably; CL 109.0; CW 122.9. w.g.i.'s nonexistent;

black -green algae all over rear of the shell - very noticeable - was not here a few weeks ago when was hot, dry weather regime.

Pg. 29.
The above 2 face to face, both withdrawn into shells, just 40 m below ponds in open area - on mora - plant #1 area borderline.
#852 ♀ - CL 90.8; CW 92.9; no lichens or algae; w.g.i.'s non existent. In open area just below ponds - basking.
#220 ♂ - CL 122.0; CW 144.8; no lichens or algae; w.g.i.'s nonexistent. Same area as #852 ♀ k- also basking.
Just north of Caseta upper ponds (pond #2) - near a small pondlet and along a trail through mora which animals use to reach Devine's central manga from Caseta upper ponds area - (used this area extensively last Nov. - Jan and have clearly been using heavily again just now after a 4.5 month period of disuse).
#1190 ♂ (painted #13) - ♂ prob. - short very thick tail - hard to tell because tail a bit intermediate in length. CL 93.6; CW 103.0; w.g.i.'s present but extremely thin lines only ; no lichens or algae.
#450 ♀; CL 90.0; CW 98.6; no lichens or algae; w.g.i.'s present but extremely thin, barely visible lines only. Up from Caseta since yesterday or day before - Re-marked because getting very faint.
These 2 face to face and about 1.5 meters apart - both drawn in mostly (heads out) when I approached so do not know

Pg. 30.
. . . . what occurred just previous to my arrival.
#529 ♀; CL 89.5; CW 97.3. Moving in open out of pond #2 and onto the trail through mora toward above two animals. No algae or lichens; scutes not smooth except in very central tiny portions; f.d., only in a few tiny superficial patches on front marginals. W.g.i.'s nonexistent. Re-marked - can read easily but getting faint.
#885 ♀; CL 80.1; CW 85.8; w.g.i.'s nonexistent; no algae or lichens; in pond #2 moving around. Re-marked, 7's getting faint.
#96 ♂ - CL 117.0; CW 131.7 - w.g.i.'s present but extremely fine and thin; no lichens, but black-green algae on rear 1/5 of carapace in fair abundance. Also moving around on bed of pond #2 - eating grasses. Re-marked because 2 of 10's very chipped and hard to read - otherwise all marks were OK - but did all anyway.
#368 ♀ - CL 105.3; CW 114.3; In pond #3 on dry bed- basking - strange - very large, very ♀ like tail, yet scutes smooth only in central

Pg. 31.
. . . . 1/10 of surface area or less; however just now has a good case of f.d. on rear ¼ of carapace and front marginals area - perhaps this is why not already smooth; no lichens or algae; w.g.i.'s nonexistent.
#123 ♀; CL 80.4; CW 89.1; In dry pond bed furthest east in the Caseta upper ponds group - eating herbs and grasses there - this bed has blossomed forth rapidly with small herbs and grasses in past week to 10 days with increased cloudiness and garua. Eating a small herb in particular which I have not noticed them eating before - but have not

noticed avoidance of it either - in this case she is eating it in particular with preference to abundant surrounding grasses and the cucurbid which used to be called *Echinopippon* (yellow-flowered orange-fruited one). No lichens or algae and w.g.i.'s nonexistent.
Up B. Devine's eastern manga just slightly east of Caseta upper ponds area -
About 1/3 of way up to first fence (i.e. about 800 ft altitude) saw very fresh trail from manga to NW out across matamonte (leguminous vine which covers and kill shrubs, including mora) - followed awhile but could not locate tortoise - this area is where I saw some fresh sign in March 1970 - perhaps same animal?

Pg. 32.
Then at about ¾'s of way up found #819 ♀ (?) about 10 m east of manga; in a big open field of *Commelina_nudiflora* and cucurbid (formerly *Echinopippon*) - all this is relatively new growth herbs from late May till now. In a big patch of *Commelina* eating heartily - has been here at least a few days because has matted down about 400 - 500 square feet of it. Interestingly because found her last fall [Marginal note: Nov. 1970 I think] on western manga of Devin at about this same altitude -that's about 200 m straight-line distance from here across solid mora.
No lichens or algae and very well developed, clear, moderately thick w.g.i.'s interesting that she is growing well in comparison to animals around Caseta and lower down - they have been suffering for greenery where as she has had such for about 1-1.5 months if she has been in this slightly higher area where not as many tortoises, no goats or burros, a bit more rain and definitely much more (in fact fairly abundant) herb cover since about mid to late May period.

Pg. 33.
CL 100.5; CW 114.9; She may have some black-green algae on rear 1/5 of carapace but hard to determine this because there is a dark black dry scum there - probably partly this algae in dry form . She has deformity which I have recorded before. She is also interesting because is large but without smooth scutes - has a very short stubby thick, pointed tail, but not as much as #305 (see above) - could be a ♂?? This area she is in is same one where have seen several animals before - past January and garua season.
Just over a slight rise from where last animal was located, I found a much larger area of matted down *Commelina* - a lot of exposed and rooted up soil due to very recent wild pig activity - also some fresh turds from this animal (#819) probably. Also a burrow of only a few days ago on other side of manga at same altitude and some fresh trails - I suspect this is all due to another tortoise in the area because burrow is too small to be from #819.
Then on up to first fence and to about 950-1000 ft. altitude above it - absolutely no more sign - nothing different from last sample all through these pampa and mora mixed areas (pampas

Pg. 34.
. . . . here are actually mangas planted to pangola grass by Bud Devine; pangola still mostly very brown and dry. Then over toward lowest banana patch at same altitude. Searched all around in normal sampling area just east of bananas in mixed pangola and elephante grass and in low mora (mixed with herbs) patches.

Finally found a fresh trail at about 950 feet - followed it for about 75 meters and found #627 at end of it in elephante grass in open on edge of a patch of "cohoho" "shrubs" or "saplings". Eating a low growing species of grass. At same altitude as upper end of banana patch. CL 108.3; CW 124.2. No lichens or algae; w.g.i.'s very, very thin and fine. Note that has moved up here just recently from R. Border in Caseta upper ponds area; interesting that has come up to this wetter greener area from dryer one below and w.g.i.'s not yet well developed like #819's.

Pg. 35.
No more seen on eastern half of land.
Western half and banana patch at 900-1000 feet inclusive -
#782 ♀ - in banana patch eating trunks - at about 950 feet - a bit lower down than where I saw her in late May but same general area - CL 88.2; CW 92.5. No lichens or algae; but w.g.i.'s clear and developed - however rather thin.
#1 ♂ - in banana patch at about 950 feet - lower end - only slightly above area where saw in May - actually a bit to west (10 m) of banana patch - in mora, eating Commelina beneath it.
Saw no more animals in Banana, but clear sign of at least 3 more animals - fresh turds and trails of varying sizes - these were all on eastern edge and a good ways away from #'s 2 and 782 - thus I think they are from different animals - also, #'s 2 and 782 are relatively to where I saw them in May and probably have not moved far since then.
Then cam down central manga - saw fresh trails and turds at 3 locations - probably all may (= made) by different animals because very recent - yesterday or day before, but I can't say for sure that all due to 3 different beasts. These

Pg. 36.
. . . . locations were at fence line, i.e. beginning of manga, at about 1/5's of way down, and at about midway down to reserve border. This latter area has a large area adjacent to the manga and out into the mora where tortoises have been eating Commelina and smashing down mora plants - about 1000 square feet or more of this with turds both fresh and up to a couple of weeks old. This is a new area and slightly above a similar cleaned out area in mora which I saw a bit lower down on manga border in late may and early June. Interesting both then and now that the tortoises are not eating pangola at all and clearly prefer native herbs growing under the mora and along the pangola mora border. Again, as on 2 previous days, impressive that the animals have moved back out into open area to graze on Commelina and such herbs with the return of the garua and clouds.
On return to Caseta Jan told me about seeing two new animals around the tents and camp.

Pg 37.
#'s 1006 ♀ (painted #15) and #274 ♀ (painted #2). I located the latter animal and measured her - CL 93.1 cm;; CW 103.6 cm No lichens or algae; w.g.i.'s extremely, extremely. Thin but visible. Paint almost totally gone and virtually unreadable - re-painted to enable further observations with ease. The animal appeared from forest -semi-open area to east of the Caseta.
#1006 ♀ appeared from SSW of Caseta from openish areas. Will try to get her measures and re-paint her tomorrow.

Caseta Weather - 1900 hours - cloudy virtually all day - about ½ hour of total sunshine, but in short spurts only. No garua, warmer than several preceding days. Max 90.0 ° F; Min 66.0 ° F; Rainfall 1.9 mm; Evap. 2.6 ml (reading 22.2).
June 24, 1970.
#'s 598 ♀ (?), 274 ♀, 423 ♀, and 1006 all around tents and camp by 0900 poking about for food and water - in heavy garua. Measured two more near camp -
#1006 ♀ (probably?) - CL 88.1; CW 94.4 - Could not re-paint because of heavy garua ; [Marginal note: Jan re-painted #, later in day]. No lichens; a lot of black-green algae on rear of shell; w.g.i.'s non-existent.

Pg. 38.
#'s 1006 and 598 are both very problematical as to sex - I had them previously recorded as %98 ♂ and 1006 ♀, but they are both very similar in total size and the tails are of very similar relative size and shape. I think they are both ♀♀, but should call both probable because tails are somewhat intermediate in length.
#598 and #1006 had a brief confrontation in front of the tent this morning at about 0830 hours. They met face to face about 5 feet outside of tarp-covered area. At first both stopped moving, settled down in grass about 3 feet apart and kept heads out about ¾'s of way and began sniffing noticeably toward each other. Then each moved forward just a bit and raised up fully on all 4 legs, extended neck out and bent heads slightly so that heads were parallel to ground and necks at about 20 ° angle from horizontal plane. Then for next 4 minutes simply alternately held these positions with heads at same level and snouts about 5 cm apart and then occasionally moved heads close together, sniffing all

Pg 39.
. . . the time till snouts almost or did actually touch. The quickly after each would withdraw heads with a jerk to former position about 5-10 cm apart. They never opened their mouths at all or attempted any of the biting down which often typifies aggression. Finally, at end of 4 minutes of this, on last touching, #598 withdrew further than usual and pulled neck and head down and in about 2/3's way - #1006 followed this movement slightly by extending neck further quickly and pushed head down toward retracting head and neck of #598 - but still never opened mouth and never touched #598 again - in fact whole lunge was a bit of a fake and only appeared to be a threatening movement. Anyway caused #598 to quickly pivot 90° so not facing #1006 anymore. #1006 responded by withdrawing neck most of way and settling down in grass. Then soon both moved off with no further display or interest in each other.
Yesterday, Jan saw #598 approach #1006 from rear at one point; it appeared that #1006 was not aware that

Pg. 40.
. . . . the other animal was even in the area. Anyway #598 rammed into rear of #1006 with gular projection. Immediately #1006 took off and #598 did not follow - this was the end of this encounter.
#1006 came into camp area yesterday after absence of several months from the open area around the Caseta - I suspect she has been in the semi-forested areas between the Caseta and the pond below (#1) for the past 2 months or so. She has no red soil on her anywhere

which might indicate she had been much lower down on the island. When she cam into our camp area she immediately began trying to eat everything - the tents (ripped a small hole in the yellow "Draw-tite" one), toilet paper, match box (successfully consumed this), gas bottles (plastic and brightly colored metal), clothes etc. Jan put a wash basin full of water in front of her, about 5 feet away - she did not respond so Jan put it about 1 foot away - still no response. Finally she placed it right under her and splashed the water into her face - at that

Pg 41.
. . . point Jan says she became extremely excited and active and immediately moved rapidly and stuck her head into the water and drank it all down without stopping once (about 2 quarts of water). Clearly indicates how dry these animals are after the long season of 3.5 - 4.5 months without any standing water in ponds even at these higher altitudes.
#'s 1125 and 1072 were both drinking from small pockets with H20 in them in bed of small pond under manzanillos to west of tents a short way.

To zones 1 and 6 to census -
None along trail to large pond on R. B. just west of Zone 1 turn off. But fresh turds (many) of a smallish animal for about last 2000 m. before reaching that pond - probably from #1168 which saw here on 16 June on way to Caseta.
#1108 ♀; CL 70.7; CW 71.5; at pond mentioned above - sleeping in open in dry pond bed (1245 hrs). No lichens or algae; w.g.i.'s extremely, extremely thin; no f.d. or smooth scutes. Notable deformity - has an extra small vertebral scute crammed in between 4th and 5th ones - this results in 4th and 5th both being a bit deformed and also slight deformity of last right costal scute.

Pg 42.
Rest of trail to Zone 6 - no new sign and no animals - lots of pig sign - tracks.
Trail into Zone 6 - no sign of tortoises but plenty of fresh pig tracks.
At pond 1 - no tortoises, no sign.
At pond 2 - fresh (this morning) track in muddy bed of pond - about 70-80 cm CL animal - but can't locate - went off to east of pond a bit [Marginal note: 1 animal]
Weather instruments - 1400 hours - Rainfall 0.90 inches; Evap _____
Searching through manzanillo groves and plant #1 pampas (dry mostly, a few new shoots just starting to emerge) on way to ponds 3 and 4.
New # 1262 ♀ - CL 92.4; CW 100.0. No algae, lichens, or f.d.; scutes smooth only in very centers; w.g.i.'s very, very thin and barely visible, but complete. In open on edge of a muddy, dry pond bed - northeast of ponds 3 and 4 a bit.
#432 ♀ - CL 78.1; CW 82.5. No algae or lichens; on (only) a few scattered minor spots of f.d. on rear marginals area. Scutes smooth only in very centers. W.g.i.'s nonexistent. Sleeping in open , trying

Pg. 43.
. . . . to bask I would guess on edge of pond #4.
Also saw clear sign of at least 1 more and perhaps and probably two more - fresh trails and turds - also in pond #3 and 4 general area - a bit east.

Perhaps should not count any of these animals for which saw only sign because easier to see now (trails that is) than in hot, dry season. However, since turds equally easy to discover at all times, probably can count animals in this manner.
Goats still up high in Zone 6. Goats in general seem a bit lower now than 1 week ago before garua had started full force. The increased moisture seems to have forced them back down a bit k- when I went to Zone 3 NA noted (on 21 June, 1970) that most goats were at altitudes from about 400 feet downwards to nesting zone, whereas up till 1 week ago they were most common at altitudes of 400-700 feet - especially dense around Caseta #1 pond and just below it - now none in the latter location. But just before garua started here a number of goats on reserve border in mora - i.e. at about 750-800 feet. Hunters and wardens killed most of them and rest left the area for lower regions. But this indicates how far

Pg. 44.
. . . . up the dry hot weather had forced them.
Caseta Weather 1900 hours - cloudy all day - some garua till noon. Rainfall 1.8 mm; Evap 1.0 ml (reading 23.2); Max 73.0; Min 63.0.
25 June 1970
To mora, El Chato for weather and northwest running arm of N. Park border (towards Lechoso) [Marginal note: Note, changed plans enroute - see following notes]
#445 ♀ (painted #1) - same exact spot as last sighting.
#73 ♂; CL 112.5; CW 125.5; in mora Reserve Border - just shy of Rt. Turn and Camote patch - 30 m. North of border in big Passiflora field - eating that and Camote leaves.
Back to this old area where was last garúa season - from hot season stint near Caseta pond #1!!
Then I wandered up to north, climbing gradually in altitude on up through a big beautiful lush pampa of new growth *Passiflora, Commelina,* and cucurbid (formerly *Echinopippon*). This area had dried up moderately in garua, killing these herbs back to almost nothing, but in May they began to re-grow after some rain and now form a

Pg. 45.
. .. . beautiful bright green and yellow carpet of about 5-10 cm height and extending over many acres up to north of this area of the reserve border just before the right turn and Camote patch. The area has only one small grove of trees and is otherwise wide open - most tortoises deserted here in hot and dry season because of solar radiation problem and drying up of the herbs I suspect. Will look through it to see how much sign there is of tortoise.
#237 ♀; CL 106.2; CW 115.4; Scattered spots of f.d. all over, especially in 2 most common areas - not much in sum total; no lichens; dried up black - green algae on rear of carapace; w.g.i.'s visible but very thin. Interesting that is definitely a ♀ (small tail, not a deep plastral depression) yet is large and scutes smooth only in small central portions - perhaps because f.d. just beginning? She is located about 50 m north of R.B. , just above #73 ♂. Feeding in Passiflora - Commelina - cucurbid field in open.
Another 50 feet up in altitude and about 150 m further north I found a lot of cleared out and eaten Commelina patches - these are along a natural drainage which runs down through the mora toward the R.B. about at the Rt. Turn; the area where tortoises had been

is all along the herb field - mora border, and they had smashed down a lot of mora also in their wanderings.

Pg. 46.
At end of this area and just a bit further up (30 meters distance) found 2 animals together, grazing on herbs.
#403 ♀ - CL 85.6; CW 90.3; no f.d. or smooth scutes; no lichens or algae; w.g.i.'s clear and moderately thick; re-marked because 400 mark very faint.
New #1263 ♂ =- CL 94.9; CW 99.6; Notably flared and turned up rear marginals; front ones also but less. W.g.i.'s clear but very, very thin; scutes smooth only in very centers and no lichens or algae; f.d. all over rear ¼ of carapace, front marginals area and scattered elsewhere over tops and sides.
Altitude where these 2 found is about 900 feet (Thommens)
Up to this altitude found scattered tortoise sign from past few months - mostly old trails and mashed down herbs, dry and disintegrating turds, and big burrows under scattered clumps of Tournefortia and mora which dot these areas and border the pampa-like herb covered areas. Not a lot of animals, but certainly was a scattering of them (perhaps 1/every 3-5 hectares?) throughout the dry season. At this altitude, Commelina and cucurbid did not all die out completely

Pg. 47
. . . (but Passiflora virtually did) and thus they had food and shade (Tournefortia and mora clumps) throughout the long hot, clear months.
Continued on up through same pampa like cover, up little drainages and over rises here and there for about another 150-200 feet in altitude and stopped just below first house up - at about 1100 -1150 feet. Farmer here has put in scattered east -west running mangas all over through the mora, has burned several large areas and has a manga running N-S which hits the N. Park - Reserve border about 100 meters east of the right turn. Saw less and less tortoise sign the higher I went from where saw 2 animals last mentioned - also all old and from hot season; scattered trails, turds and burrows here and there in herbaceous pampas and into mora which surrounds these areas. The pampas all way up to S. Rosa - Bellavista trail almost, it appears, so tortoises could move well up onto this farmer's land and beyond with relative ease - anyway, I now know that they can barrel through plain old mora anyway. It is clear that were

Pg. 48
. . . animals scattered through here during hot season at least to 1050-1100 feet, but apparently not many if any up higher because so (saw) no clear sign any higher. - of course probably were a few scattered ones up even higher given what I saw above El Chato and on Devine's land in Feb. - May samples.
Finally saw one more animal- at about 1050 feet in pampa - mora border area - had been here some time (3 weeks- 1.5 months I would estimate) because lots of turds of many ages and matted down mora and *Commelina*.
#58 ♀ - CL 105.5; CW 114.2; f.d. all over rear marginals (last ¼ of carapace also), fronts (sic) marginals, and spots elsewhere; no lichens or algae; scutes smooth only in central

1/10-1/5 of area - interesting because is a large ♀ - w.g.i.'s clear and well -developed but moderately thin.
Came back down this farmer's manga (mention above) to R. B. and saw no obvious fresh tortoise

Pg. 49.
. . . . sign (just scattered old stuff as mentioned above).
Toward El Chato -
#106 ♂ - near Rt. Turn - CL 97.8; CW 102.9; no lichens or algae, w.g.i.'s clear and well developed but thin.
#98 ♂ - just on other side of Camote patch past Rt. Turn. CL 109.1; CW 122.2. No lichens or algae; w.g.i.'s clear and moderately thick and well - developed.
#97 ♂ - bit further along trail to west - 50 m - sleeping in trail. CL 124.9; CW 135.2. No lichens or algae; w.g.i.'s very, very thin and intermittent.
At pond area just before El Chato turn off -
#1177 - CL 82.2; CW 86.8; no lichens; dried black-green algae on rear of carapace and w.g.i.'s present and complete but very thin. Moving through pond bed and then
#172 ♂ - CL 126.8; CW 148.6; no lichens or algae; w.g.i.'s clear, complete and well developed - rather thick also. Sleeping in open.
In Guayavillo - *Scalesia* forest about 3/5's way down to base of El Chato. -
#540 ♀ - (could be 541 but 1 mark a natural chip I think) and other marks are good and clear). CL 79.6; CW 86.2. No f.d., lichens or algae; scutes smooth only in very central parts - very little - w.g.i.'s not visible at all.

Pg. 50.
#1178 - a bit further down - still in forest CL 86.8; CW 91.3; no lichens or algae; w.g.i.'s nonexistent.
El Chato Weather - 1430 hours - Rainfall 0.78 inches; Evap. ----.
Noted #1250 ♀ by weather instruments. In walking through El Chato area in a straight line only to south side where trail turns off to Zone 5, I counted 13 tortoises visible just as I moved along without any searching. This indicates that they are moving back into the open areas here also and becoming more concentrated in distribution as have already notes at Caseta, Caseta pond #1, and Caseta upper ponds area.
Caseta Weather - 1900 hours - Rainfall 0.0 mm; Evap. 2.0 (reading 25.2); Max 75.0; Min 66.0; cloudy all day long - occasional very fine mist from 1000 to almost 1800.
26 June 1970.
Stayed around Caseta all day doing odd jobs and recovering from staying

Pg. 51.
. . . . up till 2 a.m. last night finishing *The Grapes of Wrath*.
Caseta Weather - 1900 hours - cloudy, very windy and cool all day long; Rainfall 0.2 mm; Evap 1.8 (reading 27.0) Max 74.5; Min 65.0 ° F.
Saw #'s 246 ♀, 1006 ♀, 529 ♀, 598 ♀, and 423 ♀ around the Caseta most of the day.
27 June 1970 -

Around Caseta all day making, arranging, and testing thermocouples. Saw all same animals around the Caseta today as yesterday except for #529 who has disappeared to east somewhere.
Saw #246 ♀ aggress #1006 ♀ twice today and #423 ♀ once. In all cases #246 ♀ quickly "won" the encounter and the other tortoises rapidly moved away ending the sequence. Nothing particular different or notable as compared to previously observed aggressions. In two aggressions #246 simply rammed into other tortoise harshly (once at front end of #423; once at rear of #1006) causing other animal to move away with head drawn in - never offered any resistance or display to #246. In other aggression #246 approached front end of #1006 and immediately started raising head up a bit

Pg. 52.
. . . and lunging toward #1006. The latter animal never offered any resistance or display. She was eating grass when #246 approached and with first lunge drew in head and started to turn and leave - #246 open mouth wide on first lunge and started following #1006 as she turned Then #1006 moved away and encounter was over. In all 3 encounters #246 moved to other ♀♀ from about 50 plus feet away; the animal attacked in each case was simply grazing and did not take any note of #246 till actually attacked. After each encounter both animals started grazing again after moving apart only a few feet - no real pursuit.
Caseta Weather - 1900 hours - cool and cloudy all day - no garua during daylight hours; Max 74.5; Min 62.0; Evap 1.8 (reading 28.8 now) refilled full at 1900; Rainfall 0.9 mm.
28 June 1970 - To La Fe to sample and Zone 3 NA to implant thermocouples in nest 1 and perhaps others.
At Caseta area and my first part of Reg. 1 -
#'s 598, 1006, 246, and 423.
Reg. 1 (cont.?)-
Just 30 m above pond near trail -
#408 ♂ - CL 86.4; CW 94.8; no lichens; dried black -green algae on rear of carapace; w.g.i.'s nonexistent; actively moving.
#827 ♀ - CL 85.2; CW 92.6. No lichens or algae; w.g.i.'s present and visible but extremely thin. Rear marginals notably turn up and flared. Sitting still.
#1013 ♀ - just on east side of pond - by trail ; sitting still.
#933 ♀ (painted #12) - same area as previous - sitting -about 15 m east of there - sitting in a dirt wallow, sleeping.
#695 ♂ - sitting in a dirt wallow - just beside trail - SE corner of pond - quite near #933; sleeping; CL 91.1; CW 93.4. w.g.i.'s nonexistent; no lichens; dried black -green algae on rear ¼ of carapace.
#421 ♂ - off to right of trail, s. side of pond - moving along.
#1022 ♂ - same location as 421 ♂, eating herbs.
**#475 ♀ (same area as above 2) - but not in sample because did not see from trail; only after leaving it to check 2 above ones.

Pg. 54.
Reg. 2 -

#1245, little fellow - about 200 m below pond under a manzanillo grove, moving along drainage, up toward pond #1.
#217 ♀ -[Marginal note: could be a ♂] about 75 m further south than previous animal; moving along upward in forest. CL 105.9; CW 117.7; no lichens; dried black-green algae on rear of carapace; spots of minor f.d. scattered all over carapace on its lower ½; scutes smooth only in very centers yet very large; but must be a ♀ - tail very short and of ♀ shape.??? Bit of superficial red soil on rear feet and skin around tail and legs - could thus have been in lower nesting area recently; but not much soil as could be old - very ground into skin.
#60 ♀ - CL 79.2; CW 84.7. Very small for such a low #; could be 460 because 400 scutes has a very slight mark in it; but 20 and 40 scutes are clearly marked and probably must be that is really just #60. At very lowest part of Reg. 2 in open, sleeping and basking. No lichens or algae; scutes smooth in central 1/20-1/5th ; w.g.i.'s non existent; no f.d.

Pg. 55.
Region 3 -
#62 - CL 70.9; CW 78.2. In steep ascent, rocky part of Reg. 3 - about midway in Region - still large trees of guayavillo forest along trail - about ¾ - 1 km at least above where saw on 21 June 1970 - still moving upwards along drainage - Altitude here about 375 feet plus or minus (Thommens). No lichens or algae; w.g.i.'s visible but very thin and incomplete.
#119 ♀ - still moving downward - about 75 meters distance below #62 - on trail - thus just below mid Region 3 - about ½ -3/4 km below where last seen on afternoon of June 21, 1970. when it was obvious (from 2 sightings that day) that she was moving downward along drainage.
#754 ♀ (marked, i.e. painted # 9), paint very faint but discernable. In lower part of Reg. 3 - about 325 feet altitude - moving up the trail just to east of drainage. CL 85.2; CW 94.7. No lichens or algae; w.g.i.'s very incomplete and where visible very , very thin. Faintly reddish brown mud on rear of carapace rubbed into scutes and skin. Not extremely recent that (past few days, i.e.) that was in this mud or soil. Not as red as La Fe or Zone 3 NA mud. Re-painted.

Pg. 56.
Reg. 4 - Weather - 1230 hours - Rain 3.3. mm; Evap. 21.2 ml. (refilled full); Max 79.0 ° F; Min 62 °F.
Through Reg. 4 - straight line sample -
#908 ♀ - 20 m south of big flat lava rocks area ; CL 79.3; CW 87.3. no lichens or algae; w.g.i.'s visible, but very, very thin and incomplete. Sitting, inactive in a loose dry soil burrow.
#713 ♀ - just slightly east of large flat rocks; also in a flat soil burrow, inactive. CL 93.3; CW 98.6. No lichens or algae; w.g.i.'s clear but rather thin.
#1058 ♀ - CL 81.9; CW 86.7; no lichen or algae. W.g.i.'s incomplete and when visible barely so and extremely thin.
#1192 ♀ - CL 81.8; CW 85.7; no lichens or algae, w.g.i.'s visible but very thin. Just noticed has II mark on 5th vertebral scutes (from B. Reeder and I last August!)

[Marginal note: both just west of flat rocks; together, sitting and prob. Previous aggression].
#890 ♂ - at flat rocks in open, sleeping. CL 136; CW 150.4; no clear lichens or algae; w.g.i.'s present and moderately well - developed but thin.
Reg. 4/5 border - just below large rocks area in Reg. 4
#1257 - sitting in loose soil burrow, sleeping.
#351 ♀ - (painted #14) - almost exactly where I saw here on June 21, 1970 - sitting, inactive, sleeping.

Pg. 57.
CL 79.6; CW 88.5; no lichens or algae; w.g.i.'s nonexistent; re-painted because marks badly chipping and becoming faint.
**#1073 ♀ - measurements taken on 21 June 1970. no lichens or algae; w.g.i.'s extremely thin and incomplete; no smooth scutes or f.d.; At flat rock area, sleeping in loose, dry soil burrow; I failed to record here just a minute ago when passed through (i.e. forgot to record her).
#1194 ♂ - CL 67.5; CW 70.2; also sleeping in a loose, dry soil depression at flat rock area; also forgot to record her a minute ago. No lichens or algae; w.g.i.'s incomplete and extremely thin where visible.
Reg. 5.
New #1363 CL 50.8; CW 53.3; ♀ probably, but rather small to sex. No lichens or algae; no smooth scutes, no f.d.; w.g.i.'s very clear, well developed and moderately thick. Only very faint, almost imperceptible plastral concavity. Resting, sleeping - upper -middle part of Reg. 5. **Note: intend to be #1264 but mis-marked, so changed to 1363.**
#1157 - lower middle of the region - moving north toward Region 5, 15 m east of the trail. CL 59.9; CW 65.6. No lichens, algae, or f.d; w.g.i.'s clear and well developed but rather thin. No smooth scutes.

Pg. 58.
Has 12 marginal scutes on each side! Otherwise scutes all appear normal.
#420 ♀ - CL 79.7; CW 89.3; moving along northward, only 50 m distance above big boulders area on Reg. 5/6 border - no lichens or algae; no f.d.; scutes smooth only in very centers w.g.i.'s clear but extremely thin.
Reg. 6 -
#3 ♀ - CL 97.6; CW 104.2. Eureka! About midway in Reg. 6 moving northward. No lichen or algae; w.g.i.'s clearly visible but incomplete and extremely thin . Does not have any fresh red soil on her body, but dies have some of the medium brown colored variety on her rear legs., tail and surround skin and the rear of her carapace on the lowest part (i.e. marginal scutes). So could have nested during the past week in the area around or some area like the site of nest #13 from 1969/70.
Then just 50 m below where saw #3, found a very small hatchling from 1969/70; was moving along on a flat lava bed area. The surrounding area is covered with lots of herbaceous vegetation but it is

Pg. 59.

. . . . . all dry. WE could not see even a green seedling in the area of about 1500=2000 square feet which we could easily survey around the little animal. This was about 1600 hours and the afternoon as all day, was cool and cloudy but without any garua at all. A very interesting aspect of this animal is that he looks as if he is starving rather severely. This is of note due to the extremely dry condition of the vegetation all around this area and all through these nesting zone altitudes. He is probably in bad condition mostly from the lack of food; but some of these symptoms could be due to recent lack of sunlight (has been cloudy continuously for 10 -14 days) and thus vitamin D problems and even more important lack of water up till about 7-10 days ago when the garua finally really began. The starvation symptoms are the following:
1. legs are very thin - little meat on them, mostly and literally just bone, a bit of muscle and shriveled, wrinkled skin.
2. entire shell, carapace and plastron, are very soft and easily compressed with only light pressure between thumb and forefinger.
3. Most of plastral scutes and especially abdominals are papery thin and can be compressed in and out to bone beneath very easily with light forefinger pressure. They "pop" in and out somewhat like the end of a tin can. Seems that there is an air

Pg. 60.
. . . . space between the scutes and the bone beneath; they are also slightly discolored, being a charcoal gray rather than the normal black of a young animal. Absolutely nothing under the scutes but bone it seems and this airspace.
4. Has no white growth increments visible anywhere on body between any scutes of the plastron or carapace - whereas those hatchlings in good health oat CDRS do have such w.g.i.'s.
He is active but seems a bit more sluggish than most new hatchlings which are just frantic to get away from an observer they can see.
Measurements: SL 78.0 mm; SW 72.0 mm; H 38.8 mm; CL 93.5 mm; CW 108.0 mm. Measurement are larger than most Santa Cruz hatchlings just out of the nest so likely that he at least grew for awhile after escaping from nest. Not surprising since he probably left nest in mid February - early March period before the vegetation was completely

Pg. 61.
. . . dried up. The herbs were drying rapidly by mid March but did not really become extremely brown and dead in total till mid - late April - then drying continued all through may and the first half of June. So he probably was able to find some scattered green herbs for food and H20 till at least the early days to middle of April. Starvation has probably been for the past 2 months most sever.
Of course he could have possibly hardly grown at all up to now and simply have come from an excessively large egg - this possibility can not really be evaluated.
Another interesting aspect of locating him is that it makes it almost certain that there are nests laid in the same general area where he was found. It is extremely unlikely that a tortoise this small could have traveled very far upwards in altitude and I consider it very unlikely that he is from the Zone 3 NA as even the area around nest #13 (1969/70) below where he was found. The area where he was found is about ½ -3/4 km above (distance)

the Zone 3 NA and at an altitude of about 210 feet (as compared to 180 feet at Zone 3 NA).

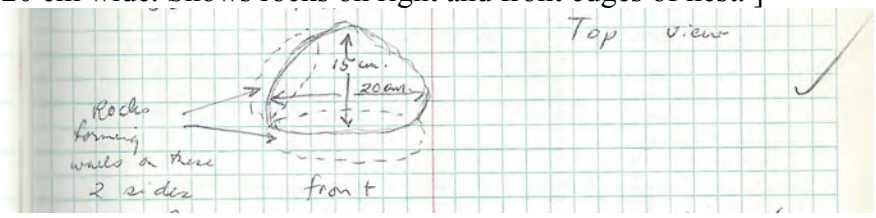
Pg. 62.
I marked the little guy with a small white painted #10 on his 4th vertebral scute in hopes of finding and identifying him again. I have not decided yet, but may release this fellow in the Zone 3 NA region because are at least few scattered new seedlings just now coming up since garua began - densities of 10-20 little seedling herbs for every 5-10 square feet in some rocky lava areas surrounding the red soiled nesting sites proper (not much in nesting sites themselves but bare soil and surface rocks.
29 June 1970.
Arose at 0700 but raining rather briskly. Can't do much till it stops because no point in getting only clothes we have with us soaked.
0930 - weather instrument check - Mad 81.5 ° F; Min 62 ° F; Rainfall 5.0 mm, emptied at this time; (2.9 since yesterday at 1700 when noted was 2.1 in tube); Evap 24.8 ml (Refilled full at this time). Cool and cloudy all day yesterday; no garua at all but no sun.

Pg. 63.
I decided to release the little one marked (painted #10) in the Zone 3 NA. Did so up on some flat rocks on edge of red soil covered nesting area where nest #3,6 7, 9 etc. were in 1969/70 nesting season. Released near some small little herb seedlings which are growing at about same height as the tiny animal's head. The tortoise hatchling proceeded immediately to there with no looking about at all and began frantically eating them. I released the animal only 10 cm from the plants this time. After about 15 minutes retrieved #10 and presented some H20 in a small pocket in the lava. However, the animal was so wary and watching me so intently by now because of this handling that he finally moved off rapidly obviously in response to my presence. So I retreated some out of his sight and left him alone. Returned in about 5 minutes and saw him moving along in same area on top of some flat lava racks - proceeded with a bee line movement to some small herb seedlings of same species as those eaten about ½ hour previously and began munching on these. After about 5 minutes and having eaten many of the leaves of these, he continued on in NW direction away from nesting area and our camp and over lava blacks and boulders.
It is notable that almost every small tortoise I have found (circa 6.5 to

Pg. 64.
. . . 20 cm curved length; i.e. hatchling to 3 or 4 years of age would estimate) has been in semi-open on fairly sparsely (vegetation) covered lava flocks, plates, or boulders. They seem to avoid soil covered areas in depressions in the lava and surrounding lava piles. Also they avoid lava piles which have dense, viny vegetation. Two reasons for the first case: 1. need well sheltered hiding places - i.e. rocks and crevices, so avoid open flat soil covered areas ; 2. soil covered areas often have a thick tangle of viny herbs which are very difficult for small tortoise to move with and through. In case of avoidance of viny vegetated lava piles I think the second reason above applies. I have watched animals of these sizes try to move through dense viny herbs and they have a terribly agonizing slow-going time at it.

Zone 3 NA - expanded sample -
Northwest loop -
#918 ♀ ? (♀ maybe but too small to sex) - CL 58.8; CW 63.1; no lichens or algae; no w.g.i.'s visible at all. Moving around on pile

Pg. 65.
. . . . of lava rocks and drinking collected garúa water from small pockets about 15 m east of trail in area near nest #1 from 1969/70. Same area where have seen often before - seems to be NE limit of its home range.
Found a nest from 1969/70 in brown soil area (like 1969/70 Nest #1) just 20 m NE of nest #1, 1969/70. Had a small opening in it about size of 1 hatchling - also a larger 30 x 30 cm lava block had fallen from a nearby pile onto the top of the nest.
Nest dimensions. Very small and dug down in amongst many rocks in this crumbly type of soil - must have been a real exercise to do so -
[Diagram drawn from top view showing distance of 15 cm from rear to front of nest and 20 cm wide. Shows rocks on right and front edges of nest.]



About 24 cm deep in deepest part. Very little room for eggs, which must have been in at least 2 layers wedge down into the cavity. About a 2 cm undercut -overhang all the way around 2 sides and rear of the nest. Rocks (small ones, ¼ fist - size) embedded all over the bottom of the nest.

Pg. 66.
Considering the 2 bit lava rocks which occupied all of the front wall of the nest and the one side wall of it from about 10 cm down below the surface to the nest bottom and beyond, must have been a real digging exercise.
Appears to have had 8 to 10 eggs but not exactly sure- Definitely 3 which hatched and were trapped and couldn't escape - decomposing carcasses inside. Definitely 1 and perhaps 2 eggs which didn't hatch and were full of live active maggots when open nest now. Definitely 4 and maybe 5 eggs which hatched and young escaped from nest - egg shells present and clean. Three which were trapped looks as if had been trying to get out by digging to surface, because were only about 5 cm down and were under the rock on top of nest - why hey did not use hole which opened to side of this rock am not sure- when I discovered nest this morning this

Pg. 67.
. . . . escape route was largely filled in with soil so perhaps young left in 2 groups (tried to leave that is) and first hole was filled in behind the 4 or 5 escapees leaving these 3 to fend for themselves- anyway did not get out.
The nest was not found by me or park warden this year - thus unprotected but pigs or rats did not get into it. Should be nest #18 for the year - 5 destroyed by pigs in this area and 7 likewise destroyed below Cerrito were not numbered.

Most must have been full of eggs to within 10 cm of surface judging from its small size and estimated # of eggs. No real hard cap to nest and no tortoise turds in that part of the nest. I would guess lack of a hard cap is due to 1. aging and drying for long time, 2 hard cap was not as durable in this loose, dry crumbly soil (which lacks clay) as in red soil even when fresh.
Continuing sample -
#1020 - CL 56.7; CW 61.7; ♀ maybe, but too small to sex accurately. No lichens or algae; w.g.i.'s visible but extremely, extremely thin. In same area

Pg. 68.
. . . . as #918, moving along.
#130 ♀ - back at small pond are just NW of camp and 1969/70 nests 3, 6, 7, 9 etc. area - where she has been seen several times before. CL 96.8; CW 108.2. Black-green algae along scute junctures all over carapace. No lichens; re-marked 100 mark because getting faint. Does not have any fresh mud or soil of red pampa colorada type on underside anywhere; so has no laid nest in that area yet. However, does have deep chocolate brown soil on all 4 feet and legs, on plastron, on tail and skin around tail and leg pockets - thus perhaps laid up here but can't say for sure - mud on her could simply be from burrowing and wallowing given its dispersion. Will be interesting to see if she lays here. Marked here with paint as #17 for future easy identification.
#245 ♀ - same area - just slightly west of pond area; CL 79.3; CW 87.4; no lichens or algae; w.g.i.'s incomplete and almost invisible where visible extremely, extremely thin. Scutes smooth only in very central parts - very small smooth places. Re-marked because all cuts getting faint;

Pg. 69.
. . . but still readable; another of same # but called ♂ up near Reg. 4 last year - duplicate?
Central area:
New 1264 ♀ maybe but too small to sex. CL 58.5; CW 61.8. No lichens or algae; scutes smooth only in very tiny central portions; no f.d.; w.g.i.'s clear but very thin - extremely thin in fact. I n main area near nest #2 from 1969/70 - i.e. southern edge of nesting areas central zone Has 12 marginals on left side, 11 on right; otherwise no abnormalities of laminae.
#3 ♀ - from yesterday! Really moving ! - "Discovered her at 1415 hours moving in very central brushy part of central nesting zone - moving in a southern direction - [Marginal note: no dried red mud on her anywhere to indicate likely previous nesting in red-soil area.]Very interesting that has moved about ½ -3/4 of a km since saw at 1600 hours yesterday. Well north of here- delicious to think that has moved all way to the NA from near Caseta - quite remarkable orientation, even if it is only based on landmarks. Do not think she entered nesting are by way of our campsite and trail where lots of nest were last year, but by a path just to east of here where we have seen several animals leaving and entering the central nesting zone [Marginal note: about 30 m east]. Will be very interesting now to see if she nest here tonight or soon and then returns to Caseta area. Clearly has

Pg. 70.

. . . . migrated to this area from above. Marked here on front and 2 sides with paint as #18 (did not mark on rear for photographic purposes).
Note: While on North-western loop of sample about 1130 - 1230 though I heard an animal thudding along just to east of me - could well have been '#3 ♀ entering nesting area by route suggested above.
Eastern - southern loop of sample:
#1171 ♂ maybe, but really too small to sex; CL 61.3; CW 64.5. In open area up on rocks, just SE of nest #12, 4, 15, etc. from 1969/70 season. No lichens or algae. W.g.i.'s incomplete and extremely thin where visible; moving along in an area near some fallen cactus. Has 12 marginals on right and 11 on left.
#787 very large. At the cactus near #1171; eating semi-dry fallen pads; when I approached here she was moving toward the open red-soil nesting area (main central part) from the south-east, stopped enroute to look over the cactus. CL 89.9; CW 103.5. Very old worn shell, scutes completely smooth and with large separations or

Pg. 71.
rather very wide area at their junctures. No lichens, but black -green algae is abundant all along and in scutes junctures as on #130 ♀ (see above). Can not really see to determine if w.g.i.'s present because of thick dried mud and algae between scutes - scraping with knife does not help much on this animal. F.d. only present in several spots, but these are deep, severed patches- 2 on 1st vertebral near junction with marginals; scattered spots on marginals and 5th vertebral and last costal on each side where all these scutes come together on lower rear of carapace. Painted her #19 for future identification; but only on side and front, for photographic reasons = i.e. hope she lays here tonight or soon.
Only soil she has on her is chocolate brown variety with slight reddish tinge to it - but has all over on underside - fore and rear areas - thus hard to say if has nested - if so, not extremely recently because mud worn into skin well- no really loose stuff.
2 other tortoises seen - failed to record before because was raining and recorded on scratch paper.
#214 ♂ - medium-large size - in central nesting area at large flat rocks this morning at 0800, drinking collected garua water in pockets in lava. [Marginal note: Is from mora area originally above Caseta!]
#1248 - on northwest loop, just north of nest #1 from 1969/70

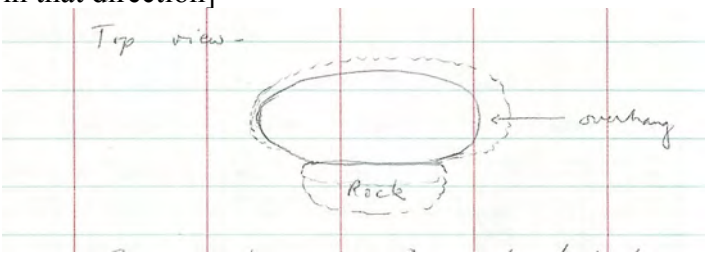
Pg. 72.
#3 ♀ burrowed into a loose soil depression for night at 1530; re-checked here at 1730 - still in same position.
#787 ♀ burrowed in at 1600 in a similar location; re-checked at 1730 - still in same position.
#130 ♀ - checked for at 1700 where had seen at 1300 but could not locate - has moved elsewhere.

Found another nest #19, from 1969/70. Was right beside nest #1 1969/70 and in fact so close that covered wall of #1 was built partly on top of and it was completely shaded all

through nesting season. Therefore it was laid sometime prior to nest #1; the soil type lack of a true hard cap, etc. are as described for nest #18, see above notes.
This shading had dire results - of 17 eggs in nest (minimum #, could have been 2-3 more but can not tell for sure - doubt it , 17 seems correct), 3 were infertile (or died at such an early stage I can not detect embryo),
1 stopped developing in 1st incubation cycle.
3 stopped developing in 2nd incubation cycle.
5 stopped developing in 3rd incubation cycle.
2 were unknown, but decomposed and with

Pg. 73.
. . . . maggot pupae inside (certainly 1st incubation cycle or before when stopped developing because no scutes or bones in shells), and 3 hatched (if there were 2-3 more in nest, they also hatched.). It looks as if only 1 and perhaps 2 animals escaped. The 3rd hatchling was inside and just died very recent as the body is whole and with almost no decomposition yet except internally and only a very faint odor. It is certainly jus beginning to rot and is only a couple of days since death at most. The animal is very soft-shelled and thin around legs and skin is wrinkled. Obviously starved to death because could not escape; was trapped partly underneath a small rock in the side of the wall of the nest and had a large caved in place in this area where was pushed up against the rock. Concavity is fairly deep and severe and on left rear ¼ of carapace.
I am rather sure that the interrupted development of most of these animals was due to the shading and it's slowed down incubation rate. The 3 which definitely hatched were from eggs at the top of the nest. I did not carefully measure the nest

Pg. 74.
. . . but it was very large - flask - shaped with a large (5 to 15 cm) overhang - undercut, the extent of this overhang depending on the location chosen - i.e. it varied. The nest was more or less oval in shape with its front wall rather flattened because of a large lava rock in this wall.
[Diagram of top view of nest - shows oval nest perhaps twice as wide as long with overhangs on back and left sides and rock against front wall constraining nest dimensions in that direction]



The nest was jammed full of eggs, about 11 in the lowest layer and 6 on top of these. The interstices between eggs was full of loose dry soil. The nest cavity, including overhang, measured about 45 cm x 30 cm and was about 35-40 cm deep at the deepest part. Note that this nest was not discovered by the wardens, even when finding and discovering nest #1, yet the nest are only 1.5 m apart. No pig disturbance at all.

Pg. 75.

Opened up the small recently dead one found in the nest - yolk sac essentially totally gone - thus used all food in it and probably then starved to death. [Marginal note: note yolk sac and starvation.] Since nest almost certainly hatched by early to mid - Feb. means that had been alive in ground for 4.5 - 5 months - i.e. extremely long time before finally starved to death - incredible!!
Also, late this p.m. checked area where I though #3 ♀ entered nesting area and found a clear fresh trail made in soil and through brush along the path I suspected - thus am sure she entered here - trail is right size for her. This entry did not take her past the main big red soil area (1969/70 nests 3, 6, 7, 9,14, 17 , etc.) of the central nesting zone - but she has other red soil areas of the central NA still near here and of course could reverse here route and return to the big area which is only about 60 m northwest of her present location.
Finally fund a small raised plane with red soil patches all over it (perhaps room for 6 or 8-10 non-over-lapping nest?) just 100-125 m to SE of main Zone 3 NA - did not know if it before. Found a corral and nest within it definitely from this past year - 3 eggs inside dried up (perhaps infertile?) and marked nest #8 - thus nest 8 is this one and the one Chappy and Villa said was #8 was another un numbered nest - should be renumbered #20. Nest 8 had at least 5 bad eggs - 3 mentioned above and 2 with fresh maggots in them - others must have hatched and young escaped. [Marginal note: will check this area for nest rest of year]

Pg. 76.
30 June 1970 -
Continuing sample to La Fe. -
Reg. 7 - straight line sample
#918 - just above central camping and nesting area.
#214 ♂ - main area - on flat rocks drinking H20 at 0630 hours w.g.i.'s extremely thin. CL 109.3; CW 122.8; scattered f.d. on sides; no lichens or algae.
#3 ♀ - flat rock area l- moving about a bit at 0630.[Marginal note: can't count as part of this sample]
#1217 - CL 61.6; CW 65.4. In thick Croton, Pisonia, Piscidia, and Bursera forest, only 150 m south of main zone 3 NA; central area in other words. Moving along toward NA, but about 5 m off of trail to west. No lichens or algae, and w.g.i.'s non-existent.
Just 20 m more down trail found 3 more animals - in an area of flat lava blocks embedded deeply in soil - little pits in rocks and in soil between them where water collects. Lots of sign of tortoises drinking and stomping around here recently. Since garua last night and early this a.m. probably accounts for 3 animals being concentrated in this otherwise dry, foodless area.
#422 ♂ - very large (could be 522, but 100 mark unclear and badly worn and chipped in that area - can not really say, but probably 422). CL 138.8; CW 147.8.

Pg. 77.
No lichens, but black-green algae all over front marginals area and scattered on rear ¼ of carapace and front marginals - especially bad on marginals and close to them; scattered spots of it elsewhere; w.g.i.'s present and moderately thick! Scutes entirely worn and smooth.

#269 ♀ - CL 102.7; CW 113.0. Also entirely smooth scutes, very worn and old; carapace with deep, wide grooves between scutes as previously described for such ♀♀ as #130, 131, 127, 3. Small bits of f.d. on rear marginals, supracaudal and last vertebral; no lichens; some of black green algae on rear of carapace, especially along scute junctures. W.g.i.'s non-existent. No red soil on her at all. In fact no mud anywhere; rear feet, legs, tail and surrounding skin and rear of plastron have some light to medium brown soil worn into skin and scute cracks deeply - but no sign of having dug in wet soil or cloacal fluid mud. [Marginal note: Has interesting deformities - 12 marginals on each side; also 4 normal costals on each side but 7 vertebral scutes; First 3 more or less normal (3rd misshapen) 5th also slightly mis-shaped like 3rd but 4th is in 3 wedge shaped pieces crammed in between 3rd and 5th - all small and very abnormal]
#1265 ♀, maybe, but too small to sex accurately; CL 53.7; CW 56.7. About 30 m down trail from above 3 animals - off to right about 5 m, sleeping - still dense Croton sapling covered area - very rocky. Could be heading to or have just left the above mentioned watering spot. No lichens, algae, f.d. or smooth scutes; w.g.i.'s very, very thin and incomplete.

Pg. 78.
#1010; CL 62.1; CW 65.6. ♀ probably; no lichens, algae, f.d. or smooth scutes; w.g.i.'s mostly non-existent and where visible extremely thin. Not far down trail from last animal - about 50 m. Up on a red soil covered area which could be a potential nesting site. This red-soil area is up on a planar area just beside the first low depression of an area with a lot of light brown, slightly yellowish soil. This latter area is about 100 m north of the location of Nest #5 1969/70 and this area had at least one nest in it last year which pigs destroyed. I searched all over the depression and adjacent areas to its east and west. On the west side is the red soil area, to the east is another higher plane with lots of dark brown soil in small pockets wedged in amongst plates of lava and also some open red soil patches. Note that in one of these pockets of dark brown soil last year there was a nest laid and destroyed by pigs (I have notes on this from last November- in volume 4 I think). There was a trail of a large ♀ tortoise running though both the

Pg. 79.
. . . . higher red-soil covered area to the west and down through the depression with yellowish-brown soil. The trail is very fresh through these areas and it obviously was made last night. The ♀ obviously was wandering from one patch of soil to another over the intervening rocks and dry herb covered areas. She first wandered through the depression and tried digging at 3 different soil spots. All of these diggings were shallow, reaching only 8-10 cm depth before they were abandoned (because of rocks and loose dry soil falling back into the holes apparently). The she wandered through the are with red soil spots, apparently inspecting them, but proceeded northwards out of the area without digging at all. I lost here trail at this point. It could have been #269 ♀ (see above) which was seen just a short distance north of here but I can not say for sure. There was only an extremely light misty garua last night and the female which dug and wandered through these areas used no cloacal fluid so she should not have any mud or here; therefore I can not really definitely determined that #269 did or did not perform this digging. She is a good bet though given her location, the general direction of the trail where I lost it and

her proximity. It is now 0800 and the digging probably occurred between 1500 and 1800 last night - she could well thus be responsible for this given the general hours of activity of the tortoises and

Pg. 80.
. . . . the distance usually moved during these hours of the day during this season.
It is interesting that this ♀, whoever she was, preferentially dug or was able to dig in the yellowish-brown soil of the depression rather than in the red-soil covered area which are raised up higher in elevation just beside the depression; more on this after I inspect areas just south of here.
No signs of digging in red soil patches and dark brown soil packets to east of these areas a short ways (see above for location description). Abundant goat sign , i.e. fresh droppings and scratchings in virtually all red soil patches and many other types of soil patches also - this sign is all over all these areas. A bit of pig droppings here and there also in the same areas - mostly 2-3 months old.
Continued on to depression where nest #5 1969/70 was located; this area is also one with fairly deep, fine, dry, powdery almost, yellowish-brown soil. Searched it thoroughly but no sign of any tortoise digging or other activity.

Pg. 81.
Slightly further south from last area are some very large pampas coloradas. Occupying about 1-3 hectares along both sides of the trail which passes through them. I also found by wandering a bit more extensively to the east than usual, that there ware more of these pampas coloradas than I formerly knew about. Went about 100 -125 m to the east and in doing so crossed 3 more of these areas to the east of the ones along the trail. Each was about 1-2 acres in size and separated by raised areas of solid lava - mostly blocks and piles of stones. The area are exactly of the same structure and vegetation type as those along Reg. 7 of the trail nearby and very similar to the central Zone 3 NA. In all respects except the depth of the soil (see below).
In searching thoroughly all through these areas of the east and the areas along the trail I usually search, saw no tortoise diggings except for one shallow 8 cm pit dug fairly recently (past weeks sometime) in the red soil patch in the furthest east areas (i.e. 125 m east of trail). Saw plenty of sign of tortoises through the area, most of it from the past dry season - there were dry turds varying all the way from mostly

Pg. 82.
Decomposed and separated to quite dried - out compact little packets scattered all overall these pampas coloradas. Very little fresh sign - a few fresh turds varying from present up to 1-2 weeks old and some few wallowing pits from past 10-12 days of garua. All in all it appears as if in the whole area there have been 3-5 animals probably most of the time through the hot season up to and including the present (see below).
The further east I went the more obvious it became that there might be these red soil areas scattered in small 1-3 acre sized pampas and separated by slightly more highly elevated rocky areas all over the island or the southern southeastern and west - southwestern sides at these altitudes. They are certainly common here and probably occur all over the island here and there at these altitudes.

Also scattered all through these altitudes (150-175 feet) and as I

Pg. 83.
Have seen before and noted scattered all the way to the coast are small depressions of about 100 sq feet up to 2500 square feet in area and filled mostly with the yellowish-brown soil described above. These areas are far less common and occupy much less total surface area than the pampas coloradas. In this general area I examined 2 of them and found 2 very fresh (past week or so) attempted nest holes in one depression of about 800 square feet surface areas. Both had been abandoned when only 10-15 cm deep despite fact that did not have many rocks in them at all. Perhaps the looseness of the soil is a problem. Anyway, no cloacal fluid had been released in either digging and I know females will lay in these areas because nest 5 from 1969/70 was in one and 3 other nest destroyed by pigs were laid in these areas last year (in fact 2 of them were in this precisely same depression where the 2 diggings were found today).
I have discussed these red soil areas previously (see Volumes 4 and 6) concerning the puzzling fact that at least superficially they resemble the Zone 3 NA very much and yet I found no nest here in any of them

Pg. 84.
. . . . in 169/70 and no real good evidence of previous nest except in a very few sites (i.e. one old lava corral around one nest of several yeas ago build by M. Castro; also a few sites with egg shell and old holes).
Anyway they present a huge total surface area of red pampa soil but nests are very, very few and far between, - exactly the opposite of the Zone 3 NA where there are plenty of nests in a relatively small central area.
The answer is definitely that the vast majority of potential site in the red pampas here are the same as at La Fe - surface rocks and lava plates are right below the soil only 1 to a few cm down. Most of the area is simply impossible to dig a successful nest hole in. This seems primarily due to the simple fact that these areas are more raised than the central Zone 3 NA and have some small surrounding depressions and lava slopes which

Pg. 85.
Allow run-off and washing away of the soil. They simply do not collect and hold the red soil here or over most of the La Fe pampa colorada as does the more depressed areas at Zone 3. The problem here is added to certainly by the goats which are abundant all over the area all year round (La Fe also in this regard) - they keep the red soil patches constantly scraped clear of even the tiniest herbs and scratch and leave dropping on every available soil patch very frequently. This certainly adds to the run -off caused loss of soil, especially when rains are severe and strong. The goats are just as abundant in the Zone 3 NA and do the same scratching (even jumping corral walls often to scratch on top of tortoise nest) but the lack of run-off drainage and the more abundant soil here prevents the same problems.
Finally, I should say that some nest are certainly laid here and at La Fe - there is plenty of evidence for this:
1. old corrals in both areas from nest found in previous years by M. Castro
2. small tortoises - 10-30 cm curved length found in both areas.

Pg. 86.
3. some few old nests found in both areas by me - holes and egg shells.
4. uncompleted test diggings found in both areas by me.
The point is that per unit of surface area of exposed soil and soil covered with only herbs and otherwise un-shaded (i.e. by trees or herbs) the Zone 3 NA (and certainly others like it) has many more nest successfully laid than in La Fe or the areas discussed above because these latter areas are in relativity too rocky and mostly offer unsuitable sites.
I was previously worried that goats scratching the surface would obscure nest already laid and thus confuse the issues discussed above, but have discovered this is not a problem - 1. in Zone 3 NA they scratched on top of nests already laid and although it changed the surface appearance somewhat one could still easily detect a nest that was even 4-7 months old, and probably older, although I can't say yet? This was

Pg. 87.
true also of nest without corrals around them ! 2. once the young escape from a nest one can detect a nest site from the escape hole and or egg shell fragments on the surface even if goats have scratched the surface of the nest badly. Concerning this latter point, I was able to detect 2 nests yesterday (#'s 19 and 19, 1969/70) in Zone 3 which had been badly scratched up and shat upon by goats by noticing the escape holes and have been able to do the same for other known nests even after goats have badly scratched the surface.
This adds to my observations of no. (number) 1969/70 nests in the red soil areas at which I am presently and over most of La Fe where I have been able to find no escapes holes or egg shell fragments to suggest previously missed nests.
The La Fe situation is further complicated by the fat that many tortoises there were removed in the 1930's according to Anders Rambeck - this could also add to the fact that few nest are found there now; the ♀♀ could largely have simply been carried off that used to lay there.
Additional evidence for these views concerning these red soil areas in lower Region 7 is that ♀♀ do did close by to these areas but most nest and "test" holes are in the yellowish-

Pg. 88.
brown soil patches in the nearby depressions which are lower than the red pampas; these areas, discussed above hold more and have deeper soil. They have less clay in their soil and are more difficult to dig in and to make a hard cap with, but they still seem to be preferred by the tortoises here. In contract in the Zone 3 NA central area where both types of soil are available, the ♀♀ definitely prefer the red pampa type when it is as deep as the other types - medium brown, dark brown, and yellowish-brown varieties. These latter kinds present a problem when dry also because they are finer, more crumbly, and looser than the red pampa type - this makes digging the hole per se much more difficult because of caving in problems.
In the red pampa areas to the east here I found 2 animals:
#31 ♂; CL 127.9; CW 138.0. Not in straight line sample - In furthest east red pampa area at an area of small water collection

Pg. 89.

pockets in flat lava rocks - drinking.
Has one of common types of lichens - 1 patch on each of last costals where these scutes join with 4th vertebral along their upper borders. Black-green algae thick on rear of carapace around lower part of 4th vertebral, upper half of 5th vertebral and all over last costal scutes; also all over front marginals area. W.g.i.'s are mostly nonexistent; where visible are extremely thin. Red soil and mud well ground into skin and scutes all around lower parts l- carapace, plastron, legs, tail - thus appears as if has been here for some time and occasionally wallowing - amazingly long migration considering was at Caseta from at least October 1969 to end of January 1970.
New #1266 - too small to sex. CL 39.1; CW 41.4; Very close to #31 ♂ - 25 m east of him in another red soil area. No lichens, algae, f.d. or smooth scutes; 8 clear growth rings - tried counting 5 of dorsal scutes - got 8, 4 times and 7 once - however exactly what this means is not clear. So small that perhaps is good evidence of nest in this area. Drinking H20 from hole in a rock when I found him. No visible w.g.i.'s at all.

Pg. 90.
Back to sample -
Region 8 - heavily Croton sapling covered area - no tortoises seen and very little sign - very scattered old turds from dry season. A real contrast to Reg. 7 where saw 7 animals this morning and lots of dry turds and old trails from past 5 hot months - indicating a scattering of animals through that area all through dry months (same as during garua season in large part). Region 8/9 border - just where Croton cover largely diminishes and first of real tree cactus forest begins - altitude about 115-120 feet.
#312 ♂ - CL 127.8; CW 139.4; eating fresh, green, moist cactus pads beneath a large Opuntia tree. Near trail - actually near some dense Croton thickets, but under cactus tree in a clear space. No lichens or algae; w.g.i.'s most non existent and when present very thin. F.d. in splotches in usual 2 main areas and scattered elsewhere on sides. Scutes smooth in central 1/10 -1/5 of their surface area only.

Pg. 91.
Starting at the Region 8/9 border and continuing all the way to the La Fe NA and the coast are occasional low depressions with yellowish-brown to medium brown fine, dry soil. Also less common are small patches of red soil or dark brown soil in wedges between plate lava blocks in the higher, raised mounds covered with tree cactus forests. Most of the area is rocky and has no soil but these soil spots do occur here and there all over the cactus forest dominated areas. Goats and pigs utilize these low depressions extensively for scratches and wallows for the shade in many of them offered by Pisonia, Acacia, Xanthoxylum and other trees.
Found 2 (new discoveries) nest (1969/70 destroyed by pigs in the area where #312 found. One in a red soil patch in a small space between plate lave blacks and the other in a depression area. No sign of other successful nest. Goats very abundant.
Reg. 9 -
#961 ♀ - CL 66.5; CW 68.5. at first high raised area of plate lava blocks after Reg. 8/9 border. Covered with huge Opuntia

Pg. 92.

And Jasminocereus trees. Was eating fallen, fresh, moist, green Opuntia pads under cactus trees when found. No lichens or algae; scutes smooth only in very centers; f.d. on rear marginals only, minor and not deep. W.g.i.'s incomplete and where visible only extremely thin. Has some interesting shell anomalies.
1. 12 right marginal scutes; 11 left ones.
2. 5 costals (scutes) on each side; one extra small "wedge" shaped one on each side in between 2nd and 3rd normal ones. I.E. [Diagram shows "rough shape of extra 2 costals" with elongate shape in vertical plane and top somewhat wider than bottom.

A bit further on in a similar area to the above, previous one this area is where I usually see at least 2-3 tortoises on every sample -
#1200 - eating cactus pads - green, moist fall ones beneath an Opuntia tree.
1 unmarked medium sized ♀ - also eating Opuntia fallen pads; failed to mark because heard some goats - went on and shot them and when returned she had moved

Pg. 93.
somewhere out of the sun which recently came out very strongly.
#1076 further on at Rt. Turn area, also eating fallen Opuntia pads beneath a tree in company with 2 ♀ goats - i.e. goats eating Opuntia pads also.
At Right turn area shot 9 ♀ goats, 2 ♂ goats and 2 ♀ pigs. Got so involved in this did not take measurements of #'s 1200 and 1076, but am fairly sure I took their measurements on May trip here.
I then continued rapidly on toward La Fe being verify short on time now - will obviously have to just count animals roughly because of lack of adequate time.
#236 ♂ - CL 017.6; CW 120.6; Saw in this same area last month I think - about 1/3 -3/4's of way to La Fe from Rt. Turn; eating fallen, green cactus pads -
At La Fe - central nesting zone - wandered over it for 1.5 hours and went part way to lagoon on coast but not all the way. Saw #1259 ♀ and 2 unmarked ♀♀, both medium-small size (1 perhaps a ♂, tail intermediate) = do not have time to mark. Saw #1259 here last month. 2 unmarked ones about 75 - 80 cm CL and both near dry pond area in central nesting zone.

Pg. 94.
Returned rapidly to Zone 3 NA where Jan and Bennett are waiting - we are semi-starved for protein so pig leg I have should make good shish-kebab.
Jan made some observations for me today at Zone 3 NA so will include those in rest of today's notes.
Noticed this a.m. before leaving area that #'s 214 ♂ and 3 ♀ were both out of their burrows and moving about some at 0630. #214 was just approaching flat rock water collection area from NE - thus probably active at least since 0600 -0615 because was not burrowed in close by last night - am not sure where was but looked all over area nearby for up to 75 m away but found no sign of him last evening. #3 ♀ near her burrow still but am sure she has been awake and moving since at least 0600-0615.
When I returned at 1700 Jan mentioned that #3 ♀ had again burrowed in for the night at 1600 hours - she sat very near (a few meters away) her last night's burrow all day

Pg. 95.
Sleeping almost all the time and occasionally eating a small herb here and there. Then she burrowed in again today in exactly the same spot for the night. #214 also burrowed in nearby to the flat rock area at 1600 also. This is interesting in terms of activity periods during this season - the burrowing in time in the afternoon is very similar to that of most animal around the Caseta. The morning time of beginning activity is however interesting because it is normally about 0730 k- 0830 around the Caseta now but about 0600-0630 in the Zone 3 NA.
#214 did not do much all day but drink water out of holes at the rocks and mostly sleep, and forage a bit for small herb seedlings in the area.
We noticed on the trip down the other day that most tortoises from the Caseta down to the middle of Reg. 3 of the trail were active regardless of time of day (this was about 090001200 when we were passing through these altitudes of 670 to 375-350 feet) - they were grazing on new green grasses and small herb seedlings which are coming back on the forest floor and in the open pampas. Around the Caseta, the 4-6 animals there each day and those animals around the Caseta large pond are actively grazing most of the day from 0800-1600 now

Pg. 96.
also (based on occasional observations for the past week or 10 days). But those in lower Region 3 and down through Reg. 8 are mostly inactively sitting and sleeping most of the day because there imply is virtually no vegetation on their level on which to feed - the abundant goats are not helping this situation any. And of great interest also is that animals from Region 9 to the coast - i.e. - tree cactus forest are active most of the today but for one reason only - they are eating fallen cactus pads during almost the whole day - about 0630 - 0700 till 1600-1700 from what I have seen.
#3 ♀ - It is also notable that #3 ♀ has rested here where she came to rest on 29 June at 1430. Perhaps she has reached the area where she intends to nest after a long journey from higher altitudes; and thus she may need a day to a few days of rest before beginning the tiring job of nesting. Will have to wait to determine this.
Weather (temperatures) - 0800 today - Zone 3 NA; Max 76.0; Min 63.0.

Pg. 97.
Was cool, cloudy, and with light garua all day today till about 1400. Then sun was out off and on till sunset.
1 July 1970 -
Today will implant thermocouples in !970/71 nest #1. Photos taken - see rolls 148 and 149 for photos of this process.
1. Nest structure - observations include only those I was able to make in placing the t. c.'s (thermocouples) and not from a complete opening of the nest. Did not want to open the nest completely because would dry out too much.
Nest from surface is a very gently sloping and rising mound, more or less circular in shape from top view - this shape of course due to hard cap. About ½ -2 cm of loose, dry, fine and almost powdery red soil, small rocks, sticks, and organic matter (twigs, dead leaves, etc.) completely covering hard cap on top; ♀ must have scraped this covering over the mud-cake hard cap after completely it. The depth of this dry soil covering is

given as ½ -2 cm because it varies with location being deeper on the lopes and generally less on the highest parts of the mound. From probing with the meter ruler in many places it was determined that the most common depth is about 1 cm plus or mine a few mm even on top of the mound.
The hard cap from the top view measures about 45 cm front to back and 48 cm left to right or side to side. Upon opening the nest I discovered

Pg. 98.
that the hard cap is till compact and composed of very thick slightly moist mud - almost like a partially dry mud cake or mud pie. It is very solid and has not cracked at all yet.
I opened the nest from one side by removing a piece of the hard cap. Discovered the hard cap to be 13 cm deep at its greatest depth, i.e. middle of the nest mound on the surface down to the top of the first egg. Actually in a few places the depth of the cap approaches are actually eggs in the second layer of eggs (see below). What is clear is that the hard cap rests immediately upon the tops of the highest eggs. There is no loose soil layer at all in between the caked, mud of the hard cap an the eggs.

Pg. 99.
The eggs number at least 10 and perhaps a few more. I can only see this many from the small hole I have made but do not wish to tope the nest any more. If there are more eggs they must be in the bottom layer or perhaps the second layer of eggs and on the other side of the nest. I rather doubt that there are other eggs because it appears that I can see the whole nest cavity but am not sure.
The 10 eggs I can see are in more or less 3 layers - 4 on the bottom, then 5 on top of these but fitting into the spaces formed by two eggs abutting in the lower layer and the spaces between eggs in the lower layer and the cavity wall. On top is 1 egg fitting into a similar cavity of 3 eggs in the second layer. Since the egg all of normal size (i.e. about 6.0 cm wide) if they were tacked on top of the other for 3 layers they would occupy 18 cm of vertical space, but by being wedged ins amongst each other from layer to layer, they actually only occupy the space from the bottom of the hard cap at 13 cm to the bottom of the nest at 26 cm (i.e. 13 cm of total vertical space). There is mostly air space between all the eggs. A bit of soil in the

Pg. 100.
form of small clumps of mud (semi-dry caked mud) is amongst the eggs but not much. In other words, by using the muddy soil wet by cloacal fluid to make the covering of the nest, the ♀ is able to leave most of the space in among the eggs as empty air filled space (this would obviously not occur if loose dry soil were used to fill the cavity). As mentioned above, the muddy cap fits right down on top of the eggs, i.e. on top of the uppermost egg in one area, and on top of the 5 second layer eggs over the rest of the nest cavity (it is in this latter areas that some 14-15 cm depths occur for the hard cap).
The bottom of the nest is covered with embedded hard rocks, so the ♀ must have dug as deeply as she could and then the rocks stopped her.
There is no sign of feces being dropped into the nest or having been used in the soil for the hard cap at all.

The eggs literally filled the nest cavity completely full within the limits of 13 to the bottom of the nest.
The probe was placed down in the side of the egg mass with 1 egg of the bottom layer and 1 of the second layer lying between it and the nest cavity

Pg. 101.
wall on one side - The thermocouples at 13 cm and below were extended beyond the probes a bit so that they lie approximately in the center of the group of eggs for that depth. The probe, t.c.'s and other equipment are just as used last year and the technique of implantation the same. The thermocouples (cooper - constantan, 30 gauge wire) were as follows (plastic insulated wires to prevent oxidation):

Position	Depth in cm	Description of Position
1	surface	(actually about 1 mm below surface)
2	3	in hard cap - very upper part.
3	5	in hard cap
4	10	in hard cap
5	13	bottom of hard cap and top of uppermost egg
6	18	top of main group of 9 eggs
7	22	center of main group of 9 eggs.
8	26	bottom of main group of 9 eggs and bottom of nest.

Also implanted 2 Bonyions soil moisture blocks (gypsum blocks) for measuring % available soil moisture at 22 cm in nest cavity wall just beside center of main mass of 9 eggs and at 5 cm in the hard cap. Will be able to compare to a control in soil near nest.
The rebuilt hard cap around probe and in hole I made to implant t.c.'s and view nest from side. Used H20 and mud to do this to restore nest to condition it was in when I opened it.
This whole process took 3 hours

Pg. 102.
and during this time had hole into nest covered most of time to prevent any drying out of hard cap and nest cavity walls and eggs. Did not remove eggs so did not measure.
Implanted a probe in soil 95 cm from nest probe - exactly same but will be a control in plain soil for comparison. Also implanted 2 soil blocks at 5 cm and 22 cm in soil near control thermocouple probe (as controls also). These are in exactly similar open red soil, no shade by trees, herbs, or shrubs, and all conditions just like nest site.
[Diagram shows layout of control probe 95 cm to SE from nest probe and something NE 45 cm (is this the moisture block?)]
Control probe

Position	Depth
1	surface
2	3 cm
3	5 cm
4	10 cm
5	13 cm
6	18 cm
7	22 cm

8 26 cm
Should be interesting to see if hard cap acts to conserve moisture in nest cavity. And to see if eggs hatch at different times because are at 3 different depths.
Leaving Zone 3 NA - 1400 hours -
Weather - Since 0930, 29 June - Rain 2.5 mm (emptied); Evap 5.5 ml.(refilled full); Since 0800, 30 June - Max 79.0; Min 61.5; High today 79.0; Min 61.5. High today 79.0 also - both reset now.
Reg. 4 - Weather - 1500 hours. - Rain 7.0 mm (emptied); Evap 6.4 ml (refilled full); Max 76.0; Min 62.0.

Pg. 103.
Caseta Weather 1900 hours - June (actually July), 1 1970 Rain 11.7 (all by 0700 today); Evap 5.0 ml (reading 5.0) ; Max 78.0; Min 63.5. Sun in afternoon from 1500 to 1800.
July 2, 1970 -
Going down past Caseta pond #1 to hunt goats so will record animals seen - not a sample, but may get some good individual movement records.
#170 ♀ - just on east side of pond ; CL 85.6; CW 90.2. No lichens or algae; w.g.i.'s clear but very thin; only a few scattered spots of f.d.; scutes smooth only in very central tiny parts. Notable red soil around lower carapace - all over in a deep red colored type such as can be found at La Fe and other places from about 200 feet alt. All way to coast. Grazing.
#785 - same areas as 270 ♀ - burrowed in at 1530.
#1189 (painted #4) - grazing on pone #1 bed.
#1022 ♀ - in Reg. 2 - 150 m south of pond #1 - in open area near manzanillo grove-sitting inactive; have not seen this animal for quite some time. Red soil all over lower part of carapace thus may have been lower down? CL 97.5; CW 109.6; w.g.i.'s clear, well developed and moderately thick. No lichens, black-green algae abundant on front marginals and rear ¼ of carapace, especially along scutes junctures; scutes smooth only in central 1/10 -1/5th of their surface area.
#60, #1021 - both burrowed in at lowest point of Reg. 2. #1021 has beautiful w.g.i.'s - very clear and well developed and moderately thick; CL 82.0; CW 84.2.

Pg. 104.
Goats are generally lower now than before in the hot, dry season but still have not moved back down to their upper elevation limit of the last garua season. The extend now in large numbers, all the say from about 475 feet altitude as an upper limit down to the coast. This of course is a marked change from their upper limit in the hot season of 650-700 feet and their highest limit of about 750 feet reached in mid-June 1970 just before the garua began again. I killed 11 today (7 ♂♂, 4 ♀♀) on the trail at about 450-475 feet in the upper part of Reg. 3 below the Caseta.
Last garua season goats were never above about 300 -325 feet altitude and the majority were from 200-180 feet and below.
Caseta Weather - 1900 hours - Max 75.0; Min 62.5; Rain 0.25 mm; Evaporation 2.2 (reading 7.2) ; cloudy and cool all day - no garua.
3 July 1970 - To Region 4 enlarged region sample -
Enroute-

#1189 - in Caseta pond #1 bed - re-painted because worn badly - #4.

Pg. 105.
#1022 - same location as yesterday
#785 - in pond bed - C. pond #1
#103 ♀ - near where was yesterday - about 100 ft lower down trail.
#60 and #1021 - same locations as yesterday
#119 - same location exactly as on 28 June. Saw here on 1 July also - sleeping mostly - little available food - only very tiny herb seedlings - has a shallow mud depression in which apparently sleeps each night. Makes 6 days in same spot!
Reg. 4 enlarged sample-
Central area along trail, around flat lava rocks and weather instruments -
#1058 ♀ - in open sleeping and inactive - 1330 hours - cloudy.
#1194 - ditto to #1058. (in open sleeping and inactive - 1330 hours - cloudy.)
#908 ♀ - ditto to #1058. (in open sleeping and inactive - 1330 hours - cloudy.)

#754 ♀ - ditto to #1058 (in open sleeping and inactive - 1330 hours - cloudy.) (painted #9)
All 4 above animals close together spatially - in an area of only 2500 sq feet about 100 feet N of flat rocks - along trail.
#1073 ♀ - ditto to above animals, in open, just slightly to side of flat rocks area. Re-marked because 1,000 and 70 marks getting hard to read.
New # 1267 ♀; CL 64.1; CW 66.8. No lichens, algae, f.d. or smooth scutes; w.g.i.'s mostly nonexistent or in a few places can see extremely thin ones; sitting in semi-open near flat rocks area; inactive and sleeping.

Pg. 106.
#718 ♀, prob.- tail somewhat intermediate in length. From Zone 1?; CL 88.9; CW 93.3; no lichens, algae or f.d.; scutes smooth only in tiny central parts, w.g.i.'s present but extremely thin. Near weather instruments, in open, moving along.
Eastern loop and pond (unless stated that at pond are on eastern side of flat rock area)
#104 ♂ - CL 93.9; CW 106.2; No lichens or algae; w.g.i.'s clear and well defined but rather thin. Form Caseta area! Last saw quite awhile ago. Sitting sleeping in open. 1430 hours, still cloudy.
#870 ♀ - CL 97.2; CW 111.0; very large, old ♀, sitting in semi-open, sleeping. Completely worn smooth; bad deep f.d. all over rear marginals and along borders of these scutes with costals and supracaudal. Has deep grooves between scutes as described for other old ♀♀ like #'s 3, 127, 130, 131. F. d. also scattered elsewhere all over carapace - can see old pits and worn places from its effects; no lichens; black-green algae on rear ¼ of carapace and front marginals area, but confined to scute margins and junctures. Can't see w.g.i.'s even with scraping - too much mud and other "gork" along scute junctures. Painted #20 on her on all 4 sides.

Pg. 107.
#890 ♂ - sleeping in open.

#1125 - CL 67.6; CW 71.2; no lichens, algae or f.d. w.g.i.'s clear and well developed but moderately thin. Sleeping in semi-open.
#693 ♀ - CL 83.5; CW 87.7; no lichens or algae; w.g.i.'s mostly nonexistent; where visible extremely thin. Sitting in shaded area sleeping - still cloudy 1520 hours. All 3 down on N. side of pond near an open flat lava black area with H20 collection pockets and mud depressions for wallowing.
Saw 2 more in pond bed but both up under Clerodendron molle bushes so far that I could not reach them to see #'s or measure - both medium size on ♀ scale.
1530 hours - Weather at Reg. 4; Rain 0.0 mm; Evap 9.1, refilled full. Max 74.0; Min 62.4; reset; Cloudy all day today - also cloudy most of yesterday - a bit of sun poked through from time to time.
Western loop -
#95 ♀ - CL 81.9; CW 90.2; Grazing on small herbs just to west of flat rock area- 1530 hours; still cloudy. No lichens or algae; w.g.i.'s visible and well developed but very, very thin.
#1059 ♀ - CL 73.2; CW 77.2; w.g.i.'s clear and well developed but thin - no lichens, algae or f.d.; no smooth scutes. ♀ probably - but tail a bit intermediate. Moving along toward flat rocks, about 75 m west of them.

Pg. 108.
#709 ♀ - CL 97.3; CW 104.0; no lichens, black-green algae on front marginals and rear ¼ of carapace especially prominent along wide scutes junctures; very old, completely smooth shelled female. W.g.i.'s - can not detect them because so much mud and debris in grooves between scutes - even scraping with knife does not help much. Sitting, sleeping in a dirt depression.
Saw 1 more but was in a hurry at 1730 to leave for Caseta - when saw though I might be lost and it was rapidly becoming dark- thus did not even stop to check #, se, etc. Was a medium sized animal, ♀ scale.
As will be noted from above comments most animals were sitting in open or semi-open areas (mostly areas covered with dried up plant #1, Blechum sp. ?) sleeping or resting; very few ere actively grazing or moving about. However, during the afternoons sampling I passed a number of the animals 2 or 3 times and noted that some which had been sleeping or resting most of the time or when first encountered occasionally moved about and grazed on small herb seedlings and small viny herbs. The general activity pattern her seems to be resting about ¾'s of the time in long periods interspersed with shorter periods of grazing and

Pg. 109.
. . . . moving about. Compare this with activity patterns at Caseta, Reg. 3, Zone 3 NA, and lowest cactus forest regions as discussed on page 95 and 96.
Caseta Weather 190 hours - Max 74.5; Min 63.0; Rain 0.3 mm; Evap - 2.0 (reading 9.2) Cloudy and cool all day - no garua except in early morning.
4 July 1970 -
The following notes are from those jotted down in a temporary notebook on 1 July and 2 July from some aggressions observed near the Caseta on those dates.

Previously on 27 June saw #246 ♀ attack both #1006 ♀ (painted #15) and #423 ♀. See pages 51l-52 for these records. Failed to note it at that time but these aggressions took place just east of the Caseta I the large open ¼-1/2 acre field of grasses, small herbs, and plant #1 (Blechum sp.) This area is a favorite grazing area of tortoises now and was all the past garua season and up till the plants all dried up and withered away and the sun became too strong for the animals to feed in the open here in February, 1970. Last year (garua season) of Oct. (1969)- January (1970) the animals most frequently grazing here (nearly every day) were #'s 31 ♂ (very large), #3 ♀ (very large) and #1006 ♀ (medium-large sized). Aggression all through that period were extremely rare - tortoise simply turned

Pg. 110.
. . . . and wandered a bit (i.e. a few meters) away from each other when they came very close to one another.
However, #246 ♀ seems to be very aggressive while grazing in this area - on the 27th when she attacked #'s 1006 and 423, she did so from quite a distance away in all 3 aggressions; i.e. she did not just wander close to the others or vice versa while normally grazing. In all 3 instances she and the other animal were grazing in the area and #246 suddenly seemed to spot the other animal and deliberately moved directly toward the aggressed from distances of 10-20 meters away and immediately on reaching the other animal began lunging at her and bumping her harshly with her gular projections and the 1st marginals on either side of her nuchal notch. The thing that puzzled me was that if this aggression was an attempt o drive the aggressed ♀♀ from #246's feeding grounds why did she not pursue the animal once it started rapidly moving away from here. If she had, the aggressed in each case certainly would have continued to

Pg. 111.
. . . . move away until she had been driven from the open field grazing area into the surrounding bush. But in those 3 previous encounters as noted on Page 52, #246 left the other animal alone as soon as it had moved away from her only a few feet to a few meters after offering no resistance.
Perhaps the effect of such aggressions is cumulative - i.e. if #246 persists in attacking another tortoise often enough then the losing ♀ will eventually desert the open field area and thus competition for food will decrease for #246 ♀.
Should mention that #246 has spent part or most of every day from 0800 to 1600 grazing in this area since we returned on 16 June 1970. And of course she was around the Caseta much of late may and early June when I was here and probably from June 4 - June 16 while I was at the coast getting Jan, Bennett and equipment. Should also note that as of now #246 certainly is not short of food even in this small field alone - it is covered with new growth green herb seedlings and plant #1 and grasses (all getting greener and more succulent each day with more and more garua). The are could probably support at least 2 more tortoises than #246 on

Pg. 112.
. . . . a continual grazing basis - at least now and for awhile to come - probably and perhaps all the garua season from what we saw last garua when #'s 31, 3, and 1006 never

were able to really dent the herbs and grasses in this field over a period of 4 months of almost daily grazing.
Some of these thought had been circulating in my head about #246's aggression patterns when, returning from Zone 3 NA on July 1 at 1600 hours we found #246 ♀ and #1006 ♀ in a real aggression struggle on the far edge of this field of grass and herbs. 'the aggression was going full tilt when we arrived and continued till 1725 hours - i.e. at least 1 hour and 25 minutes and certainly longer since we missed some of it before 1600 hours. The animals were face to face through almost the entire 1.5 hours. Two main techniques were being used by both of them - mainly they simply rammed and tried

Pg. 113.
. . . . to push the other animal backwards by using the front end of their carapace (1st marginal on each side) and plastron (gular projection). When "resting" their carapace front ends were only a few cm apart usually from the previous pushing match. Usually one or the other would then initiate the next round by charging the other animal with a big ramming blow. Immediately the attacked animal would dig its rear feet in and start pushing back toward the attacker and they would more or less usually hover there in one area, first one pushing the other back a few feet and then the reverse. These pushing bouts usually lasted anywhere from 30 seconds to 3 minutes, most being 1-2 minutes long - I timed about 15 of them. Occasionally both would lunge to begin the attack at the same time and they would crunch their carapaces together and push back and forth as described above. Through most of the 1.5 hours neither animal seemed to be particular winning the encounter or in the ascendancy, except for one long 3 minute encounter in which 1#1006 manage to get #246 backed down on a slight decline. #1006 then proceeded to push and push #246 for about 15 feet very fiercely with a

Pg. 114.
. . . . series of lunges and crashes and by just continuously moving her feet and shoving. But this encounter eventually ended with both sitting at the bottom of the decline with heads withdrawn and the front of their carapaces only a few centimeters apart. #246 never gave up pushing back at #1006 and never turned as if defeated throughout this encounter. She was simply at a disadvantage on the decline with #1006 slightly above her.
It is interesting that #1006 is a slightly smaller animal and thus certainly lighter in weight than #246 - yet till the very last moments of the entire aggression sequence #1006 was never really pushed far at all by #246 - #1006 was certainly "right in there" being very aggressive and attacking first at least as often as #246 through the entire 1.5 hours I watched them.
Actually, the majority of the time, about 70%, they were sitting facing each other much of the time during this "resting" they were alternately cautiously poking their head out a bit from the withdrawn position

Pg. 115.
. . . . and then suddenly and quite rapidly jabbing the head forward rapidly under the carapace of the other animal and trying to take a bit of the head (most often) or forelegs of the other beast (occasionally). Sometimes they would alternate for 5 or 6 biting

attempts, at other times one animal would attempt 2-5 of these in a row and at other times they would both try it at the same time. In the latter case the heads would meet outside of the carapaces and they would take a quick swipe and bit at each other's head. Most often in this latter case both would hiss and withdraw simultaneously after making only a slight bumping contact or no contact at all. Only very rarely did they actually achieve a bit on the head or legs of the other animal in any of these situations. When only one of the animals was making the biting lunge the other responded by withdrawing his head and forelegs (which were already mostly withdrawn when in the resting position) even further into the shell. This effectively prevented the other animal from biting its head completely and made anything but superficial contact with the forelegs impossible. On rare occasions when one lunged under the shell of the other to bite at its head or legs, the

Pg. 116
. . . . attacked animal would respond by sticking its head out suddenly and trying to bit back - this always resulted in a near or slight collision of the jaws or heads - then both withdrew quickly with a hiss. In sum, neither every really accomplished a good solid bit on the others head. Or legs during the whole time - the technique was mainly just threatening display movement in operational terms and results.
Most times when charging and pushing each other their heads were withdrawn well back under the carapace. But not uncommonly they would try this lunging biting technique while pushing each other back and forth. These were usually aimed at the other animal's head and simply produced a further withdrawing of the head by the attacked and no success in biting by the attacker. These lunges usually alternated back and forth during a pushing match and in no case did

Pg. 117.
. . . . the biting attempts cause the attacked animal to settle down from its raised -up, standing position and to slow its pushing attempts at all. They just both kept on pushing, occasionally lunging the head forth and trying to bite the adversary. Less often while pushing the head lunge was directed at the other's foreleg but these attempts never seemed to result in bites or causing the attacked to withdraw its legs and thus stop pushing.
Up to the very end of the entire encounter the match seemed to be a real stalemate. The at about 1725 hours after a short resting period #246 charged #1006- after only about 30 seconds of resistance (i.e. - back pushing), #1006 turned sideways and both settled down by drawing up their legs part way (should mention that in resting position 4 legs always in somewhat and both rested on plastron). The sat this way for about 5 minutes; then #246 charged again and without resisting after being slammed in the side by 246's front end, #1006 moved around #246 and off to the east into the brush. #246 did not pursue

Pg. 118.
. . . . after the initial charge - just sat down and watched her go. Then #246 moved off to brush to south and both burrowed in. So #1006 gave up the encounter after more than 1.5 hours in a very simple non-resisting manner.
Interestingly, the next morning both animals entered the area by 0800 and were grazing about some 20 meters apart. About 0930 #246 took notice of #1006 and approached her

from 20 m away and slammed into her rear end. #1006 took off with no resistance for brush to east again. #246 chased her for about 8 meters and then gave up the pursuit. Continued on out of the area to the brush, moved through it about 10 m and grazed the rest of the day in the brushy area without attempting to re-enter the open pampa field. Yesterday and today,

Pg. 119.
#246 was again in the field grazing (all day yesterday, up till 1130 hours today). #1006 came a short ways from the bush each day toward the field, seem to look it over and #146 also, the then remained in the bush grazing all day on the 3rd and is still there as of 1130 today - i.e. perhaps she will not enter the area now after having been driven out twice by #246 - so perhaps the cumulative affect of being attacked which I mentioned above does in fact occur.
Yesterday (3rd July), #598 ♀ wandered into field (does not go there often- usually stays over to west around tents, cook shack, and at most on west side of the Caseta). #246 ♀ was about 20 m from her grazing when she entered. #246 immediately charged her head on and when she was about 2 m from 598, the latter turned and started away rapidly; #246 continued on and slammed into #598's rear end, then followed her for about 20 m till #598 left the area into the brush to the south. Then #246 stopped pursuit and returned to grazing in the field.

Pg. 120.
Today up till 1130, #598 also did not enter the field - she came as close as the Caseta's south and west sides, but did not go to the field where #246 was grazing alone (as stated above #1006 is just to east of the field, grazing in the bush there). Could not of course tell if #598 avoided the area because of the presence of #246, but seems as if #1006 did so because she approached the edge of it, looked at it (and) #246, and then retreated into bush to grazing place of afternoon of 2 July, all of 3 July and today.
Should also note that after being attacked on 27 June, #423 ♀ soon (30 minutes later)left the field and has not returned any of the days we have been here since (28 June, 1-4 July).
Then after all this activity by 346 and dominance of this field and constant grazing in ti from 27 June till 1130 this morning, she left the area at that time this morning

Pg. 121.
. . . . and moved past the cook shack, tents, and toward the small pond and manzanillo groves just to the west.
At the time (1230 hours) no other tortoises have gone into the vacated field - so will see what happens not the #246 has apparently, at least temporarily, deserted her domain.
Took some photos of this aggression of #246 and 1006 on 1 July - Roll 149 - approximately #'s 12 or 14 - 21-22.

This afternoon went up to upper Caseta ponds area to paint, I hoped, #'s 13 and 1. However did not see either and started raining hard anyway so I could not paint them.
At or near the ponds saw all the following animals (not a complete sample- about 2/3's of one only):
#'s 256, 369, 258, 692, 123, 695, 96, 274 (painted #2), 539, 216 ♂ (painted #7) needs re-painting but rain prevented it., 852.

Saw 256 ♂, 852 ♀, 529♀, 96 ♂, 123 ♀, 216 ♂ and 274 ♀ near here recently (June 23, 1970) for most of these). Do not have recent sightings for the other 4. Will try to measure these 4 and paint #7 (and 1 and 13) if can find) tomorrow morning. Went back over to east of Caseta in area between it and Caseta pond #4 to see if could find any animals- found 2 - each grazing in separate small

Pg. 122.
. . . . ponds on grasses beneath manzanillo groves.
#220 ♂ l- down from Caseta upper ponds when saw on 23 June 1970.
#501 ♂ - has been quite awhile since saw him.
Caseta Weather - 1900 hours - cool, cloudy all day - garua almost all day. Max 69.0 ° F; Min 62.0° F; Rain 3.5 mm; Evaporation 0.1 ml, reading 9.3.
[Marginal note: Flycatchers and tortoises]
Today while at Caseta upper ponds saw a ♀ vermilion flycatcher riding on #529 tortoise. The tortoise was moving along at a normal walking pace and the bird was sitting squarely in the center of the 3rd vertebral scute facing forward. As the tortoise moved through an open field of grasses, small herb seedlings, and especially the dominant plant #1 (Blechum sp.), the flycatcher would occasionally dart out to the front of , the side of or in between the front and side of the tortoise to catch or attempt to catch an insect. I was only able to observe this process for about 1.5 minutes during which time the bird stayed on the tortoise and caught several

Pg. 123.
. . . . flying insects stirred up by the moving tortoise. Then the tortoise saw me and collapsed with a hiss causing the lady flycatcher to desert her perch on his back. I waited about for awhile but the flycatcher left the area and the tortoise remained withdrawn. The other day I saw a flycatcher, male vermilion that is, sitting near a resting and sleeping tortoise on a guayavillo semi-prone trunk, Occasionally the bird would dart over and grab a "fly" or "gnat" or some similar type insect which were buzzing about the head. Forelegs, and carapace of the tortoise. Occasionally the bird would even trap an insect of large size (flies I think) against the carapace of the tortoise with his bill. Then he would "beat" the insect several times against the shell of the tortoise, thus macerating it a bit and finally eat the mangled thing.
5 July 1970
To areas above El Chato to N and NE - Los Hermanos, Mirador, Moreno's etc.
Enroute -
#369 ♂ - CL 89.4; CW 99.2 - At mora -forest border on N. P. border just above Caseta; no lichens or algae; no smooth scutes except I tiny central parts; w.g.i.'s nonexistent; no f.d.; still burrowed in at 0730.

Pg. 124.
#408 ♂ - about 150 m Northwest of #369 - on Reserve - NP border - just east of burrow at 0745.
#445 ♀ - (painted #1) - just at Rt. Turn slightly east of Camote patch - i.e. has moved about 1 - 1.5 km west of last sighting. In burrow at 0800.
#97 ♂ - actively feeding on Commelina at Camote patch at 0810.

#98 ♂ - burrowed in just on other side of Camote patch (west) 0815.
#106 ♂ - in burrow on Reserve border- awake and looking about - 0820 - just at Segundo Herrera's manga - i.e. about 75 -100 m west of Camote patch.
#1361 - exact same location as sighting on May 31, 1970. Actively feeding on Commelina - 0840 hours in open.
Near small pond beside R.B. just east of R. B - El Chato turn - off intersection - these animals scattered all about this area.
#172 ♂ - huge - moving south more or less
#549 ♂ = very large ; in burrow still; CL 142.8; CW 156.1; (painted #34); no lichens; black-green algae all over rear ¼ of carapace especially along outer scute borders where annular rings still not worn smooth.
#383 ♂ - CL 109.8; CW 117.2; [Marginal note: grazing near pond] no lichens or algae; f.d. deep on rear ¼ of carapace and light spots on front marginals and scattered elsewhere. W.g.i.'s visible
Pg. 125.
. . . . but extremely thin. Re-marked because cuts becoming very shallow. Re-marked because cuts becoming very shallow.
#853 ♀ - CL 95.4; CW 105.3. No lichens; black-green algae on rear of carapace especially along and mostly confined to scutes margins and junctures of supracaudal and rear marginals. W.g.i.'s present but extremely thin. Re-marked because cuts becoming shallow. Moving to pond bed from north.
Just west of pond and El Chato turn off - in oopen fields of mara mixed with commelian, morning glores and other herbs - these 2 tortoises clearly have been here for 1-2 weeks at least - have penetrated into mora border to some depth (20-30) meters in places to get at herbs beneath it.
#310 ♀ - CL 93.3; CW 103.2. No lichens or algae; scutes smooth in central 1/6-2/3's; f.d. very extensive on rear ¼ of carapace, on front marginals and scattered in spots and lines all over reast of carapace, mainly where growth rings not yet gone and scutes mooth. W.g.i.'s - can't see because lots of crud along scute junctures - but certainly if present, extremely thin, - can tell that much at least. Grazing when found at 0930. Re-marked - cuts faint.
#441 ♀ - CL 89.9; CW 99.2. No lichens; black-green algae on rear marginals. Scattered minor f.d. on front marginals and rear 1/5 of carapace; scutes smooth in central 1/6 -2/3's. w.g.i's non existent; deep red-brown soil well worn into carapace all around lowest parts - i.e. from El Chato or probably even below it? Grazing.
Back near pond - just starting north -
#609 ♂ - CL 89.6; CW 97.4. (painted # 35). No lichens or algae; w.g.i.'s mostly nonexistent; in few places where visible are extremely thin.

Pg. 126.
Moving north away from pond.
On up to north -
In open field of about 10 acres of Commelina and Passiflora - about ½ km above Reserve / NP border - area where used to see 2-4 animals on each census past garua season = altitude about 870 feet (Thommens).

#18 ♂ - large; was here on 31 May also - he clearly stayed here munching on new growth of Commelina, Passiflora, and other lush herbs now about ½ - 2 dm all over the place. CL 146.2; CW 152.7. (as not remember if I measured him in May) w.g.i.'s clear and moderately thick - no wonder lots of vegetation here and wet each morning for last 2 weeks - area covered with dozens and dozens of his big turds.
Sad to note, but farmer from above (I think Chappy?) has put in about 2500 sq. foot plot of con here and has just cleared another 5000 sq. feet for some planting purposes. He also has another (300 or 3000? - number not clear) sq. foot plot cleared just beside Reserve / NP border to west of small pond a bit - inevitably this lush open garua season grazing are for the tortoises will be destroyed.

Pg. 127.
Painted #18 as #21 just to check on further movements and to descourage his potential murder.
#611 ♂ - CL 89.8; CW 96.1. Bit higher up - at 900 feet (Thommens) in an open, small field of *Commelina* and other herbs in a *Xanthoxylum* stand. Eating *Commelina*. F.d. all over front marginals area, rear ¼ of carapace and scattered elsewhere; black-green algae on rear ¼ over a good bit of it, but not only where f.d. is located. Scutes smooth in central small portions of surface area only. w.g.i.'s visible but very, very thin. Painted as #22.
#176 ♂ - CL 112.4; CW 125.5. Slightly higher up - 910 feet altitude - in a similar area as #61. - very near an area where found several animals last November- sleeping; scutes mostly smooth except for border areas which still have growth rings; 80-90% smooth; f.d. scattered in streaks all over carapace, especially along growth rings still present and especially on rear ¼ of carapace. No lichens; bits of black-green algae along scutes junctures at rear of carapace. W.g.i.'s very, very thin but visible. Painted #23.
#87 ♂ - almost certainly but tail a bit stubby. Could be #487 but I doubt it - 400 mark looks like a chipped scutes only. No lichens or algae; f.d. on rear ¼ of carapace, front marginals, and scattered elsewhere. Scutes smooth in central 1/10-1/3 only. W.g.i.'s non existent. Painted #24 - CL 99.3; CW 112.8. In area just mentioned above, 10 m west of last animal; grazing on *Commelina* in open.

Pg. 128.
#781 ♂ - CL 121.4; CW 133.8. Same area; also grazing on *Commelina*. Lost of activity (2-3 weeks or even a month's worth of turds and matted down herbs in these open areas; lots of matted down mora too). Painted #25 - no lichens; black-green algae all over rear ¼ of carapace and front marginals area; f.d. in same areas, especially dense only on rear marginals and 5th vertebral. Scutes smooth in central 1/5- ¼ of their surface area; w.g.i.'s present but extremely thin.
#609 ♂ - CL 112.6; CW 118.2. No lichens; black-green algae and f.d. all over rear ¼ of carapace and front marginals area; f.d. scattered elsewhere also; w.g.i.'s visible but very, very thin. Just 35 m west of last animals; again in an open spot with much herb cover in *Xanthoxylum* stand. Eating herbs. Painted #26. **[Marginal note: duplicate - see page 125].**
#175 ♂ or #75 ♂ - can't be sure - 70 and 5 marks clear and OK; 100 mark not clear - perhaps a chip but looks like a poor mark - is in edge of 100 scute, very near 2nd scute -

Part of problem may be that has 12 right marginals and normal 11 on left side; CL 130.0; CW 146.2. **[Marginal note: definitely was just above El Chato, south 100 m of R. B. at end of May and first days of June!]**

Pg. 129.
Very large but scutes smooth only in central 1/5-1/4 of their area; extensive f.d. all over rear ¼ of carapace, front marginals and scattered all aver elsewhere; especially heavy f.d. in lines along growth rings still present. No lichens; black-green algae present on rear ¼ of carapace but dried up mostly; w.g.i.'s present and rather well developed and moderately thick. Painted #27.
In open beside trail eating *Commelina* at 1000 feet, just a base of Los Hermanos hills. Has been here a few days - old turds of at least that age and big matted down eaten out patch of the herb.
Nearby, just 20 feet in altitude higher saw #1077 ♂ moving SE in another open field of herbs - area he is leaving has fresh turds and others up to 2 weeks old and extensive eaten and matted down areas of herbs. Heading toward #175's location but certainly can not see each other. CL 124.4; CW 132.5. could not take other information or paint because garua just now is fierce -can hardly see clearly.
Then went looking in area for the source (i.e. paths of entrance) of these 2 animals - hard to tell but looks as if they came to these areas from SW - i.e. from area where saw #'s 176, 87, 781, and 609 awhile ago. Certainly came from that general direction up along natural drainages to NNE and NE from El Chato -through fields of *Commelina*, *Passiflora* and other herbs.

Pg. 130.
Then went on up past Los Hermanos and Mirador hills to 1200 feet altitude - above the last 2 beasts absolutely no sign of tortoises recently.
Big open fields of herbs at 1100 -1150 feet there where was a lot of activity last garua season (late Nov. December) and in part of the past hot, dry season are all grown over with a beautiful new carpet of *Commelina* and *Passiflora* and scattered other herbs. But no tortoise sign - if tortoise had been there in past month since I examined this area in May their trails and turds would be obvious - but definitely nothing like that.
Proceeded back down hill to SSW toward El Chato and small pond - at 950 feet examined the extensive open fields of *Commelina*, *Passiflora*, the cucurbid (formerly *Echinopippon*) and other herbs (*Ipomaea*, other ones, small seedlings). In May were few animals and or recent sign here - all old sing from hot season and last garuas season. This is still present, but herbs have grown a lot and fields are ½- 2 dm deep with them This area is only

Pg. 131.
200 m or so east and slightly above and up a gradual rise from area where saw # s 609, 781, 87 and 176 this a.m. Fields of a similar type with scattered mora patches and *Xantoxylum* dominated groves form a natural pathway with abundant new growth food from small pond and El Chato below directly to this area - Now - tremendous amount of fresh tortoise sign - mostly from past 2 -3 weeks - they have really moved into this area

and have grazed out tremendous area of it - especially concentrating on *Commelina*. Quite a few tortoises - to wit:
#2 or #4-87 ♂ (i.e. 287 or 487) - have seen before in small pond - El Chato turn off area - problem is a tiny little scute jammed in between supracaudal and first normal-sized one on right side. - 2nd normal scute is notched - logically thus 400 but marker could have meant 200. CL 119.2; CW 129.8. No lichens or algae; w.g.i.'s clear but very thin. Eating *Commelina*. Painted #28.
#1041 ♂ - CL 122.6; CW 133.5. No lichens or algae; f.d. all over rear ¼ of carapace and scattered on front marginals; scutes smooth in central ¼ -1/2. w.g.i.'s visible but rather thin. Sitting on a loose dirt wallow sleeping. Painted #29.
#154 ♀ - CL 96.0; CW 107.7. grazing on viny herb (plant #2 from my collection;); scattered f.d. all over

Pg. 132.
Rear of carapace and much elsewhere, especially where growth rings still present; no lichens. Dried black-green algae on front marginals area and rear of carapace especially along scutes junctures; w.g.i.'s present by extremely thin. Painted #30.
#562 ♂ - CL 109.9; CW 122.4. No lichens; semi-dried black-green algae all over rear ¼ of carapace and front marginals; same areas have extensive f.d; w.g.i.'s present but incomplete and extremely thin. Eating *Commelina*. Painted #31. Slightly lower down - 940 feet altitude - but same conditions - 75 m South-southwest toward El Chato from above animals.
New # 1268 ♂ - CL 88.3; CW 98.1. No lichens; dried black-green algae on rear ¼ of carapace and front marginal area; scattered f.d. in same places and a few spots elsewhere; scutes smooth in central 1/12 -1/4 of their surface area; w.g.i.'s visible but extremely thin. Grazing on *Commelina*. Painted #32.
#59 ♂ - CL 96.9; CW 103.9. No lichens; black-green algae extensive on rear ¼ and front marginals - but semi-dried out; scutes smoothness highly variable; from only very central tiny part to 90% on 3rd and 4th vertebrals F.d. extensive on front marginals area ands scattered on rear especially where worn growth rings.

Pg. 133.
Still persist w.g.i.'s very, very thin. Eating cucurbid vine (formerly *Echinopippon*). Painted #33.
On return to pond area painted #549 as #34 and #609 ♂ (smaller one of 2 ♂♂ with this #) as #35.
Saw a new one near El Chato turn off - #607 ♀ - just up from El Chato probably because has fresh red mud on feet -dry but chunky. Grazing on grasses. CL 99.6; CW 110.5. No lichens; black-green algae in semi-dry form all over rear 1/5 of carapace and front marginals area. F.d. in usual places, mostly superficial, and scattered elsewhere; scutes smooth in central 1/6-1/3 of their area. W.g.i.'s present but rather thin. Painted #36.

On return to Caseta -
#106 ♂ had moved 150 m further west toward El Chato.
#408 had moved 150 m further west toward El Chato also. Re-painted #445 - i.e. as #1 painted.

#216 ♂ (i.e. #7 painted) just above Caseta at R. B.) - re-painted also - Julio saw at Camote patch - Rt. Turn area on 30 June 1970!
Jan re-painted #'s 11 and 13 near Caseta today - #13 came to Caseta, and #11 to tents from small pond - manzanillo grove in drainage to Caseta pond #1 - i.e. just west of tents. (#11 painted = #444 ♂; #13 painted = #1190)

Pg. 134.
#1006 returned to field just east of Caseta today - interesting because #246 left there yesterday about 1200 hours and has not returned there. #1006 entered the field when no other tortoises there today in late morning. She also checked around cook shack - garbage pit area.
Caseta Weather - 1900 hours - Cool and cloudy almost all day except for a few 10 minute periods of sunshine in mid and late afternoon; garua of and on all morning and up to 1400 hours. Rain 3.0 m.; Evaporation 1.3 (reading 10.6); Max 72.5; Min 62.5.
July 6, 1970 -
To Region 4 to implant thermocouple control column (tomorrow morning).
Enroute noted several animals-
#119 - same area (20 m west) where has been for 10 days plus.
#835 ♀ - (from Region 4) - moving along in about middle of Reg. 3 in upwards direction.
#245 ♀ - from Zone 3 Nesting Area! **[Originally found in Region 4 I think! Will check.]** Moving upwards; about 100 -150 m above Region ¾ bordr - sawe in Zone 3 NA on June 29th moving to NNE - has really been traveling - recognized because recently re-marked (on June 29) and can still plainly see this recent

Pg. 135.
Notching - originally found this animal in Region 4.
#693 ♀ - in Region 4, but 100 m north of weather instruments and central area.
Did a bit of exploring to west of Region 4 area. Found some well used goat trails passing through a fairly dense (in terms of # trees) nicely structured guayavillo forest. This forest area has been rather well cleaned out at the shrub and herb layer by the very abundant goats, burros, and pigs in this area.
All these trails ran in like the spokes of a wheel to a hub or central area which consists of huge areas of many acres each of dry pond begs. These pond beds are very open areas just like that small bed at the weather instruments in Region 4 . I walked through these areas for about 30 minutes in two straight lines and as far as I could see to the south and west (several hundred meters) after I turned back, the areas continued. The pond beds are made up of dry cracked brown and yellowish-brown soil with large #s of lave rocks embedded all over them. The beds varied in size from small ¼ acre ones to some of 3-4-5 acres and more . In places there were areas of heavily concentrated *Clerodendron molle* bushes (deeper parts) but these were few and far between. The area in total lies at the bottom end of a large rocky

Pg. 136.
Drainage line coming down from above. This drainage is certainly another spoke from the Caseta pond #1 area - another being the one running into Region 4 and its large pond.

Despite the hug abundance in these pond bed areas of potential tortoise burrowing sites (during rainy season of heavy rain, also potential H20 buildup, and drinking and wallowing sites) there were few tortoises there and very little tortoise sign. There are even flat rocky areas (not as good as Region 4's albeit, but still are some) where garua collects in pockets. Saw few old or fresh turds, only 2 tortoise skeletons (both dead large ♀♀ - both slaughtered; one 2-3 years old, the other 5 + years old) and a few recent mud depressions/wallows. Saw only 2 tortoises in 45 minutes of searching all over about 10 acres of the area. One an unmarked 760 cm. CL ♀. The other **#51** ♂**,** very large. CL 137.3; CW 149.0 completely smooth scutes; no lichens or algae; w.g.i.'s present but rather thin; sitting in a mud (dry) depression made 2-3 days ago during strong garua. In total and very interest area and most notable that animals very sparse all through it and forest between it and Region 4, but very concentrated in Region 4 - brings up idea of selected pathways of tortoise migration!

Pg. 137.
July 7, 1970 -
Ran down early this morning to Zone 3 NA to check for nest and pick up some equipment needed for thermocouples in Region 4. Enroute saw **#718**, 75 m south of lava rocks area in Region 4 where last saw.
Saw **#1151** at big boulder area of Region 5/6 border.
Checked about for nests in area of yellowish-brown soil patches where 1969/70 nest #13 was located - saw no signs of digging or even tortoise activity here as of this date.
Then to Zone 3 NA - made normal circuit checking all regular sites for nest or digging sign. En route saw a number of animals.
#1193 - little guy - back near his regular burrow - just moving about and feeding at 0815 - where has he been when checked here in May and June several times? Nearby? Re-measured - CL 31.3; CW 33.7. No lichens, algae, f.d. or moothing of scutes yet. W.g.i's nonexistent now- ca't see at all.
#214 ♂ - only 25 m away for 1193 in eastern open red-soil area of nesting area; sleeping in open.
#278 ♂ - CL 109.0; CW 120.6. 10 m away for #214 ♂; still in loose soil depression up against a *Pisonia* tree at 0830 hours. Scattered bits of f.d. on front marginal; good coating of black-green algae on rear ¼ of carapace and front

Pg. 138.
Marginals area; no lichens; scutes smooth in central 1/20-1/10 only; w.g.i.'s prebut very thin. Is from Caseta area originally! Quite upturned rear and front marginals - very flared.
Both of these ♂♂ are near path which leads up to north - same one #3 ♀ and others have used to enter and leave Zone 3 NA.
Painted #278 ♂ as #37
Painted #214 ♂ as #38.
#131 ♀ - CL 90.8; CW 101.2. Just 25 m SW of the nest saw her lay last September (nest 12, 1969/70); she is beneath the same cactus, eating a green, fallen fruit, where saw ♀ # 787 on 29 June 1970. No lichens, but a lot of black-green algae on rear 1/5 of carapace and front marginals, especially along scutes margins and wide grooves between scutes;

w.g.i.'s present and moderately well developed - medium thickness. Painted #39 on all sides but rear. She has definitely no (not) nested yet as she lacks any dried mud of any type on feet, legs, tail, plastron, and carapace.
[Marginal note: nesting].
Found no fresh nest anywhere in main Zone 3 NA. Found 2 spots where surface had bee dug in a bit and looked over, but only to a depth of about 4-5 cm. Both of these sites close

Pg. 139.
Together and very near where we last saw #3 ♀ on 1 July 1970 - thus could have been her. Found no sign of her in this location and have not seen her yet on this mornin's wanderings in the main nesting area.
Then proceeded to smaller ed soil area (nest 8, 1969/70) to SE a short distance from main Zone 3 area. Thre found no digging and no new nests but just east a few meters from nest #8 found a nest I missed the other day - destroyed by pigs and definitely from 1969/70 - thus nest #20 for Zone 3 NA total area. (+ 5 others in this total Zone 3 area destroyed by pigs). Also there found another small fart about same size as #1193; moving about in NA, red-sil area at 1000 hours. Has a little burrow there in loose soil under two dead *Cordia* poles.
New #1269 - can't sex - too small; CL 35.7; CW 38.0. No lichens, algae, or smooth scutes. No f.d. dorsally, but bits of it on underside of rear marginal scutes and scattered also on parts(gulars, around leg pockets lower borders; w.g.i.'s present but incomplete and extremely thin. Carapace and plastron normal - no deformities.
Also saw #787 ♀ (painted #19) moving along just southeast of #131 ♀ - about 30 m away - not far from small nesting zone mentioned above where #1269 was - she has not laid - no mud on her at all.

Pg. 140.
Zone 3 NA - Weather - 1025 hours - Rain 2.8 mm, emptied; Evaporation 21.1 ml, refilled full; Max 79.0 ° F; Min 60.5 ° F. Read soil moisture (% available) at nest #1:
1030 hours: Nest - 5 cm (hard cap) 20 %; 22 cm (eggs) 49 %;
Soil near nest - 5 cm - no register; 22 cm - just barely registers.
Back to Region 4 -
Saw #1255 just entering central Region 4 from south.
[Marginal note: copulation.]
In Region 4 - #890 ♂ mating with #1026 ♀, looked and sounded successful.
Also #713 ♂ moving around near weather instruments.
Region 4 Weather - 1430 hours - Rain 3.65 mm, emptied; Evaporation 11.7, refilled full.; Max 75 ° F; Min 61 °F.
#1026 ♀ - measurements - CL 70.5; CW 78.8. No lichens, algae, or f.d. Scutes smooth in central 1/20 -1/15 only; w.g.i.'s clear but very thin; this animal was passive through entire copulation mention above.

Pg. 141.
Implanted a column of thermocouples in Region 4 at about 275-280 feet altitude=- as last year but in a place not flooded by water occasionally. Area is about as open a one as

could find at thisaltitude which had soil that was not in a low temporary pond bed. Area has trees close around it and is in a fairly dense guyavillo forest (canopy cover = about 40-50% when tree leafed out). This location in particuarl is open above in about a 70-80 ° arc if draw lines from thermocouple column up to canopy overhead at 2 furthest points. Soil is deep brownish red type, tyiical of this zrea when not in pond begs; goats and burros use the these soil sites as scratching and marking rougds. Soil is deep and easy to dig in and ♀ tortoise could certainly make a nest here - perhaps a bit of difficulty in making hard cap because lacks clay and organic matter - but could do it never the less. But ♀♀ do not nest this high and I hope to see if temperature and sil moisture are one or two of the reasons why they don't. That they don't in pondbeds is no surprise - not profitable if these areas flood every few years in Jan - March period and drown hatchling still in nest. But why

Pg. 142.
Not in these other sites?
Put in thermocouples in standard plastic climn at following depths.

Position	Depth
1	Surface
2	1 cm
3	3 cm
4	5 cm
5	10 cm
6	13 cm
7	18 cm
8	22 cm
9	26 cm

Soil blocks put in soil at 22 cm and 5 cm. So can directly compare to nest #1 and soil column in Zone 3 NA.
Caseta Weather - 1900 hours - cool and cloudy most of day = little garua; sun out a few times for short 5 minute periods between 1100-1500. Rain 0.5 mm; Evaporation 5.6 (reading 16.2); Max. 76.0; Min 62.0.
July 8, 1970 -
To Caseta upper ponds area to paint as many animals as is possible.

Pg. 143.
In trail just above Caseta and near it -
#529 ♀ - painted #40; grazing.
#885 ♀ - painted #41; grazing.
#274 ♀ - already painted #2; grazing.
Pond #2 area -
#258 ♂ - CL 117.3; CW 131.3. No ochens; black-green algae on rear 1/5 of carapace especially along scute junctures. W.g.i.'s well developed but rather thin. Sleeping in open. Painted #42.
Fields below ponds -

#270 ♀ - CL 85.4; CW 90.9; no lichens or algae; small bits of f.d. here and there, scutes smooth only in very central tiny parts; w.g.i.'s present but very thin. Painted #43; moving about in pond.
#256 ♂ - grazing. Painted #44.
#720 ♀ - CL 87.9; CW 97.3. No lichens, algae, or f.d. Scutes smooth in central 1/20 -1/5; w.g.i.'s clear but rather thin. Painted #45; grazing.
#852 ♀ - grazing on grass and plant #1. Painted #46.
#1190 (painted #13) just north of small ponds on Devine's central manga, up from Caseta.
Back to Caseta -
#134 ♂? - just west of tents 20 m. CL 98.5; CW 105.8. ♂ perhaps - tail thick but short and stubby - probably ♂. No lichens; black-green algae common on rear 1/5 of carapace and front marginals area; w.g.i.'s present but extremely thin. Painted #48. Around tents all day, active and grazing; came into area from drainage just to west.
#117 ♂ - came into tent area from drainage just to west and grazed way over past Caseta and left to east in bush.

Pg. 144.
#246 ♀ , #1006 ♀, #598 ♀ - all around tents and Caseta today - (actually 1006 never got to tents, was only in field on Caseta's east side - see below).
#103 ♀ - passing by Caseta area just 20 m south of weather instruments, WSW to ENE - coming from Caseta pond #1 area nd heading into bush and guayavillo - Scalesia forest, small pond and pampas area to east. Painted #47.
Caseta Weather - 1900 hours - cool and cloudy almost all day; some sun for 5 - 10 -15 minute periods from 1400 - sunset, but only about 45-60 minutes of total sun in all. Max 74.0 ° F; Min 60.5 ° F; Rain 1.2 mm; Evaporation 2.4 , reading 18.6 ml).
[Marginal note: Aggression: #246 ♀ and #1006 ♀]
Saw another notable confrontation between #'s 246 ♀ and #1006 ♀ this morning at 0815. Between 0745 and 0800 both entered the field on east side of the Caseta, #1006 from its bush area to east and #246 from tent are to west. Then proceeded to graze within the are for 30 minutes, beginning about 15 m apart and gradually getting closer together, but without really looking each other over ever. Suddenly

Pg. 145.
When only 20 feet apart #246 ♀ suddenly seemed to take notice of #1006 grazing nearby. She immediately raise up on all 4 legs and extended head out quite away (from resting on plastron, grazing) and began moving directly at #1006's head end. As she came within a few feet raised neck and head up full and opened mouth to biting position. #1006 waited till 246 ♀ was within about 3.5 feet, then rapidly turned and took off, offering no display or resistance. #246 stayed right on her heels for about 15 feet, then both stopped when #1006 got about 10 feet ahead of #246. Both started grazing and rest off and on for about 3 minutes, then #246 raised up, charged #1006 and rammed into her rear. Again 1006 took off, this time directly toward here entrance to the bush on east side of the field (without ever looking back at #246 or offering resistance). This chase lasted about 30 seconds; again #1006 got about 15 feet ahead of 346 and the later stopped chasing her and settled to ground to rest. #1006 then responded by stopping and began grazing, still

in field and about 40 feet from bush. After about 3 more minutes #246 again charged and this time after

Pg. 146.
Ramming into rear of #1006 continued pursuing her only a foot or two behind her till #1006 went directly into bus h and left the field. Just as soon as she entered the bush, #246 stopped chasing her and wandered off along field -bush border and began grazing in field. #1006 went about 25 feet into bush and began grazing here and did not return to field all day, even when #246 was not in it for various periods. At days end #1006 still in bush for night and #246 burrowed in bush on east edge of the field. So looks as if #246 is being aggressive specifically about this field. Have not seen here aggress animals elsewhere even though has met other animals in other locations away from this field - usually simply passes other animals by.

Pg. 147.
July 9, 1970 -
To CDRS to measure young tortoises and write a few letters. Jan and Bennett will remain at Camp - Caseta.
Enroute saw 5 tortoises -
#444 ♂ - (painted #11) at Caseta pond #4.
#220 ♂ - at Caseta pond #4.
#1108 - 250 m west of large pond near Zone 1 - R.B intersection
#582 ♂ - (medium-large); 150 m west of large pond near Zone 1 - R.B intersection.
One unmarked smallish ♂ - about 75 cm CL - at entrance to large pond.
Beyond these all way to and ½ km past Zone 6 occasional sign but not much activity.
July 14, 1970
Returned to Caseta today; enroute found things along trail much the same as on the 9th when went down.
Saw 2 tortoises.
#425 ♂ - moving through guayavillo forest to north crossing NP border just 40 m east of Zone 6 turnoff.
#259 ♀ - moving south crossing NP border halfway between turn-off to Zone 6 and Zone 1.
While I was gone several people took data for me.
Julio San Miguel and Galo Torres went tot the new nesting area below Cerrito and on to Cerro Gallina, cutting a new trail between those 2 points.

Pg. 148.
They took weather twice at El Chato -
(El Chato Weather) - July 9, 1970 - 0930 hours; Rain 0.90 inches; Evaporation 24.0 ml, refilled full.
(El Chato Weather) - July 10, 1970 - 1300 hours; Rain 0.15 inches; Evaporation 6.0 ml, refilled full.
In the new nesting area they noted all the following animals: all on 9 July 1970. Will try to find these same ones on my trip there to verify the numbers.
#82 ♂ copulating with an unmarked ♀.

#1046 ♂ copulating with ♀ #469.
#440 ♂
On 10 July 1970 saw these additional ones:
#1019 ♀
#1128 ♀ - dead of natural causes - mostly decomposed thus only a few weeks to 1 month dead. Both of these about 300-400 m south southwest of new nesting area near Miguel Castro's "Cerrito nesting zone"
[Marginal note: Note of these I saw #'s 440 and 1046 on 20 July. Also perhaps the unmarked large ♀.]
They did not spend much time at Cerro Gallina but did walk around for about ½ hour at the base of the hill. Saw no tortoises but plenty of old broken up tortoise skeletons from animals killed over past 10 years or so.

Pg. 149.
There were no new nests in the new nesting zone Julio counted 12 1969/70 nests in the zone overall, all destroyed by pigs; he saw no nest which appeared to have been successful here. The also went to SSE about 300 -400 meters and found 2 corrals, nest #10 and 11 from 1969/70. These were in a small area with soil and were found in late August 1969 by Oswaldo Chappy. Julio looked in nests and found that all young had hatched and escaped from both nests - no trapped young and no infertile or partially developed eggs. A bit beyond this area they found another depression with a little soil in it and found 2 successful 1969/70 nest there also - again all young had hatched and left these 2 also; neither of these nest and this area had not been found in 1969/70 though he could not determine it accurately, Julio thought that each of these 4 nests had contained about 6-8 eggs. I will try to visit this area and determine these facts later if possible.
[Marginal note: Checked Jan 8, 1971; 6 in #11, 8 in #10.]
Jan took information at Caseta on tortoises in that area and marked (painted) 2 tortoises-
July 9 - only #'s 598 ♀ and #1006 ♀ around the Caseta.
July 10 - 1330 hours - #'s 1006 ♀ and #598 ♀ only ones around today. Both behind the Caseta now. #1006 sitting in the shad; #598 marched up to within 10 feet of the former as if to start aggressing but then stopped, settle down and began eating; #1006 is watching her but not moving at all. Then #598 raised

Pg. 150.
Up and started directly toward #1006's side with head out straight. #1006 immediately put head and neck way out and up and opened her mouth in an aggressive posture. #598, seeing this, rapidly turned away and started off; no contact was ever made between the 2 animals. #1006 did not chase here at all.
July 11, 1970 - 1500 hours.
#62 ♀ showed up at the Caseta today; saw her first in front of the tent then she beaded down trail toward Caseta pond #1 - unknown where she cam from most recently. However last sighting was in middle-lower Region 3 on 28 June - so has really moved up from Region 4. CL 71.0; CW 78.5. Painted #49.
Other animals around today - #'s 598 ♀, #246 ♀, and #1006 ♀.
July 12, 1970 - Only animal around which was seen today was #598 ♀. #1006 ♀, and #246 ♀ seem to have moved off to somewhere else.

Pg. 151.
July 13, 1970 -
Heard #598 ♀ clomping about at 0615 this a.m. in garua and cold temperatures. For last 2 weeks have noticed that she burrows in the same general areea each night between 1600 and 1730 sometime, namely early in that period.
1200 hours - #354 ♂ came up from direction of pond #1 to tent area. CL 108.5: CW 114.5. Painted #50. Moved off to NNW of tents along series of hanging ponds toward mora and Reserve Border.
Only other animal around today was #598 ♀.
On return today (14 July 1970) I noticed several animals just below Caseta on trail to Pond #4.
#220 ♂ - at pond #4.
#48 (painted) - i.e. #134 ♂ just below weather instruments.
#15 (painted) - i.e. #1006 just below weather instruments also.
Also, no sign of #246 ♀ in the area at all.

Pg. 152.
Weather data taken by Jan while I was gone- not much rain - several completely sunny and breezy afternoons. **[Marginal note: all Caseta data.]**
July 9, 1970 - (Caseta Weather) - Max 74.0; Min 60.5; Rain 0.6; Evaporation 1.7 (reading 20.3)
July 10, 1970 - (Caseta Weather) - Max 76.0; Min 60.0; Rain 0.1; Evaporation 3.6 (reading 23.9)
July 11, 1970 - (Caseta Weather) - Max 74.0; Min 56.0; Rain 0.0; Evaporation 4.4 (reading 28.3)
July 12, 1970 - (Caseta Weather) - 1800 hours -Max 74.0; Min 57.0; Rain 0.0; Evaporation 3.2 (reading 31.5)
July 13, 1970 - (Caseta Weather) - 1800 hours - Max 76.0; Min 58.0; Rain 0.9; Evaporation 2.1 (reading 2.1)
Today, July 14, 1970 - Caseta Weather - 1900 hours - cool and cloudy all day; no garua; Max 72.0; Min 62.0; Rain 0.0; Evaporation 3.2 (reading 5.3).

Pg. 153.
July 15, 1970 -
To Zone 1 to sample -
At pond along Reserve Border just west of Zone 1 turn off very little sign of tortoises - a few recent muddy burrows and turds -
#268 ♀ - CL 81.8; CW 89.0; just north pond 20 m; no lichens or algae; w.g.i.'s extremely thin; grazing.
Into Zone 1 to pond #1 - nothing - no tortoises or sign.
At pond #1 - same - no fresh trails or turds - most recent at least 2-3 months old. Pond of course still dry and with a lot of *Heliotropium* and some *Casia* growing on its floor.
Between ponds #1 and #2 - still little sign - 2 tortoise seen, both grazing.
#432 ♀ - CL 78.0; CW 82.5. No lichens or algae; f.d. only on rear marginals in a few spots. Scutes smooth only in very centers; w.g.i's nonexistent.

#356 ♂ - medium-large sized.
At pond #2 - fresh sign of 2 animals - one turd from this a.m. from medium sized ♂ or large ♀ - on trail into pond; another small one (♂ scale) made a trail over much of the open pond surface soil; can't find either one. Pond dry with much open soil; lots of burros. **[Marginal note: 2 animals]**
At and around pond #3 - Pond in same condition as #1. Fresh tracks of 1 small (♂ scale) animal on its bed, but could not find. At pond lots of burros sign. **[Marginal note: 1 animal]**

Fresh sign of 1 animal just west of pond #3 in usual sample area - also **[Marginal note: 1 animal]**

Pg. 154.
Could not find.
I then went far to south - ½ km or so looking through many pampas of dried up herbs, open spots, muddy depressions under manzanillo groves. In all this searching found only fresh sign of 2 more medium-sized (♂ scale) tortoises. Very little fresh tortoise sign. Mostly very scattered old turds, trails and dry wallows from hot season. Clearly since end of February at latest the animals have been very, very dispersed here.
Perhaps lack of tortoise influx back into this region is due to fact that herbs still mostly dead and dry and really badly eaten out by goats - will take another 1 to few months to green-up again to grazing level for tortoises.
Indications are that animals probably are and have been very scattered in the area through hot season that many moved up also to greener forests and pampas near colonized zone; others moved down to cactus forest. Finally, most probably simply dispersed widely at these altitudes.
Even though few here and little sign now, certainly are more and more sign

Pg. 155.
Than I encountered on a similar sample in late may 1970 towards end of the hot season.
While I was gone Julio took measures in Zone 3 NA and Region 4 - today I mean.
Region 4 - (Weather) - 1020 hours - Max 76.0; Min 62.0; Rain 1.2 mm, emptied; Evaporation - dry!, refilled full
Zone 3 NA - (Weather) - 1120 hours - Max 78.0; Min 64.0; Rain 1.0 mm; Evaporation - dry!, refilled full.
Caseta - Weather - 1900 hours - cool, cloudy, and garua almost all day long. Max 68.0; Min 60.0; Rain 1.6 mm; Evaporation - 0.l4 mm (reading 5.7).
July 16, 1970 -
Doing a few odd jobs at Caseta most of the day. In afternoon going to south and southwest of Caseta looking for a goat for photographic purposes. Will note tortoises as I see them.
At Caseta pond #1 -
#351 ♀ - (#14 painted) - moving northeast toward Caseta area along drainage out of Caseta pond #1. Up from Region 4 in a relatively short time!
In pond #1 beg -

#665 ♀; CL 97.6; CW 106.4. F.d. over much of rear 1/5 of carapace and spots on front marginals; w.g.i.'s present but extremely thin. No lichen's; black-green algae in a few places on rear of carapace especially along scute junctures. No red soil.

Pg. 156.
On her anywhere to indicate that has nested below here in Zone 3 NA or a similar location. Only mud is of type from this area. Scutes smooth in central 1/20-1/6 only, but shell notably worn everywhere.
#570 ♀ - CL 97.6; CW 110.9. No lichens or algae; very little f.d. - only a few spots on rear of carapace and front marginals; w.g.i.'s extremely thin; Scutes smooth only in central 1/30-1/10. Red soil of dark red type on skin around legs; well worn in, but does not indicate much about where she has been. Very domed.
#717 ♂ (probably) - CL 83.5; CW 90.2. No lichens or algae; w.g.i.'s nonexistent. Think I last saw in Region 4 several months ago; has red-brown soil that is found in places just east of that region well worn into skin and lower part of the carapace. Tail rather intermediate in length.
In areas just 30-40 m west of pond #1 -
#891 - sleeping in open trying to bask.
#699 ♂ - (painted #16) - CL 95.3; CW 100.2. No lichens; a few places and bits of black-green algae on rear of carapace; w.g.i.'s non existent. Heading toward pond #1.
#1022 - on S side of pond.
On to south -
#835 ♀ - same exact place where last saw her over 1 week ago.

Pg. 157.
Around Caseta today -
#598 ♀, #1006 ♀
#48 painted just southeast of Caseta 30 m.
#220 ♂ at Caseta pond #4
Caseta Weather - 1900 hours - cool and cloudy all day - garua off and on till noon, then none. Max 72.0; Min 61.5; Rain 4.4; Evaporation 0.8 (reading 6.5).
July 17, 1970 -
To El Chato to sample -
Enroute many animals in mora area -
#827 ♀ - ½ way between forest - mora border and top of first hill.
#96 ♂ - half way between forest - mora border and top of first hill.
#167 ♂ - half way between top of first hill and Rt. Turn.
#450 ♀ - same areas as #167.
#50 (painted) - same area as #167 - (= #354 ♂) - at Caseta on 13 July.
#1186 - 75 m east of Rt. Turn.
#1 (painted) - 30 m east of Rt. Turn.
#408 - just before Rt. Turn.
#327 ♂ - CL 152.3; CW 162.3. no lichens; black-green algae and f.d scattered in normal places; completely smooth scutes; w.g.i.'s present but thin; very huge. At Rt. Turn near Camote patch.

All the above animals active and grazing between 0815 and 0845 hours when encountered - all feasting on *Commelina* and *Passiflora*.
#97 ♂ and # 98 ♂ - in exact same places where last saw 10 days or so ago. Grazing.
#372 ♂ - CL 123.7; CW 136.1. About 200 m east of El Chato turn off, just a few m N of Reserve Border - grazing.

Pg. 158.
No lichens; abundant f.d. all over rear 1/5 of carapace, front marginals area and along sides of carapace low down. Black-green algae abundant on rear of carapace and front marginals area. W.g.i.'s clear but very thin. Scutes smooth in central 1/6 - 1/3 of their surface area. Painted #51.
#92 (4 or 7) ♂ - moving near Reserve Border toward El Chato to SW - about 750100 m east of El Chato t.o.(turn off). CL 98.1; CW 109.3. No lichens; abundant algae (black-green) all over rear 1/5 of carapace; w.g.i.'s almost none existent in few places where visible are extremely thin. Painted # 52.
#301 ♂ - CL 114.5; CW 130.2. Perhaps 101 ♂ but doubt it. Has 12 right marginals and first two rear are small, but both notched as best as I can tell. Re-marked as 301 anyway. No lichens or algae; f.d. scattered all over usual areas. Scutes smooth in central 1/15 - 1/4. w.g.i.'s present but thin. Grazing. Painted #53. Same area as previous animal.
#515 ♂ - CL 113.8; CW 119.0. slightly further to west of previous 2 animals; no lichens; bits of black-green algae on rear of carapace; w.g.i.'s mostly not present at all; where can see are extremely thin. Painted #54.

Pg. 159.
In area of El Chato turn off and small pond near Reserve Border - National Park border -
#513 ♂ - CL 129.0; CW 137.7. No lichens or algae; w.g.i.'s clear and well developed - medium thickness; basking. Painted #55.
New #1269 ♀ - CL 96.2; CW 104.8. No lichens; black-green algae along scute junctures of rear of carapace; only a few spots of f.d. on rear and front marginals; scutes smooth in central 1/15-1/3. w.g.i.'s clear, thick, and well developed. Moving to pond bed from north. Painted #56. **[Marginal note: This is a repeat (mistake) see July 6, 1970 notes.]**
#441 ♀ - saw here over 1 week ago - moving north away from pond. Painted #57.
#195 ♂ - CL 110.8; CW 118.5. No lichens; black-green algae and f.d in usual 2 areas; also f.d. scattered along lower sides. Scutes smooth in central 1/10-1/2. w.g.i.'s nonexistent. Painted #58. Grazing on *Commelina*.

Region 1 - guayavillo forest above El Chato to pond #1 at base of the hill.
#30 (painted) - moving up from direction of pond #1 - ¾'s of way up through forest already.
3707 ♂ - in forest just up trail a short ways from pond #1. - CL 97.9; CW 103.3. No lichens; black-green algae abundant on rear 1/5 of carapace and front marginals area; a lot of f.d. in same general areas; scutes smooth in central 1/5-2/3. w.g.i.'s nonexistent. Basking in an open spot under the canopy.
#775 ♂ - moving through forest away form pond #1 to NE.

Pg. 160 (unnumbered - last page of notebook).

Around pond #1 -
#149 ♂ - CL 144.5; CW 159.5. F.d. scattered in usual places and elsewhere also; black-green algae common on rear 1/5 and front marginals area; no lichens; w.g.i.'s non existent. Scutes smooth all over. **[Marginal note: grazing , pond bed.]**
#296 ♂ - CL 137.7; CW 151.2. No lichens; small bits of black-green algae on rear of carapace along scutes junctures. W.g.i.'s incomplete and where present extremely thin. **[Marginal note: grazing , pond bed.]**
#63 ♂ - CL 128.8; CW 137.8. No lichens; black-green algae common on rear of carapace especially along scutes junctures; w.g.i.'s present and well developed, but thin. Climbing about in pond bed.
#171 ♂ - CL 141.6; CW 150.7. Drinking from lava basin in pond bed. No lichens; black-green algae in usual 2 areas especially along scutes junctures. W.g.i.'s present and well developed but thin.
#68 ♂ - CL 119.8; CW 128.7. No lichens; black-green algae in usual 2 locales. W.g.i.'s non existent. Basking in open near pond.
#139 ♂ - CL 143.4; CW 152.7. No lichens; black-green algae abundant in 2 usual areas; w.g.i.'s nonexistent. Sleeping and basking in open.
#658 ♀ - CL 83.7; CW 93.6. No lichens but rear ¼ covered with black-green algae- also a lot on front marginals. W.g.i.'s non existent; moving around near pond.
#211 ♂ - CL 131.3; CW 147.3. Grazing on grass in open near pond. No lichens. Black-green algae in 2 usual places; w.g.i.'s non existent.

End of notebook.

Isla Santa Cruz Volume #10.
Field Notebook of Craig MacFarland

Pg. 1.

July 17, 1970 - [appended note: see pp. 60 ff. for additional data for this day]
El Chato sample continued -
#51 ♂ - CL 142.7; CW 142.5 - very elongated shape; no lichens; faint traces of black-green algae in 2 usual places; wgis present but extremely thin. Moving NE to pond #1 from pond #2 area.
Between Ponds 1 and 2 - saw none but plenty of fresh turds and trails in mud all over - wallows well used also.
Around Pond #2 -
3192 ♂ - CL 122.9; CW 138.2. Mating attempt (more below) k- No lichens; black-green algae in 2 usual places along with abundant f.d.; wgis present but very, very thin.
#130 ♂ - (note this is a repeat # - other #130 is a ♀ from zone 3 NA) - CL 130.4; CW 139.3. No lichens; black-green algae in 2 usual places especially along scutes margins and junctures; wgis present and moderately thick and well developed. Wallowing in shall sticky mud.
#1121 - CL 57.8; CW 59.6; ♀ maybe but too small to sex accurately. No f.d., lichens, or algae; wgis nonexistent. No smooth scutes except central large patches of 2nd and 3rd vertebrals have f.d and are coming off as almost whole pieces - will leave central 1/8-1/6 of each scutes smooth! Eating grass - where is this tiny fellow from ?
#540 ♀ - CL 79.8; CW 86.3. No lichens; black-green algae along scute junctures at rear of the shell. Wgis nonexistent; moving along just NE of the pond.
#1208 ♀ - CL 74.9; CW 82.2; No lichens, bad f.d and lots of black-green algae in 2 usual places. F.d. all around lower 2/3's of carapace; wgis nonexistent; in open, basking.

Pg. 2.
New # 1270 ♂ - CL 101.0; CW 107.4. Scattered minor spots of f.d. on rear ¼ of carapace and along sides; abundant f.d. on front marginals area; black-green algae abundant in 2 usual places; no lichens; wgis non existent. Eating grass near pond. Scutes smooth in central 1/20-1/8.
#703 ♀ - CL 86.9; CW 92.8. Moving out of forest into pond #2 pampas area. Only a few spots of f.d. along sides; scutes smooth only in small central parts. 1/30-1/20 or so; no lichens; black-green algae on rear of carapace here and there. Wgis non existent.
#616 ♀ - CL 97.8; CW 108.1. No lichens, no algae; wgis complete but thin. No soil to indicate previous nesting; moving along pampa forest interface- eating herbs - saw eating Passiflora especially.
#109 ♂ and #608 ♀ (CL 102.0) - mating in guayavillo forest; copulating - see discussion which follows days notes.
New #1271 - CL 62.6; CW 66.5. Maybe a ♂ but too small to sex accurately. No lichens, algae, or f.d. Most scutes worn some but smooth only in very centers of vertebrals #2, 3, and 4. wgis non existent. Eating grass near weather instruments.
Weather - 1400 hours - Rain 0.46 inches, emptied; Evaporation 19.5 ml, refilled full.

Pg. 3.
Ponds #3 and 4 and surrounding area -
#168 ♂ - CL 129.8; CW 145.0. No lichens; black-green algae scattered and light in 2 usual areas. Wgis well developed but very thin. Basking in open.
#182 ♀ - CL 105.8; CW 116.1. Bad f.d. all over. Black-green algae all over rear 1/3 of carapace, front marginals area and scattered elsewhere! Wgis non existent; scutes smooth in central 1/10-1/4. No lichens. Basking in open.
#10 ♂ - back in old stomping grounds near pond #4 - CL 140.4; CW 151.5. No lichens; some black-green algae scattered all over shell but confined almost exclusively to junctions of scutes. Wgis present but very thin. Basking in open.
#142 ♂ - CL 139.4; CW 148.0. No lichens; black-green algae in 2 usual areas confined mostly along scute junctures; wgis well developed but rather thin. Basking in open.
#449 ♀ - CL 82.4; CW 88.5. Basking in open; bad f.d. on front marginals area and bits of it on rear 1/5 of carapace and elsewhere; no lichens; black-green algae scattered and light in 2 usual areas. Scutes smooth in central 1/30 -1/10. wgis present but incomplete and extremely thin.
[Marginal note: Mating]
#1231 ♀ - CL 84.3; CW 90.4.
#339 ♂ - CL 134.7; CW 152.4 - copulating - came upon them - looked successful - interesting because ♀ is relatively small one.
#281 ♂ - CL 132.5; CW 138.4. No lichens; scattered patches of black-green algae on rear of carapace; wgis clear, w. d. (well developed) , and moderately thick. Sleeping.
[Marginal note: mating]
#New 1272 ♀ - CL 100.9; CW 112.0. Very old, all smooth scutes ♀; no lichens, algae, or f.d.; carapace much like those of ♀♀ like #'s 3, 127, 130, 131, etc.
The above 2 animals sitting by each other - ♂ asleep, ♀ withdrawn and inactive - probably a previous copulation attempt.

Pg. 4.
#302 ♂ - CL 139.8; CW 156.5. Several splotches of a light blue-green gray lichen on 4th vertebral scutes; black-green algae scattered but common on rear ¼ of carapace and front marginals area. Wgis clear and well developed - moderately thick - basking in open pampas.
#146 ♂ - CL 107.8; CW 113.2; Moving along on forest - pampa border. Has an unusable left rear hind leg - apparently was broken.
This completes 2/3's of sample only, will continue tomorrow.
On return saw 2 additional animals-
#1036 - along trail (Reserve Border) about 75 m east of El Chato turn - off - actually 20 m south of Reserve Border in Passiflora pampas.
#106 ♂ - moving along trail at a very steady pace from west to east toward area above Caseta - saw about 10 days ago way to west, almost to Reserve Border just above El Chato. Now is almost to top of first hill just west of Caseta upper ponds area.
Also #775 ♂ had moved up through forest to edge of mora along new trail above El Chato.
Matings today -

First ones involved animals #192 ♂, #109 ♂, and 608 ♀. Heard groans of #192 ♂ and found him mounted on #608 ♀ in bushes just east of pond #2. At about time I spotted them I heard #109 ♂ crashing through the bushes about 25 m

Pg. 5.
Away from the pair and heading directly toward them. Can not say for sure he was attracted by the groaning but it is an entertaining though that, that was perhaps the reason. The ♀ was clearly trying hard to get away from ♂ # 192 and was being successful at frustrating him by pivoting under him. She was not having too much difficulty in doing this because relative to his size she was rather large compared to most mating couples. Finally, after I watched them for only a few minutes, she broke loose from under him and he chased her close behind. She passed easily (and just barely cleared it) under a semi-prone guayavillo trunk. He rammed into this full force and was unable to pass it because of his height- he simply settled down in the dense brush and gave up.
She moved directly into the path of #109 ♂ who is a bit larger than #192. He immediately gave chase, caught up with her and mounted. He then proceeded to emit rhythmic groans and mate in normal fashion for about 30 minutes - at the end of this time he dismounted voluntarily and she soon moved away - thus probably a successful mating. She tried squirming under this male also but was crammed up hard against some shrubs and he was heavier than the previous ♂. The other definite mating today is mentioned on page 3 and was probably successful - it was normal in every way - the ♀ was very small relatively speaking and thus of interest.
May have been one other copulation - see page 3.

Pg. 6.
On return to Caseta - saw following animals -
#1205, and #1036 - both near Reserve Border on new El Chato trail - i.e. 75 m east of El Chato turn - off on Reserve Border.
Caseta weather - 1900 hours - cool and overcast almost all day - occasional light garua but not much; Max 73.0; Min 63.0; Rain 4.5 mm; Evaporation 0.9 ml (reading 7.4).
[Note: added units after confirming what standard is for Caseta; Chato rainfall is always inches]
July 18, 1970 -
Continuing El Chato sample South side of El Chato in pampas:
New # 1273 ♀ - CL 70.5; CW 73.0. Scutes smooth only in very centers; no lichens, algae, or f.d.; wgis very, very thin. Basking in open pampa.
#567 ♂ - CL 142.5; CW 153.5; Basking in open pampas; no lichens; f.d. and black-green algae all over 2 usual places the latter mostly along scutes junctions; wgis extremely thin; scutes entirely smooth.
#653 - CL 59.7; CW 62.2. Very tiny fellow; sitting inactive under a manzanillo in pampas. ♂ maybe but too small to se accurately; wgis clear and well developed; scutes smooth only in very centers, no f.d or lichens; some scattered black-green algae (very thin covering) on rear of carapace.
#1231 ♂ probably - tail a bit intermediate in length. CL 84.5; CW 90.5. F.d. all over and black-green algae also in 2 usual places. No lichens; wgis clear but very thin. Burrowed in - 1400 hours. **[Marginal note: repeat from yesterday but copulating yesterday.]**

Pg. 7.
Heard a copulating ♂ to NW of sample area and found the pair - out of sample area but will record - male was groaning very rhythmically about every 5-6 seconds and copulation looked very successful. Stopped when I approached because got very close before I could see them and then ♂ saw me.
♂ #208 - CL 139.9; CW 147.0. No lichens; black-green algae all over rear 1/5 and front marginals; wgis nonexistent.
♀ #1224 - CL 76.3; CW 80.7; no lichens; bad f.d. and black-green algae all over 2 usual areas; wgis present but very, very thin.
Back to sample -
#566 ♂ - CL 124.4; CW 134.3. In a mud wallow in pampa - manzanillo grove area - sitting quietly; no lichens; completely smooth scutes (but relatively small); no algae; wgis present but very thin. F.d. only in a few minor spots on front and rear marginals.
New # 1274 ♂ - CL 85.1; CW 88.8. Grazing on grass in open pampas; no f.d., or algae, scutes smooth only in very central 1/20 -1/10. Black-green algae in thin coating all over 2 usual areas. Wgis no existent.
#612 ♀ - CL 87.8; CW 93.2; moving along in pampas. Wgis present but very thin. F.d. all over rear of carapace, front marginal area and some along lower sides; no lichens; black-green algae extensive on lower rear of carapace and bits on front marginals also.
One more medium sized ♀ - but well burrowed in and can not reach to check her # or get measurements.
On return nothing new except #106 ♂ almost to Caseta turn off on Reserve Border.
Caseta Weather - 1900 hours - cool and overcast all day, garua off and on all day - Max 70.0; Min 63.0; Rain 3.8 (mm); Evaporation 0.3 (ml)(reading 7.7).

Pg. 8.
July 19, 1970 -
To Cerro Gallina - 3-4 day trip.
Region 3 of trail - beginning just on edge of south side pampas at base of El Chato.
#548 ♀ - CL 78.8; CW 88.3; no lichens, black-green algae and f.d. all over on rear 1/3 - 1/4 of carapace and front marginals area. Scutes smooth only in very centers; no lichens; wgis clear but very thin. In first small pampa only 50 m below El Chato main pampas; resting and trying to bask in open - raining like hell.
Three animals just 50 m more south along main drainage - pampitas, manzanillo groves and flat lava blocks with H20 in small pockets.
#2? - marked in 10, 20, and 70 scutes. CL 139.2; CW 155.7; no lichens; black-green algae scattered all over in 2 usual areas, f.d. in same areas but only scattered spots; all smooth scutes; wgis nonexistent. Resting in open in rain.
#198 ♂ - CL 140.8; CW 148.7. Huge and all smooth scutes; scattered f.d. and black-green algae in 2 usual areas. Wgis nonexistent. Lichens of one type - (usual pale blue-gray-green) in several large patches on last, left, rear costal scutes. Drinking on lava rocks in drainage bed.
#714 ♂ - CL 82.0; CW 84.0. No lichens; scattered minor spots of f.d. on front marginals and rear 1/8

Pg. 9.
Of carapace; a few patches of black-green algae on rear marginals and supracaudal scutes. Wgis present but very thin; basking in open about 15 m east of trail in an open pampita. Scutes smooth only in very centers.
In next (and last) pampa to south - 50 m more -
#685 ♂ - CL 134.8; CW 145.4. Have seen him here several times previously. Sleeping out in open in rain. No lichens; black-green algae all over the rear of his shell (1/4) and front marginals area; wgis well developed but moderately thin.
#633 - about ½ way from last animal to Zone #5 - where just becomes drier forest.
From here to almost in Zone 5 saw no more tortoises and almost no sign - apparently has not been much vertical movement - very interesting because influx at El Chato - thus must not have come from below to any great extent.
Almost in Zone 5 - Region ¾ border-
#1220 - CL 74.2; CW 74.9; Black-green algae all over rear 1/5 of carapace and front marginals area; no lichens; bad f.d. in usual 2 areas; wgis very, very thin. Sitting under a guayavillo tree; inactive.
#150 ♂ - CL 134.3; CW 151.0. Moving along very deliberately and steadily down trail along drainage into Zone 5 area. Have seen him before I am sure- has deep cuts in 2000 and 4000 scutes. No lichens; abundant black-green algae especially along scutes junctures in 2 usual areas. Bit of f.d. in 2 usual areas; scutes all smooth. Wgis clear, well developed and moderately thick.
Region 4 or 'Zone 5 - Straight line sample-
New #1275 ♂ - CL 94.4; CW 96.4. In first part of the region, sleeping in an open spot. Only a few very

Pg. 10.
Minor spots of f.d. on rear and front marginals; scutes smooth only in very central parts. No lichens; wgis non existent; black-green algae abundant in 2 usual areas.
#856 ♀ - almost in camp - dry pond area; sleeping in forest. CL 101.2; CW 109.8; all smooth scutes; no lichens; black-green algae prominent and thick along scutes junctures of rear ¼ -1/5 of carapace.
#921 ♀ - CL 74.3; CW 78.2. Walking about and grazing along trail area just beside dry pond. No lichens or f.d.; Scattered black-green algae on rear 1/5 of carapace. No much visible of wgis and very, very thin in few laces where exist at all.
#1164 ♂ - CL 84.2; CW 90.1. Grazing near pond in semi-open. No lichens or algae; wgis incomplete and extremely thin.
New # 1276 ♀ - CL 80.5; CW 86.5; edge of pond, sleeping in semi-open area; no lichens, algae, or f.d.; wgis present but very thin; scutes smooth in central 1/20 only.
Three huge males all in pond bed right beside trail, sleeping and basking. Obviously came here in morning to drink H20 collected on and between lava plates:

Pg. 11.
#1181 ♂ - up from nesting area below Cerrito!
#507 ♂ - old scarred friend.

#289 ♂ - CL 136.5; CW 145.4. No lichens; dried black-green algae along scutes junctures in 2 usual area; all smooth scutes; f.d. scattered in small spots in 2 usual areas and some along sides here and there; wgis nonexistent.
Heard a pair mating and went to investigate - saw several animals in process - not in straight line sample.
#1163 ♂ - CL 98.6; CW 105.5. No lichens; abundant black-green algae in 2 usual areas despite lack of almost any f.d.! wgis non existent. Moving around in pond bed.
#619 ♀ - CL 97.7; CW 108.7. Almost completely smooth save for very outer edges of scutes where can still see slight old, worn growth rings; very old shell typical of this size ♀ - like #'s 3, 131, 130, 127, etc. F.d. scattered all over shell especially and mostly confined to these areas with growth rings; no lichens; black-green algae thick and dense in 2 usual areas, especially all along scutes junctures; wgis nonexistent.
#220 ♂ - CL 144.8; CW 151.3. Incredibly bad f.d. all over carapace in huge patches (even worse than #507) despite fact that scutes are entirely smooth. Wgis non existent; no lichens; black-green algae extensive all over rear ¼ of carapace and a lot along front marginal areas scute junctures.
[Marginal note referring to #619 ♀ and #220 ♂: mating- successful - for 35 minutes ♂ groaning every 10-14 seconds - see below - note repeat #]
Back to sample of straight line:
#545 ♂ - CL 137.6; CW 151.7. Moving along on east side of pond edge. Almost all smooth except for just along margins of each scutes; extensive f.d.

Pg. 12.
On rear 1/3 of shell and front marginals and scattered elsewhere, especially along scutes margins; no lichens; black-green algae in light covering on rear of carapace and along scutes junctures in front marginals area. Wgis non existent.
New # 1277 ♀ - CL 71.1.; CW 72.8. No lichens, algae, f.d.; scutes smooth only in very centers; wgis clear but thin. Coming up trail -about 25 m south of dry pond.
On return from straight line sample I noted that #619 ♀ had taken off directly down hill soon after being mated with by #220 ♂. She left pond bed at 1530 and at 1610 was about 100 m south moving along trail I.e. drainage bed downhill to south. Sill be interesting to see when she reaches the nesting areas below if that is where she is heading.
Also saw #1276 ♀ moving exactly similar and lonely a few dozen feet behind #619. Also to nesting area?
Also on return to campsite discovered #856 ♀ moving very deliberately along trail to south - also perhaps to Nesting Area? She is about 75 m from where first saw here sleeping this afternoon. Watched here awhile and found that she went to dry pond and searched around till found some H20 in small lava pockets.

Pg. 13.
Enlarged sample of Zone 5 - i.e. first ½ of it today.
All of above animals plus -
#348 ♀ - 50 m southwest of dry pond- campsite area - off of trail about 50 feet - perhaps heading to Nesting Area but can not say. Burrowed in when found at 1545. CL 98.8; CW 110.1. All smooth scutes except for a small area at very outer margins of each scutes;

only scattered minor f.d. in 2 usual area; no lichens; black-green algae in 2 usual areas but not much and confined along scutes junctures; wgis present but very thin.
#1225 ♂ - just a few m SW of dry pond - burrowed in at 1600.
Beyond sample area to SW along some goat - tortoise trails - only 25-50 m from dry pond campsite area - this is all I examined.
#708 ♂ - CL 137.2; 'CW 151.0. Very large, old and all smooth shell- f.d. scattered all over shell, sometimes in deep corroded patches - black-green algae all over rear ¼ and front marginals area; also some in other places along scutes junctions. Wgis nonexistent. No lichens; moving around behind a small one and then away from it - still active at 1700 but smaller one burrowed up against a log (#705).
#705 ♀? - CL 82.5; CW 86.5. No lichens, algae, or f.d.; scutes smooth only in very centers (maximum 1/15-1/20). Wgis non existent.
One more medium (♀ scale) one seen but burrowed in so well I could not reach to examine for sex, #, measurements, etc.

Pg. 14.
On returning to get equipment for bivouac, found #856 ♀ still ambulating around in pond bed at 1730 - all other animals I have seen for last half hour are burrowed in. Not quite true - just found #1275 ♂ at dry pond walking about also - looks to be searching for a burrow site under *Clerodendron molle* shrubs. Interesting - moved about 300 -350 m since I first saw him at Region ¾ border at about 1200 hours.
[Marginal note: copulation]
Mating between #220 ♂ and #619 ♀ was apparently successful. I head the male first start groaning rhythmically near me at 1450 hours. Went to investigate and found them in a pond beg; jammed up under some Clerodendron bushes. I was able to watch the whole process from behind them at only a few feet distance. ♀ was passive during the entire process and mating was normal as I have described it before. - ♂ with forefeet on her front marginals, lifting of back feet off of ground with each thrust etc. He thrust every 10 -14 seconds, accompanying each thrust with a low, deep 1-3 second groan throughout the entire period. After 35 minutes he stopped, climbed off of her and walked away. One interesting aspect was that with every thrust he put his tail under the rear end of her.

Pg. 15.
Carapace and near here cloaca; with the end of each thrust as he re-extended his hind legs and relaxed his forelegs and rocked back into the non-thrust position his tail (simply because of obvious mechanical necessity and size) rocked out from under her carapace and away from her cloaca.
Rained all day till 1330 - then no garua but cloudy to and after sunset.
July 20, 1970 - Continuing to Cerro Gallina -

Found #619 ♀ about 30 m further down trail from where last saw her last night - continuing on at a steady pace down trail toward coast - at 0730.
About 250 m south of Region 3 (Zone 5) - at another area of big flat rocks and small soil patches in amongst small boulders- a dry pond bed with *Clerodendron*; small pockets of H20 here and there -

#1025 ♀ - CL 87.7; CW 100.4. All smooth shelled but notably small for this old worn condition! Shell looks like those of #'s 3, 127, 130, 131, and the next animal mentioned below. Scattered f.d. all over shell in small, often deep, patches. No lichens; black-green algae thick along almost all scutes junctures all over shell; wgis nonexistent; basking in open on pond bed.
#826 ♀ - CL 105.3; CW 117.0; All smooth and very worn shell; no lichens; wgis present and reasonably well developed, but thin. Black-green algae prominent only along scutes junctures in rear and not very much there; also basking in same place.
[Marginal note: these two only about 1.5 m apart - aggression?]
Neither ♀ as with all those seen in Zone 5 and El Chato has any soil adhering to tail, feet, shell or skin which would incite having nested below here yet.

Pg. 16.
Rest of Region 5 -
No tortoises seen and virtually no fresh sign beyond those 2 above - i.e. no recent (last 2-4 weeks) traffic.
Region 6 - ditto to Region 5 lower part.
Region 7 - rocky area leading to first nesting zone.
New #1278 ♂ (maybe) - CL 69.5; CW 71.3. Just at upper part of rocky zone at base of Cerrito where Reg. 7 begins. Basking in an open spot beside small soil burrow amongst rocks (last night's burrow). No lichens, algae, or f.d.; scutes smooth only in very centers; wgis non existent.
New #1279 - CL 46.1; CW 48.9 Too small to determine sex. No lichens or algae; no smooth scutes; no f.d. on carapace upper surface but a few tine streaks just starting to appear on underside of rear marginals. Wgis non existent. Moving along near trail (new trail to Cerro Gallina and new nesting zones) at about same level (180 feet altitude) as old nesting are where I did enlarged samples through may 1970. Tried counting growth rings and got 14-16 every time!
[Marginal note: death]
Very near here found dead decomposed (only bones and scutes left) body of what was a huge dome-shaped male. Could not measure because died in upright position and whole tope of carapace has caved in. Died of natural causes.

Pg. 17.
Because whole skeleton there and no signs of human cutting or disturbance. Collected the skull. Under a large Pisonia tree - of course, impossible to determine cause of death but certainly not from falling or such type of injury. Perhaps heat, starvation or disease. Must be 4-10 years old since death.
On toward nesting area -
#1046 ♂ - CL 129.9; CW 147.5. <u>From El Chato area.</u> About 20 feet lower in latitude from last stop. Just finished mating with the ♀ recorded next. As I walked up he was just dismounting. They are on a flat lava raised area where lots of small H20 collection pockets are this area is slightly lower down than last years nest #16 area. There are depressions around here with small patches of soil suitable for nesting. **[Marginal note: probably a successful copulation - he is wandering away from her.]**

He has plenty of black-green algae in 2 usual areas. Has patches of several kinds of lichens -
1. common pale gray-green-blue scattered over lower half of 4th vertebral, on later 2/3's of each last coastal scutes, and on upper half of 5th vertebral.
2. a more greenish pale type on lower half of 4th vertebral and on first marginal on each side in front.
3. one triangular shaped patch of a yellowish green type on last left costal near its border with 5th vertebral.
Wgis non existent.
New #1280 ♀ - CL 94.3; CW 107.2. Old, worn shell, complete smooth scutes. Almost no f.d. - only a few patches scattered in usual areas. No lichens; black-green algae on rear marginal and front marginal areas but confined to scutes junctions; wgis present but very thin.

Pg. 18.
Painted #1046 ♂ as #59.
Painted #1280 ♀ as #60.
Took 2 photos (#'s 34 and 35, Roll ----) of lichens on last rear left costal of #1046.
Continued on trail - short distance, i.e. about 75-100 m more and hit a large area of soil sites and potential nesting locations.
Continued to Galo and Julio's campsite in this area. Will describe area in a few minutes.
On trail - i.e. part of straight line sample -
#469 ♀ - CL 94.0; CW 105.6. Very old, deeply grooved, completely worn shell; no lichens or algae; f.d. only in spots and along scutes junctures; wgis non existent; basking in open near potential nest sites; can't tell if has laid yet - some red soil on rear end.
Painted #61.
Then searched around all over area for more tortoises, nest, and to get a good look at the area as a whole. Found a lot of tortoises in one small area -
New # 1281 - CL 49.6; CW 53.1. No f.d., lichens, algae or smooth scutes; wgis nonexistent. Foraging in the area of soil in a large depression.
#1282 - CL 36.7; CW 37.3. No lichens, algae or smooth scutes; 2 tiny spots of f.d. on rear marginals outer surface and abundant f.d. on underside of rear marginals; wgis very, very, extremely thin; foraging on plant #2 stems (no leaves available) in same area.

Pg. 19.
#1283 - CL 41.3; CW 44.5. No lichens, algae, or smooth scutes; a few spots of f.d. on both surfaces of rear marginals; wgis present but extremely thin; basking in open in same area.
#66 ♀ - CL 69.3; CW 75.8. No lichens or algae; scutes smooth only in very centers; only a few tiny spots of f.d. in usual 2 areas. Wgis non existent; marks almost faded beyond visibility so re-marked. Moving around in same area. Painted #64.
#440 ♂ - CL 136.8; CW 144.3. No lichens or algae; scutes smooth except for about a 1.5 inch border all around margin of each; f.d. scattered all over shell, especially along lines where growth rings still present. Wgis clear, well developed, and thick! Probably has been down here for several months eating cactus pads??! Basking just above this soil

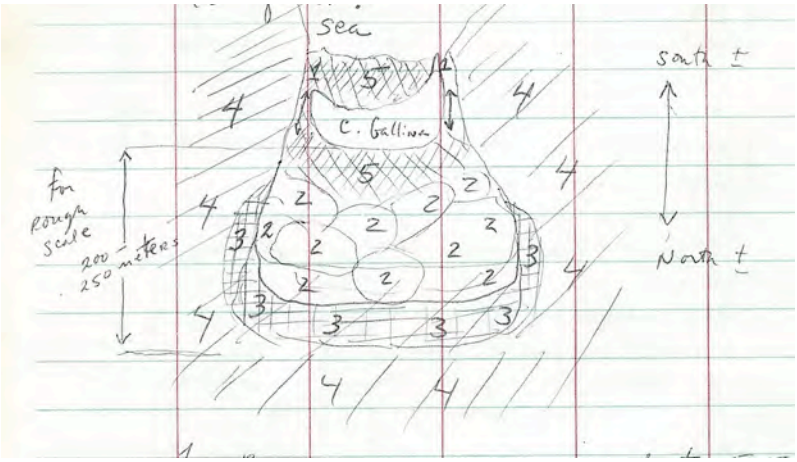
depression where 4 above animals were - on a flat rock area where H20 is collected in pockets. Painted #62.
#189 ♂ - CL 135.5; CW 151.5. From El Chato!! No lichens; dried up black-green algae in usual 2 areas; faint bright yellow-green algae on lower ½ of 4th vertebral and rear of 3rd costals and upper part of 4th costals of each side; f.d. scattered in tiny spots all over shell - scutes all smooth; wgis clear and moderately thick. Basking on raised up rocky area above soil depression noted above. Painted #63.

Pg. 20.
Back on trail -
New # 1284 - CL 48.1; CW 50.9 - short ways beyond campsite - rocky uplift but still lots of nesting sites and depressions with soil. Moving along on uplift. No lichens, algae, f.d., or smooth scutes; wgis non existent.
#472 ♀ - CL 99.8; CW 109.2. Only 50 m further along tail - Basking out in very open large depression with much soil - certainly a nesting area. Can't ell if she has nested yet - no recent mud on rear parts; no lichens; black-green algae in grooves all over shell; very old worn deeply grooved, all smooth shell. Only scattered small spots of f.d. in 2 usual areas. Wgis non existent. (Painted #65).
#486 ♂ - CL 155.9; CW 161.7. Huge, all smooth shelled animal; one of the biggest I have yet seen. Sitting inactive just N of trail abut 100 m beyond Nesting Area - in fairly dense small stemmed *Pisonia* forest - very near another flat lava plate area with small water collection pockets. No lichens; dry black-green algae in 2 usual areas; f.d. scattered in large deep patches on rear ¼, front marginals, and in a few other locations. wgis beautifully developed and thick. (Painted #66).

Pg. 21.
Another 75 m down trail encountered a very small fellow.
New #1285 - CL 34.3; CW 36.3. No lichens or algae; one spot of f.d. right in center of 5th vertebral scutes and extensive f.d. on undersides of front and rear marginals and gulars. No smooth scutes; wgis no existent. Sitting in brush - probably for night - time is 1430 hours. Very rocky area - no soil - must be a nesting area nearby.
Continued on to Cerro Gallina - saw no more tortoises and no sign. In fact after new nesting area where tortoises and sign are abundant there is a rapid petering out of sign such that for 2/3's of way (last) to Cerro Gallina I aw absolutely nothing.
Enroute did come across several small depressions with reddish- or yellowish-brown soil where nests could be made - but no tortoises or sign in any of these. There were well separated and scattered out. Virtually the entire way from the new nesting zone to Cerro Gallina is all rocky and covered with a good covering of small stemmed *Pisonia*, *Croton*, *Palo Santo* and dry herbs.
Also crossed several NS and NE-SW running goat trails in this last 1/3's of this hike k- these probably, or at least some of them, go to other small soil filled depressions with suitable nesting sites.
Arrived at Cerro Gallina about 1530 and explored the area till 1730. Will write up this area and describe findings tomorrow.

Pg. 22.

July 21, 1970 -
Searched over the Cerro Gallina area from 0630 - 0930 this morning to familiarize myself with it and to look for tortoises.
First, the area shows signs of heavy grazing and destruction by goats and donkeys. Immediately around the hill itself are large "pampas" of read and reddish - yellow soil and may vary shallow, low, dry pond -like areas with dark red-brown soil which is cracked deeply now, probably due to the recent very dry hot season. A rough diagram of the area is as follows:



1 - encañadas - narrow - about 5-15 m wide running down on either side of steep sides of mountain; squeezed in between the mountain itself and rock barrancas.
2 - dry pond beds, with some *Clerodendron molle* but mostly *Maytenus* trees and saplings and some dried out, leafless, unidentifiable (by me) shrubs; very rocky all over pond beds.
3 - partly rocky, partly soil covered areas between pond beds and barrancas.
4 - Barrancas on rocky uplifts - almost no soil at all.
5 - open all soil covered areas; on north more or less level, on south side of hill a fairly steep slope - 5°-15°; also same soil along and in encañadas.
Vegetation - trees mostly *Bursera* and *Piscidia* with some Maytenus, very occasionally others like *Erythrina*; did not see any *Psidium* or *Pisonia* here; tree *Opuntias* very few and far between, generally smallish, though trunked; no *Jasminocerus*. Goats clearly bad on tree cacti; many eaten fallen pads and partly chewed - through and falled chewed - through trunks. In open soil covered areas immediately around hill which would be fine for tortoise nest (because among other things don't collect H20) almost nothing on ground at all but dead litter. All herbs and shrubs destroyed by goats and burros - nothing to eat here for tortoises. Before goats must have been rather nice grazing here for tortoises - especially herbs.

Pg. 24.
Dry pond beds- no trees, mostly dry shrubs and sapling sized Maytenus trees (leafed out). No herbs at all virtually.

Areas #3 and 4 have tees of same species as described above, a bit more Opuntia trees, few shrubs, but more herbs than other areas. However, herbs mostly dry or very eaten back . Again almost no tortoise food.
Tortoises - few seen and almost no sign. No large or medium sized ones at all. Saw 2 smallish ones very near barranca to north in area 3, only 15 m apart - both sitting in shallow soil burrows.
459 ♀ - CL 56.8; CW 59.0. No lichens; algae, flaking disease; scutes smooth only in very centers; wgis extremely thin.
#765 ♀ - CL 62.6; CW 68.0 - carapace conditions all same as for #459.
Saw one in open soil area just at northern base of hill on flat area. Had just emerged from burrow between 0800 and 0900 and was moving north toward area where above two seen.

Pg. 25.
New # 1286 - CL 48.1; CW 50.0. No lichens, algae, f.d. or smooth scutes; wgis non existent.
Also saw no tortoise droppings anywhere except for smallish, dry ones of 1 month - 6 or 8 months age of about size made by animals of the above three's sizes - no droppings at all from medium or large animals. Did find 5 definite kills and 4 probables - certainly by fishermen. All carapaces of large ♀ or ♂. Four of them were only in small pieces scattered over areas of several meters diameter and weather worn. Probably all, 3 plus years old - can't call kills for sure but very likely. One was killed within past 6 months - 1.5 years - #9 (♂ probably) - CL 121.0 plus or minus; CW couldn't take because of places where persons cut plastron away from carapace. Carapace and plastron whole and carapace even though upside down in dirt still whole and not rotted at all. Scutes fallen off of bony carapace and plastron. Probably dead only 6 months plus or minus due to condition of the carapace.
All five kills in open soil area on N side of hill. Why no tortoises - 2 factors.
1. Killing and being removed by fishermen in past years and up to right now.
2. lack of food and H20 caused by heavy goat and donkey use - certainly has caused many if not most

Pg. 26.
Tortoises to leave the area, especially during dry years as the one has been to date - especially dry, hot, unfavorable hot season this year.
Also should note, lots of scattered pieces of tortoise bones in encañadas on either side of hill running to sea - all old - up to 10 years plus - probably some few from natural deaths but mostly from tortoise killings.
Returned to Nesting Area and on to Zone 5.-
In process I saw the following animals all in same or close to same locations where were yesterday afternoon - #'s 1285, 486, 472, 189, 66, 1283, 1282, 469, 1046.
No ♀♀ had nested yet - searched through all of new nesting area again. Counted 8 1969/70 nests destroyed by pigs in western 2 depressions of the area and 3 more in eastern part - agrees well with Julio's total count of 12 for all of nesting area.
Nesting area is at about 130-140 feet altitude more or less directly south of Cerrito hill. It consists of 4 small and 3 larger depressions filled with

Pg. 27.
Red soil as in Zone 3 Nesting Area - some of upland rocky areas between lower depressions also have patches of same type of soil suitable for nesting. Most of soil covered areas are devoid of trees and shrubs and thus shade. Main vegetation of the area is similar to Zone 3 Nesting Area - a lot of *Bursera* and *Piscidia* trees, few *Pisonia* trees; however unlike Zone 3 Nesting Area are some scattered small *Psidium* trees; almost no shrubs, some scattered herbs like in Zone 3 but less dense than there (probably due to heavy infestation of goats all through this area).
Clearly a well used Nesting Area. - lots of 1969/70 destroyed nests in a small total area and lots of smallish sized tortoises attest to this. Also pigs clearly get almost all or all nests here; presence of adult ♂♂ known previously from El Chato and large adult smooth shelled ♀♀ almost surely means this is a main nesting area for some ♀♀ from El Chato and Zone 5.
Description of 2 new areas to add to El Chato - Cerro Gallina trail - Region 6 still from base of Cerrito on south to new nesting area - lots of small *Croton* and *Pisonia* trees very thick, almost no *Opuntia* trees- very small -and very scattered where few occur. All

Pg. 28.
Rocky, virtually no soil depressions till new Nesting Area, good herb cover most of way when garua is bountiful or rainy hot season; not many shrubs at all. Few tortoises even in this region - too rocky and hard going.
Nesting zone - Region 7 - as described; fairly heavy tortoise population because of open soil for burrows, nesting potential and flat lava rocks for H20 collection.
Region 7 of trail - To Cerro Gallina from nesting zone - not greatly different from Region 6 - rather densely covered - lots of small *Croton* but gradually a few more *Opuntia* (still smallish mostly) per unit area, *Pisonia* and *Guayavillo* peer out completely and become dominant *Bursera* with a good admixture of *Piscidia*; more shrubs and less herbs than Region 6; very rocky also; soil depressions and patches more common but not much - Also few tortoises and almost no sign.
Returned to Caseta - On side of Cerrito where saw one small one last November

Pg. 29.
In dense, green vegetation. - 2 little ones!
1. same one saw last November - single vertical mark on 4th and 5th vertebral - CL 21.1; CW 21.6. Still no lichens, algae, f.d., or smooth scutes; wgis nonexistent; in very good condition; beside trail, eating herbs in wood.
2. 25 m away from above one - in trail moving across it into dense vegetation - CL 15.2; CW 16.2. Carapace conditions and general health same as previous one; put a single vertical mark on 5th vertebral lowest pint down onto upper part of supracaudal scutes.
#619 ♀ - almost to Cerrito! Thus has moved at least 400-500 m from where last saw on 20 July (yesterday) - beside trail resting at 1400 hours; (painted #67).
#1025 ♀ - same location as yesterday- (painted #68).
#348 ♀ - at southern end of Zone 5 proper - i.e. 50 m south of where saw on 19th July. (painted #69). Perhaps moving south also.
Zone 5 - finishing sample - eastern half -

#193 ♂ - CL 147.2; CW 156.4. Bad f.d. in 2 usual areas plus located all over shell in other places. Black-green algae in 2 usual areas, especially along scutes junctures; no lichens; wgis rather thin; scutes all smooth; sleeping in open.

Pg. 30.
Two more seen in pond bed but well under dense Clerodendron and could not reach them.
Very, very little sign in whole eastern area - they seem to be definitely concentrated around dry pond with many rocks and H20 collection pockets rather than eastern areas.
#50 painted - in same area as where saw last.
#7 painted - about 150 m West of Caseta turn off on Reserve Border - moving west again from Caseta upper pond area apparently.
[Marginal note: El Chato Weather - 1500 hours - Rain 0.47 inches; Evaporation 3.5 ml, emptied and refilled full respectively.]
Caseta Weather - cool and cloudy all day - 1900 hours - no garua except up till 1100. Max 72.5; Min 61.5; Rain 3.15 mm; Evaporation 2.8 ml, reading 11.2)
Caseta Weather on 19th July (not taken on 20th) 1800 hours - Max 71.0; Min 62.0; Rain 2.1 mm; Evaporation 1.4 ml (12.6 reading).
22 July 1970 -
Working at Caseta today with few short side trips.
At Caseta Upper ponds - 1200 hours - Painted #'s 41, 42, 44, 47.
In field just below these ponds - Painted #'s 40, 48, 49.

Pg. 31.
#14 painted showed up at Caseta at 1000 hours and moved past it in brush slightly to east and up toward upper ponds area. From Zone 4 ! Re-painted because old numbers hard to read.
Julio San Miguel was in Zone 4 today -
One copulation - #687 ♂ and #860 ♀
One egg laying on top of ground in dry pond there with ♀ beside it - ♀ #851 - very strange and why?? -
--- x --- mm. Very thick egg shell it appears; will take to CDRS as soon as possible and try to incubate.
In afternoon I was hunting goats and at 1735 ran into #127 ♀ about 00 m south of pond #1 in upper central Region 2 moving steadily south on trail! Up from Zone 3 Nesting Area to pond and now perhaps returning to lay another nest! Interesting that at 1730, very cloudy and cool now, she is moving south on trail whereas another 15 animals I saw all through this are between 1600 - 1700 were all already burrowed in for the night. Very notable I think!
Caseta Weather - 1900 hours - cool and cloudy all day; garua off and on most of morning and till mid - afternoon. Max 71.0; Min 62.0; Rain 4.0 mm; Evaporation 1.4 (reading 12.6)

Pg. 32.
23 July 1970 -
At Caseta writing notes most of day.

[Marginal note: tortoise locations especially #127 ♀].
At 1600 went down to check on location of #127 ♀; found that she had progressed no further than last night and was burrowed in at 1615 beside trail. Near her was #416, also burrowed in.
Also saw a few other animals -
#53 ♂ at lowest part of Region 2, burrowing in at 1630.
#119 - returning up trail, same area as #53 - could see clear trail well below where she had been moving north along drainage and my trail today.
#307 ♂ - and an unmarked 75 cm CL animal together, 15 m west of trail along drainage, 100 m south of Caseta pond #1.
#699 ♂ (painted #16) - 110 m below Pond #1 moving south along drainage.
At pond #1 - #1068 and #712.
Caseta Weather - 1900 hours - cool and cloudy all day; a little garua till mid morning, none after that. Max 71.0; Min 60.0; Rain 1.9 ml; Evaporation 1.3 ml (reading 13.9).
24 July 1970 -
To Region 4 to take temperatures
Enroute saw the following -
#699 (#16 painted) - middle upper Region 2 - about 50 m S of where was yesterday evening, still moving south deliberately.

Pg. 33.
Re-painted.
#60 - lowest Region 2 - only 30 m above where saw several times in June and July - little movement.
#106 ♂!! - Highest part of Region 3, moving south along trail; has moved on considerable distance; last saw on July 17 and 19 moving along Reserve Border just above Caseta, but earlier had been almost to El Chato turn off area of Reserve Border.
#835 - exact same location where last seen.
In Region 4 while poking around - #'s 242, 95, 890 ♂, 709 ♀, 1058, 1073, 1074.
Region 4 - Weather - 1430 hours - Max 74.0; Min 62.0; Evaporation 13.0 ml (refilled full); Rain 15.3 mm (emptied).
Took a 1.5 hour exploration trip to newly discovered area of dry pond beds and open, dry plant #1 (*Blechum*) pampas to SW of Region 4. Found it to be much larger than on previous exploration on last trip her, but absolutely dry and mostly barren and essentially same as the description given then. Whole area is at least 10 -15 hectares. Found that in a number of places it contains lava plates with H20 collection pockets with obvious signs of tortoise use of these. Tortoise sign here but more scattered than in Region 4 and lower density for certain.
Found nine more tortoise kills of 2-10 year age in these areas, 6 in one pond bed alone. Can't be certain all killed, but very likely - 3 I could tell had been killed from cut plastron, other 6 were

Pg. 34.
Too broken up to say much. Six tortoises seen in these areas - mostly well scattered and separated from each other.
#51 ♂ - same spot where last saw.

#260 ♂ - CL 122.8; CW 135.2 - very near (20 m) #51 ♂; well developed but rather thin wgis; no lichens; or algae; f.d. all over carapace, especially bad in 2 usual areas and along lower sides; scutes smooth in central 1/20-1/5 only.
#1030 ♀ probably - CL 66.0; CW 72.8. No lichens, algae, flaking disease; scutes smooth only in tiny central parts; wgis well developed and thickish.
#1219 - CL 70.0; CW 76.0; no lichens or algae; wgis well developed and moderately thick.
#406 ♂ - CL 124.4; CW 131.5. No lichens or algae; f.d. in 2 usual areas but scattered ; scutes smooth all over save for about 1 - 1.5 inch outer border on each; wgis well developed and moderately thick. Near a very nice deep H20 pocket in a flat rock.
One more 70 cm CL sized un-marked one.
Goats also use these areas and water pockets heavily as trails and dropping in the are show.

Pg. 35.
July 25, 1970 -
Region 4 expanded sample -
Central area along trail and rocks:
#438 ♀ - CL 98.9; CW 109.3. No lichens or algae, f.d. in scattered deep patches in 2 usual area but not much of it; scutes all smooth and shell typical of very old, worn ♀ type, wgis nonexistent. No mud on body anywhere to evidence having nest recently; moving NNE through Region 4 along trail. (Painted #70).
[Marginal note: see comments on pages 48-49 of this volume.]
#1073 - (painted #71)
#709 ♀ - (painted #72)
#1058 - (painted #73)
#242 ♂ - CL 87.0; CW 98.3; no lichens or algae; wgis extremely thin.
#95 -
#1074 - (painted #79)
Saw all of these but #95 on straight line sample through the area.
Weather instruments and pond area:
#128 ♂ - CL 133.6: CW 143.2. All smooth scutes; no lichens or algae; light scattered f.d. in 2 usual area; wgis well developed and moderately thick. Sitting near H20 collection pockets (none last night) just on NW side of pond. (painted #74)
#460 ♂ - CL 70.0; CW 73.0. No lichens, algae, or f.d.; scutes smooth only in extremely tiny central parts; wgis clear and complete but rather thin. Puttering about on floor of dry main pond (painted #75).
#205 ♂ - CL 134.8; CW 139.6. Could be #245 but 40 mark looks like a natural chipping - almost certain. F.d., fairly severe, scattered all over, especially a lot in 2 usual area and along lower sides. No algae; scutes

Pg. 36.
All smooth save for a 1.5 - 2 inch outer border on each. Wgis clear, well-developed and moderately thick; lichens - none definite - there is some bright yellow stuff scattered all over 4th and 5th vertebrals, with bits also on last left costal and last left marginal. Could be a lichen and in odd long streaks so does not look like a painted number. But looks and

chips off like paint - could have been a number painted on 4th vertebral which dripped down onto other scutes - most reasonable explanation. (painted #76). Moving across weather instrument area toward dry pond.
Area to south of dry pond and east of lat rocks -
#890 ♂ - (painted #77).
#1194 - not painted, never seems to leave this area.
#404 ♀ - CL 86.2; CW 94.1. No lichens or algae; f.d. extensive on front and rear marginals; scattered a bit on (1/5) rear of carapace. Scutes smooth only in tiny central pars; wgis clear and thick; no clear evidence of recently having nested or been in nesting area (painted #78).
#16 ♂ - CL 145.0; CW 157.6. No lichens or algae; scutes all smooth; wgis clear and well developed and moderately thick, f.d. scattered in small patches in 2 usual

Pg. 37.
Areas with tiny bits elsewhere; a bad deep, f.d. infected hole in 3rd left costal at upper rear corner - several cm. deep (painted #80) - If data correct is from El Chato!
Eastern loop out into guayavillo forest:
#754 ♀ - (painted #9) - near instruments - 100 m west of Region 4 trail.
New #1287 ♀ - CL 81.2; CW 86.0 - 100 m west of Region 4 trail. No lichens, algae or f.d.; scutes smooth only in very tiny central parts; wgis nonexistent.
Went up to Caseta to get a few things, enroute I saw many of same animals seen yesterday on descent - to wit:
#699 - (painted #16) k- only 100 m below Caseta pond #1 - thus has moved back up some.
#60 - same area as yesterday - slightly higher and about 50 m more up trail.
835 - lower down, about 50 m. down trail from yesterday's location.
#106 - really moving - well down to lower-middle region 3 area k- in very dry rocky area k- saw at 1430 hours today; yesterday saw at about 1130 hours just below Region 2/3 border.
#242 - same location, in Region 4, as this morning.
Jan took temperatures of thermocouples all day at Region 4 sites. Also she saw #376 ♂ (old friend from Caseta area last year during garua season) He appeared from south through forest, moved by tent and burrowed in just NE of tent at 1600 hours. Jan (painted him #91)

Pg. 38.
not being sure of what number I was currently up to in my painting campaign. I later took measurements - CL 115.0; CW 125.2. He had a lot of red soil of type in nesting and lower areas well worn into skin and carapace so probably has been down at 200 feet altitude or lower to the south.
I was cool and cloudy only up till 0800 this morning; sun peeped out a few times from then till 0930, was out about 1/3 of the time from 0930 - 1300, and from 1300 till sunset was out almost continuously. There was no garua all day. Still clear at 2300 when I went to bed and sometime in early morning (next day - 26 July) hours it became overcast and then sprinkled a very tiny bit during the night's few remaining hours.
Temperatures are on the following page:

Soil moisture readings: Region 4

	0800	1200	1600	2000	0600
5 cm	no register	NR	NR	NR	NR
22 cm	Just barely registered	Just barely registered	Just barely registered	Just barely registered	Just barely registered

Pg. 39.

Soil probe - Region 4 - 25-26 July 1970 (time)

Position	0700	0800	1000	1200	1400	1600	1800	2000	2200	0600
1	18.5	20.7	32.2	35.4	37.0	29.2	23.1	20.0	18.4	18.9
2	1808	20.0	27.6	31.4	34.3	28.6	24.4	21.4	19.5	19.6
3	19.5	20.0	24.9	29.0	32.1	28.7	25.4	22.5	20.9	20.2
4	21.6	21.0	21.7	24.5	26.6	27.2	26.3	25.0	23.1	22.1
5	22.5	22.1	22.0	23.3	24.9	26.1	26.0	25.3	24.1	23.0
6	23.7	23.4	23.1	23.0	23.3	24.2	24.7	24.8	24.5	24.2
7	23.2	22.8	22.6	22.6	23.5	24.5	25.1	25.1	24.5	24.2
8	23.9	23.5	23.4	23.2	23.4	24.0	24.2	24.6	24.5	24.4

Pg. 40.
26 July 1970 -
Broke camp and went to Zone 3 Nesting Area to take temperatures and sample Will sample Region 5 through Nesting Area today while along trail.
Region 5 -
Region 4/5 border -
#223 ♀ still burrowed at 0745; close to Region 4 proper; last time saw her was in December (I think) in soil area of Region 7 south of main Zone 3 Nesting Area - CL 82.2; CW 88.7 (faulty tape measure)
#1196 - CL 63.6: CW 68.2; no lichens algae, or flaking disease; white growth intervals non existent. Burrowed at 0820 still. in mid-Region 5.
#756 ♀ - CL 72.1; CW 79.5 - no lichens, algae, f.d. or smooth scutes; white growth intervals extremely thin; Burrowed also, only 15 m away from #1196.
Just 30 m south of previous 2 animals - 2 more "burrowed" = actually looks as if #1104 was burrowed and #1157 came up behind the former. Now head to tail only mm apart. Aggression??
#1157 - this is same area where saw this one in June sample -
#1104 ♀ - (probably) - CL 63.5; CW 71.2. No lichens, algae, flaking disease; scutes smooth only in tiny central parts; white growth intervals rather thin.

Pg. 41.
At big boulder area- Region 5/6 border-
#1151 - CL 61.8; CW 63.7; same place saw burrowed in late June - exact spot; white growth intervals non existent; no lichens, algae, or flaking disease.
100 m east of here saw a ♀, <u>not in sample</u>. - was chasing goats.

#872 ♀ - CL 94.0; CW 103.7; no lichens or algae; only a few tiny minor spots of flaking disease on rear of carapace. Scutes smooth only in small central 1/8 or less. white growth intervals present but very thin. Has nesting are colored red soil well ground into carapace lower parts and skin but no fresh mud to indicate nesting.
Region 6 - nothing - no sign or tortoises; Plenty of goat sign and some fresh pig shit here and there.
Will do Region 7 straight line tomorrow and expanded sample today if possible.
Soil moisture readings - 26 July 1970 - 27 July 1970

	26 July			27 July				28 July
	1200	1600	2000	0800	1200	1600	2000	0800
nest 5 cm	no reg.	no reg.	no reg.	no reg.	no reg.	27.5%	27.5%	26.0%
22 cm	30%	30%	30%	27.5%	27.5%	27.5%	27.5%	26.0%
soil pit 5	no reg.	no reg.	no reg.	no reg.	no reg.	no reg.	no reg.	no reg.
22 cm	no reg.	no reg.	no reg.	no reg.	no reg.	no reg.	no reg.	no reg.

Pg. 42 and 43 **[Originally entered as separate file entitled CGM Vol10Pg42-43.xls]**
Probe #1 in nest #1 1970/71

	26-Jul					
Postion No.	1000	1200	1400	1600	1800	2000
1	31.1	28.5	31.7	29.8	23	20.6
2	27	28.8	28.8	29.5	25.5	22.3
3	25.5	27.6	27.9	28.8	26.1	23.4
4	23.9	25.9	26.4	27.1	26.6	25
5	23.9	25.1	25.3	26.3	26.4	25.6
6	24.5	25	25.1	25.6	25.9	25.6
7	24.6	25	25	25.5	25.8	25.4
8	25.4	25.4	25.3	25.5	25.7	25.4

27-Jul									28-Jul	
600	800	1000	1200	1400	1600	1800	2000	2200	600	800
18.7	21.5	27.9	31.4	40.1	33.5	24.2	22.3	21.5	19	21.5
20	21.5	25.2	29.4	33.9	32.9	27.1	24.4	23.1	20.1	21.5
21	21.4	24.1	27.3	31.1	31.5	28	25.2	24	20.8	21.6
22.5	22.3	23.1	24.7	27.1	28.6	27.9	26.4	25.3	22.5	22.5
23.6	23.3	23.5	24	25.1	26.6	27.2	26.7	26	23.9	23.6
24.5	24.1	24.1	24	24.8	25.5	26.1	26.3	26	24.5	24.4
25.1	24.9	24.5	24.3	24.8	25	25.1	25.9	26	25.1	25
25.6	25.4	25.4	24.5	24.9	25.1	25.1	25.7	26	25.6	25.2

Pg. 43 - CGM Vol. 10
Probe #2 beside nest #1 - in soil

Postion	1000	1200	1400	1600	1800	2000
1	36.6	29.7	30.7	29.5	22.1	20.3
2	28.1	29.3	29.5	29.5	25.6	22.6
3	26.5	28.6	28.7	29.2	26.6	24
4	24.9	27	27.2	27.7	27.4	25.6
5	24.5	26	26.2	27.2	27.1	26.1
6	24.7	25.4	25.6	26.5	26.6	26.2
7	25.1	25.8	25.9	26.1	26.5	26.1
8	25.8	25.8	25.9	26	26.5	26.2

600	800	1000	1200	1400	1600	1800	2000	2200	600	800
18.6	21.8	31.2	34	42.2	30.9	23.4	22	20.9	18.7	22.4
20.6	21.9	26.4	30.3	39.7	32.3	26.4	24.5	23.2	20.9	22.4
21.7	21.9	25.2	28.6	32	31.5	27.7	25.6	24.4	21.8	22.4
22.1	22.9	23.9	25.6	28.1	29.4	28.1	27.1	26	23.3	23.3
24	23.7	24	25	26.4	27.5	27.1	27	26.5	24.5	24.1
25.1	24.6	24.3	24.8	25.4	26.4	26.4	26.7	26.5	25.5	25
25.7	25.2	25	24.6	25.2	25.9	25.9	26.1	26.4	25.8	25.4
26.2	25.9	25.4	25	25	25.9	25.9	26.1	26.4	26.1	25.7

Pg. 44.
Weather - 26 July - 1230 hours - Zone 3 Nesting Area. - Max 76.0° F; Min 52.0° F; Rain 10.4 mm (emptied); Evaporation 26.6 ml (refilled).
Zone 3 Nesting Area enlarged sample - eastern loop first:
[Correction: Decided did not have adequate time so will look over all potential nesting sties in main area and small area to SE a short way and will do a bit of exploring to the east.]
1150 - CL: ------; CW ------;
Found no new signs of digging and no new nests since those present on last visit.
♀ #19 (painted) may be getting ready to lay soon - evidence for this is scanty and circumstantial however: she has been prospecting about in open red soil covered area to south of campsite in the main nesting area. She did this from 1500 to 1735 when she finally retired for the night in an open spot. It is hard to say whether she was really looking for a nesting site or just wandering about and looking for a burrow site. She occasionally was eating fallen, green, moist *Opuntia* pads also during these wanderings. Real reason for suspecting pre-nesting behavior is that she is sniffing about on the ground and scratching with front
Pg. 45.
feet very often in same places where she sniffs. Will watch her tomorrow night.
Saw a number of tortoises while looking through main area for nests-
#'s 1150, 1195, 19 (painted), and 422 (a large smooth shelled ♂).
Also went east about 200 m looking around about 100 m east of main nesting area saw a small unidentified 60 cm CL animal and #37 painted beneath cactus eating fallen green pads in both instances. At about 175 m east saw #1146 also near an *Opuntia* tree with partly eaten pads although at the time was basking. virtually all of this area is far as I went is very rocky, almost solid rocks in fact with a lot of Croton, Piscidia, Bursera, and some scattered large Pisonia. Tree *Opuntia* are a bit more common in some of the more open areas here than in the nesting central zone. In general area very much like Region 6 and much of Region 7 below main nesting Zone of Caseta - La Fe trail. Found one small flat planar area at top of a large rocky pile with some scattered patches of red soil - could be suitable for nesting but no sign of nests from 1969/70 or before. Also found several long stretches of raised flat lava rocks - worn by extensive goat use as a trail. also

tortoises use as a trail as are many old, dry droppings along it. Several small "H20" collection pockets areas also with

Pg. 46.
plenty of tortoise sign around them. Virtually every *Opuntia* tree had tortoise sign, partially eaten pads, and old and new dirt tortoise wallows around their bases. In general tortoises seemed nearly as abundant (lightly less so) in these areas as in the Zone 3 Nesting Area central and immediately surrounding areas.
When I found #422 ♂ near the new small Nesting Area just SE of main Zone 3 Nesting Area, noted he was beside a small, i.e. 3 feet high, *Opuntia* and that he had completely eaten off the two spring pads it had possessed, leaving only the trunk. Thus if hungry enough, tortoises will even eat the younger more heavily spined pads right off of a young *Opuntia*.
Tortoises are clearly existing largely on *Opuntia* fallen pads now and I see many of them eating such pads in these areas and every *Opuntia* trunk from here to La Fe almost shows tortoise sign and partly eaten pads at its base.
27 July 1970 -
To S and SE to check other potential nesting areas along Region 7 trail. In a very thorough search of main red soil upland and soil filled depressions I

Pg. 47.
found no new nests or even any signs of digging; did however see scattered freshly used soil depressions/wallows so there are tortoises in these areas. Mostly 60-70 cm CL and less sized ones to judge from the depressions, but still are animals about of ♀♀ large adult size. However tortoises very scattered - saw only two.
In 3 new areas to east-southeast of trail, i.e. where I found #31 ♂ last trip found 3 more nests from 1969/70 destroyed by pigs. **[Marginal note: note-nests destroyed by pigs]**
Also saw #1159 k- CL 58.4; CW plus or minus 61.5 (tape measure obscured); No lichens or algae; white growth intervals clear but thin. Crawling through same area near where saw #31 ♂ in June.
#1266 - same general area - 50 m SW of where saw and marked on last trip.
Returned to Zone 3 Nesting Area and did enlarged sample-
<u>Eastern Loop -</u>
#1150 CL 66.9; CW 68.0. No lichens, algae, or flaking disease; white growth intervals extremely thin; <u>re-marked</u> because getting hard t read. Moving about.
#422 ♂ - over near new Nesting Area to SE a bit from central area; sleeping.
Central Area -
#19 ♀ (painted #) - sleeping beneath a cactus only a few feet from where slept last night. More on her later.
#1195 - sleeping in soil depression.
New #1288 - CL 39.8; CW 41.7; crossing area NW to SE; no lichens, algae, flaking disease or smooth scutes; white growth intervals nonexistent; counted growth rings - has 27 clear ones!!

Pg. 48.
Northern and Western loop -

#918 - slightly east of area near trail just north of camp where are some nests in yellowish-brown soil; moving around, foraging.
#1020 - CL 56.8: CW 61.5 plus or minus (tape measure obscure here). No lichens or algae; white growth intervals not complete and where can see, are extremely thin.
That is all! Very spread out - probably due to recent dry weather (4-5 days), some hot sun on 2 or 3 days and still there is almost nothing except for very scattered small herb seedlings. Tortoises were notably more concentrated here on last sample - probably partly due t a lot of garua and areas of plat lave rocks with H20 collection pockets.
Dryness now seems to have caused a thinning out - witness #37 painted and #1146 to east of here quite a ways now - were here recently and before dryness commenced.
Noted same phenomenon in Region 4 between this sample and previous one - although found a lot this sample time were much more thinly dispersed and spread all over the sample area. On previous sample were much more concentrated, especially

Pg. 49.
around 2 flat rock H20 collection sites and along tail. Conditions there reasonably similar to here - dry, virtually no food save for seedlings.
Weather tonight - 1900 hours Zone 3 Nesting Area - Max (today) 75.0° F; Min (last night) 59.0° F.
Watched #19 painted ♀ - became active at 1600, leaving from open under *Opuntia* tree where she rested all day long doing nothing. She searched through area where 1969/70 nest #2 was (essentially around cactus where she had been resting); then crossed to area where 1969/70 nest #12 was laid, checking for a nesting site all way in between. Then to are where 1969/70 nests #4 and 15 were. Finally stopped looking for a nesting site at 1830 and retired in last mentioned are in the open. Am sure now she is getting ready to nest and looking for a suitable site because here behavior is extraordinary and not at all normal for a none-nesting animal -
1. inactive all day; active only late afternoon till dark; where as on previous trip here she was actively grazing, foraging and eating cactus all day and retired promptly and quickly circ 1600 hours then without a prolonged search for a resting site (burrow or soil depression).

Pg. 50.
2. During this whole 2.5 hour foray today she was moving along slowly, sniffing ground in open soil spots all along the way and occasionally test scratching these same spots with here fore feet with sideways - outward strokes. She was painstakingly checking almost every potential spot. She was clearly not foraging as she passed many herb seedlings and some green fallen cactus pads and she ignored all food. Also, this type of topping and then putting the nostrils right down flush on the ground to sniff is characteristic only of just pre-nesting behavior of ♀♀ as far as I have seen up to now from watching many olfactory behaviors.
She never did today try any digging with the back feet that I saw- she moved very slowly from spot to spot but just never seemed satisfied enough in any place to stop and seriously dig. In most sites she did not even scratch with forelegs but just sniffed and then moved on.

Pg. 51.
28 July 1970 -
Weather summary for Zone 3 Nesting Area for past 2.5 - 3 days - weather mostly cloudy for whole period, less sun in general than during 25-26 July period when took temperatures at Region 4 - for Region 4 weather summary see pg. 38.
To Zone 3 Nesting Area -
26 July - mostly cloudy all morning; a few very short 5-10 minute periods of sun. Between 1300 and 1600 sun out more often but still cloudy 1/3 -3/4's of the time. Almost no garua.
27 July - cloudy all morning again but no garua; from 1230 - 1600 sun out about 1/3 -1/2 of time. Bit hotter and more sunny than 26 July.
28 July - up till time left (0930) very cloudy, cool and occasional light garua.
Weather Zone 3 Nesting Area - 0930 hours - Min (last night) 60° F; Evaporation 6.5 ml (refilled full); Rain 0.2 mm (emptied).
Weather Region 4 - 1100 hours - Min 60.0; Max 74.0; Evaporation 12.8 ml (refilled full); Rain 1.4 mm ; emptied.
On way through Region 4 -
[Marginal note: note movements]
106 ♂ - painted as #81 (now in Region 4 weather instrument area)
#1103 - painted as #82
#223 - painted as #83
Also saw painted #'s 71 and 79 and #242 to west 100 m near thermocouples.
Sample from Region 4 to Caseta - (took Region 4 straight line sample on 25 July). This completes Region 6; Region 1 to La Fe and Devine's still to be done.
Region 3:

Pg. 52.
#376 ♂ - painted #91; several hundred meters above where Jan painted on 25 July; moving steadily up trail at 1215 when encountered - in middle steep ascent part of region.
#205 ♂ - painted #76 - in uppermost part of Region 3 moving steadily along trail. Both of these animals apparently returning to Caseta and pond #1 area after pending hot season in lower regions !!??
Region 2:
#416 - slightly above middle of Region.
#699 (painted #16) - only 100 m below pond #1.
#1022 and #933 ♀ (painted #12) on south side of pond. **[Marginal note: Region 4 border area]**
#1230 ♀ (from Region 5!) - on east side of pond - will measure tomorrow. **[Above marginal note applies to this animal and #'s 1022 and 933]**
Region 1:
#104 just below Caseta 25 m moving up trail toward Caseta. ♂ probably but tail intermediate. CL 94.1; CW 106.1. No lichens or algae; white growth intervals extremely thin (painted #84)
#1006 ♀ (painted #15)
#246 ♀ - both this and above animal very near Caseta at upper most part of Region 1.

Some catch-up notes which have been keeping in temporary notebook and id not record before:

Pg. 53.
1. Goats - for past 15-20 days they have been moving back up a bit. Are a lot scattered through altitudes from 500-250 feet and even come up as high as Caseta pond #1 from time to time. No higher, but certainly have come up a bit from areas to which they had retreated during last 2 weeks of June and first weeks of July. Are lots of them al way from 500 feet to coast now - sort of scattered out all over the South side of island in this altitudinal range.
2. Aggressions - Recent behavior of #'s 1006, 598, 246 and 104 (today only for latter animal) - See previous notes on pages 109-121 and 144-146 of Volume 9. Also pages 149-150 of Volume 9.
On July 12, 1970 when I was at CDRS both #1006 and #246 ♀ wandered off from usual areas near Caseta. When I returned on July 14, 1970, #1006 was down trail below weather instruments a bit; could not locate #246 near Caseta anywhere.
By July 16, 1970 #1006 had returned to near Caseta and was grazing in open field beside Caseta to East - Note using this area in absence of #246. #1006 continued to graze here and was still here when we left for lower Zones on 24 July 1970.
Today when we returned at 1400 noted that #246 had returned to the open field and #1006 was east of it, grazing in brush. It is very tempting to conclude that #246 ran her out of the open field again or

Pg. 54.
at least her presence forced #1006 to leave the open area.
Then #104 approached #246 at edge of open field about 1430 today just as soon as #104 came into Caseta open field from below along tail. A "heads-up" aggression occurred for about 15 minutes but I failed to see all of it. Eventually #246 drove 3104 out into field of brush where #1006 grazes when #246 is in the grassy field. Then #104 went through this brush up on to trail leading north from Caseta and disappeared to north toward Caseta upper ponds.
#598 is not in the area now, but she had been off and on till we left on 24 July. Noted that she stays to west of Caseta, mostly around tents, cook shack, garbage pits, etc. - i.e. she clearly avoid grassy field occupied usually y #246 and sometimes by #1006.
Caseta Weather - 1900 hours - cool and cloudy all day except for a few short periods of sun in afternoon and at sunset. Max 76.0; Min 53.0; Rain 2.65 mm; Evaporation 11.9 ml (reading 25.8).

Pg. 55.
Some tourist here on 24 July in morning at 0930 saw several animals ("about 6-8") just below Banana patch - i.e. at 900 feet altitude plus or minus. Noted 3 painted ones - #'s 2, 13, and 42.
29 July 1970 -
To Caseta pond #1 area to monthly sample.
Around Caseta itself - #1006 ♀, #246 ♀.
2/3's way down trail to ponds-

#541 ♂ - (almost certainly; but tail somewhat intermediate in length, like #104 from yesterday); CL 101.8; CW 110.1; scattered bits of flaking disease all over shell, but very little in total; no lichens; dried black-green algae in 2 usual areas; scutes smooth in central 1/10 or less only. white growth intervals thick and well developed; moving along trail (Painted #85).
#1230 ♀ - CL 97.4; CW 106.0. East side of pond on trail just above it - moving east down a side branching hunters trail. No lichens; dried black-green algae in usual areas; white growth intervals present and moderately well developed and thick (Painted #86).
Two more just a bit further east in a small pond beg- one was grazing and other approached and aggressed it.
#1022 - was grazing (painted #87)
#254 - approached and attacked - #1022 now sitting withdrawn with #254 beside her and with head out over her carapace.
Data for #254 ♀ - CL 79.8; CW 86.1. From Chato?? No lichens, algae, or flaking disease; scutes smooth only in very central 1/10 or less. white growth intervals clear and well developed - moderately thick. (Painted #88).

Pg. 56.
South side of Pond:
#820 ♂ - (perhaps 720 but doubt it - because looks like was cut in 100, then chipped badly later.) Calling ♂ based on size and condition of shell - notably stumped tail - in fact no point to it at all - end of tail is cloacal opening - certainly an injury. CL 120.3; CW 130.0. No lichens; black-green algae in usual places but dried up; flaking disease extensive in usual areas and scattered along sides also; scutes smooth in central 1/10-1/5. Moving into pond on SW corner up drainage; (Painted #89).
#939 ♀ - (painted # 12) - in open spot basking.
Inside pond circuit: no animals and almost no sign - only a few trails and droppings; #541 ♂ and #820 ♂ entered pond and are looking about probably for H20 and or mud. But is dry! No mud at all.
Western side of pond in open areas and forest -
#444 ♂ (painted #11) in open area near a small mud wallow (mostly sticky, very thick mud now after a week of dry days); grazing.
#719 ♀ - CL 96.3; CW 106.1. No lichens; dried black-green algae in usual areas; white growth intervals clear and well developed but rather thin. Basking in semi-open (Painted #90).
North side of pond -
#103 (#47 painted) - moving around NW corner toward west side where

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small manzanillo ponds are with bit of mud (and H20 for drinking when rains) unlike large pond #1.
To small series of hanging ponds just below Caseta -
One animal - heard one thumping near this area but could not locate - very close somewhere but thick brush.
#1125 - just west of tents in open area near manzanillo ponds - eating grass.

#1184 - same place as #1125; also eating grass CL 67.2; CW 68.4 (Painted #92). Small bits of flaking disease on rear of shell on rear marginals and supracaudal; no lichens or algae; white growth intervals very, very thin but clear. (Painted #93) **[Editorial note: its not clear whether he indeed painted this animal #92 or 93; has arrow from #1184 to near line where painted #93 is written; potentially #92 was painted on #1125 but just a guess.]**
Very few animals - 12 in total - clearly scattered out, during past 7-10 days because of fry weather.
At Caseta -
#1006 ♀ - grazing in open on east side of hut;
#246 ♀ - grazing in open in tall grass and brush just south of Caseta about 25 m.
Early this morning #246 ♀ was out in the open field on east side of Caseta. She was actively grazing there from 0700 to 0930 (she became active at about 0615 and searched for H20 in (word not clear - perhaps pan) around Caseta, cook house and tents for 45 minutes before beginning to graze in the open field). During this 2.5 hour period #1006 ♀ was only 20-30 feet away from open field in higher brush in her usual grazing area to east just out of sight line of #246. She never attempted enter the field while #246 was there. Then about 0930 #246 wandered down SE running trail a short ways from filed and out into more high dense

Pg. 58.
brush and grass like area where #1006 was grazing. This effectively put #246 and #1006 out of sight of each other completely and meant that either animal , I in the open field could not see the other animal. About 1100 hours #1006 came west and entered open field and grazed there till about 1600 when she returned west to higher brush and burrowed. **[Marginal note: very interesting that #1006 entered field only when #246 was absent from it!]** Very (neatly - word not clear), #246 remained beyond vision of #1006 and could not herself see #1006 though she was to south in brush only 25 m from #1006. Just after 1006 left field to burrow, #246 re-entered it gradually grazing across it and then burrowed on its SE side at 1700.
Caseta Weather - 1900 hours - cool and cloudy all day ; no garua. Max 74.5; Min 59.0; Rain 0.0; Evaporation 3.7 ml (reading 29.5).
July 30, 1970 -
To El Chato with Grand Expedition (Bill Reeder, etc.)
In mora and trail enroute-
#40 (painted) just above Caseta at manga
#7 (painted) - ½ way to first hill.
#167 ♂ - just over top first hill
#50 (painted) - last sighting site - exactly same.
#1 (painted) - same area as last sighting
#1186 - 75 m east of Right turn out; in field.

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#97 - same area as #1186.
#98 - near Camote patch.
#25 (painted) - just 75 m east of El Chato Turn off on Reserve Border.

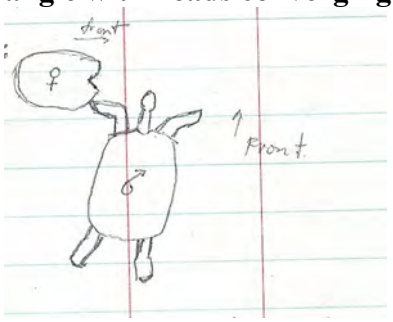
#54 (painted) and #51 (painted) - 50 m east of El Chato turn off on Reserve Border.
#58 (painted) at small pond near El Chato turn off.
#36 (painted) - at entrance to forest above El Chato.
El Chato Weather - 1600 hours - Rain 0.32. inches, emptied; Evaporation 19.2 ml, refilled full;
#211 ♂ - coming down through Guayavillo forest toward base of El Chato ½ way up in forest.
To Caseta - enroute saw #1202 on new trail in Passion flower pampa in mora just south of Reserve Border and above El Chato. CL 73.9; CW 78.8. No lichens or algae; white growth intervals complete but rather thin.
Caseta Weather - 1900 hours - cool and cloudy all day, but no garua. Max 72.0; Min 57.0; Rain 0.0; Evaporation 2.5 ml, reading 32.0, refilled full).
Today till about 1400 #246 ♀ occupied and grazed in open field on Caseta's east side and #1006 stayed put in brush area just a few dozen feet away - came to edge of field once but retreated to grazing in brush after spotting #246. About 1400, #246 moved off into brush to south again and 1006 about 1 hour later moved out of brush, crossed field grazing slowly and went on to burrow just beside our tent to west of Caseta.

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On return from El Chato this evening saw #49 (painted) already burrowed in at about 1715 hours in dense brush and well worked down into moist, loose soil. #40 (painted) approached #49 at rear and then rammed into the latter animal. This produced no movement in #49, only a hissing and retraction of the legs. So #40, still flush up against the shell of #49, turned so that her side was against #49's rear an d proceeded to pivot in about a 15-20° arc and work itself down into a loose soil burrow flush up against #49. First time I have ever seen this type of clumped burrowing outside of muddy pond beds. Noted not near as many animals in view at El Chato as during last sample - again as at Zone 3 Nesting area, Region 4 and Caseta, due to recent 7-10 dry days.
July 31, 1970 -
Around Caseta virtually all day discussing 1st 10 months results of study with Bill Reeder.
Couple of pieces of data I recorded in temporary notebook on 17th July 1970 but am just now transferring to permanent notes - all this seen at El Chato on that day:
1. Yellow warbler (♂) using tortoise

Pg. 61.
for feeding: Saw this warbler feeding from perch on carapace of a moving tortoise but for only about 30 seconds. Could have been going on much longer because I did not witness beginning of this behavior but only came upon it in process. Warbler was sitting on front - center of carapace where marginals come together to form nuchal notch. Tortoise was a medium - large ♂, i.e. #146. Warbler was clearly using movement of tortoise to advantage. Tortoise was moving along determinedly with neck and head ½ way out in from parallel with body. Bird twice clearly flew down to ground in front of tortoise, (about 45-60 cm) and snapped up insects (very small flying types, what exactly, do not know) which movement of tortoise was flushing out of 1-2 dm high grass in pampa was moving through. After catching insect each time, warbler flew back to perch on tortoise

and faced forward again looking pert and alert for new feeding chances. After 3rd flight down from tortoise and catching insect, tortoise because aware of me and collapsed and contracted legs and head with a hiss. Bird flew off when this happened. This is first time have seen warbler using tortoise to direct apparent advantage. Certainly not as common

Pg. 62.
as use by vermilion flycatcher.
2. Hissing upon contracting - use? As noted on page 3 of this volume found #'s 281 ♂ and 1272 ♀ sitting together in open semi- (mostly) dry grassy pampa on east side of El Chato at its base. Were sitting as follows:
[Diagram shows ♀ sitting at left front corner of larger male and oriented at right angle with heads converging at right angle]



Only about 2-3 feet between heads of 2 animals; both sleeping - ♀ had legs and head/neck withdrawn about ¼'s of way; ♂ all stretched out with head and first part of neck resting on ground.
I was able to quietly and slowly approach ♀ from behind with disturbing either animal. Keeping out of sight of ♂ behind ♀, I pinched her rear feet. She rather quickly (within a few seconds hissed and withdrew head/neck and legs fully. At first nothing immediately happened. But about 8-10 second after the hiss ended

Pg. 63.
the male raised his head and neck slowly, eyes till shut and began pumping hyoid area for olfaction. About time got head and neck level with nuchal notch (but still stretched out full) he slowly opened eyes, while continuing to sniff. Then he saw me and retracted legs and head/neck with a loud hiss.
I am certain that his response was definitely initially to hearing the hiss of the ♀ and not to hearing or smelling and definitely not from seeing me. Anyway, will have to try these experiments more thoroughly later both like this one and with tape recordings.
Caseta Weather - 1900 hours - cool and cloudy all day and almost no garua - slight garua last night - Max 74.5; Min 61.5; Rain 0.4 mm; Evaporation 1.4 ml (reading 1.4).
1 August 1970 -
To Zone 3 Nesting zone with group.
Enroute:
#119 - 125-130 m below pond #1 on trail
#376 ♂ - painted #91 - mid - Region 2 - moving steadily to north along trail and drainage still.
#106 ♂ - painted #81 - moving steadily north along trail and drainage in mid Region 3 - transition from very dry to moister forest.

[Marginal note: note- heading back up from Region 4.]
#835 ♀ - same area as other day.

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In Region 4 on trail and around weather instruments-
#79 painted (same area as on 28 July).
#71 painted; north of weather instruments by 25 m.
#1135 - CL 67.4; CW 71.4 **[note order of these two standard measures was inverted and apparently so too were measurements - labels were corrected to fit normal pattern by thf]**; no lichens or algae; white growth intervals clear and moderately thick.
In dry pond at weather instruments.
#73 painted and #82 painted - near lava rocks.
#713 and #1256 face to face sleeping.
[Marginal note: Region 4 Weather - 1030 hours - Evaporation 16.0 ml; Rain 0.2 mm; Max 73.0; Min 59.5. Soil block measures - at 1100 hours, Region 4; 5 cm no register; 22 cm - just barely registers.]
Region 4/5 border
#72 painted - beginning of Region 5 in rocky area in woods.
#1104 - mid-upper Region 5 - in open dry pond area. Clearly has moved up from Zone 3 Nesting Area. CL 63.4; CW 71.1
#1196 - same area as above one - in open rocky dry pond bed also. CL 63.7; CW 68.5; white growth intervals mostly non existent and extremely thin.
#1157 - same area as last sightings.
#1216 l- CL 57.5; CW 61.8; At big boulder area of Region 5/6 border; no lichens or algae. white growth intervals well developed and moderately thick.
#418 ♂ - (perhaps 18, but 400 mark is OK, I think; cut but chipped); moving north it seems over barranca just south of big boulder area l- CL 85.6; CW 90.1. No lichens, algae, or flaking disease; scutes smooth only in tiny central portions. white growth intervals present but very thin.

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#872 ♀ - CL 94.0; CW 101.3; moving south from big boulder area over bad rocks toward nesting area below. Has red soil like type from nesting area well ground into skin on rear areas and all around lower carapace - but not very fresh mud so can't say if nested recently. white growth intervals incomplete and extremely thin where present. no lichens or algae; f.d only in a few small spots on rear. Scutes smooth only in central 1/15-1/10 or less.
Zone 3 Nesting Area - Weather - 1400 hours - Rain 0.0 mm; Evaporation 18.1 ml, refilled full; Max 79.0; Min 58.0.
#1055 - CL 56.7; CW 61.2; no lichens or algae; white growth intervals present but rather thin - however complete. In central nesting zone; in shell, resting.
#131 ♀ - painted #39 - in raised up, but open area with small soil patches, 25 m west of Nest #2 from 1969/70. sitting in shade at about 1500 hours inactive. Are a couple of areas near her which could have been attempted diggings; but not clear, because could have equally well been nothing more than night-time burrows. Anyway, interesting that

she is hanging about in an area where she could be nesting soon. Definitely no sign of recent nesting anywhere on her skin, tail, carapace, etc. Re-painted because getting worn. #787 ♀ - (painted #19) - back near site of 1969/70 nest #2 - under a *Pisonia* in shade nearby to two cacti where she fed most of day on 26 July. Had been eating cactus (*Opuntia*) pads on ground then, but no sign of it now. Has fresh, recently dry and chunky pieces of red soil on tail, hind feet,

Pg. 66.
and nails, general skin on legs and in this area and on supracaudal and tips of rear marginal scutes. Clearly from nesting behavior and digging - see following notes; re-painted her because paint very chipped.
Searched all over central main nesting area but found no nest other than one new one in northern largest soil-covered area. In open spot of red soil just a few feet from 1969/70 nest #7, near to raised up rocky area, but still in open soil area. Therefore will be Nest #2, 1970/71. did not open it - looks very normal. Protected temporarily with heavy rocks on top. Will build corral there within a few days. Had a very thin covering (plus or minus .5 cm) of loose dry soil on ti but just below this hard cap was still moist and compact. Since we left Tuesday, July 289, nest must have been made on 28th, 29th, 30th or 31st at night. From partial notable drying out already of several large mud chunks around nest on surface where she dug and complete dryness of mud on her would guess that she nested on 18th or 19th rather than one of past 2

Pg. 67.
days.
Another interesting fact is that she clearly dug no other holes anywhere in main nesting zone - examined whole area carefully and no other digging sign that is new. Therefore on first try she seems to have successfully laid. This is of particular interest in relation to fact that she was so fuzzy in looking for a nest site on evenings of 26th and 27th July. apparently when she found what she desired she was successful.
Spot in which she dug had some dead debris, small rocks, and dead vegetation scattered, standing herbs on it, but not any obstructions like rocks on surface anywhere around. About 8 half-fist sized and many smaller lava rocks were dug out of soil by her in making nest.
Nest was clearly detectable by me, but also was much more disguised by loose soil and organic debris on top and in general area she disturbed in digging than other nests I have seen up till now.
Caseta Weather - 1900 hours - cool and cloudy but no garua through 1300 then sun about ¼ of time till 1600 then cloudy again. Max 76.0; Min 60.5; Rain 0.0 mm; Evaporation 2.9 ml, reading 4.3)
[Marginal note: copulation ♀ #3]
Yesterday, between 1330 and 1430 Frank Iwen and Ed Beals saw a significant tortoise copulation at area near small manzanillo grove in Region 2 just 100 =125 m below

Pg. 68.
Caseta pond #1. Involved #3 ♀ (painted #18) and #205 ♂ (painted #76). Interesting because saw #205 ♂ well below here on 28 July moving steadily northward from Region

4. First found him in region 4 main area on 25 July. This gives good evidence of time involved in immigration of a large ♂ like #205. #3 ♀ was last seen in Zone 3 Nesting Area moving south in early July. As will be clear from the description given below each of these 2 was moving independently up the trail (and drainage - virtually same here) about 10 minutes apart, toward the Caseta pond #1 very definitely.
The following notes were from Frank and Ed - gleaned by questioning them at length. If further notes arise on this occurrence I will ask them and write it up later.
No red soil around rear parts of #3 ♀ was noted by Frank or Ed (which would perhaps indicate recent nesting) , but also the admittedly did no examine her closely for such. The did however see her cloacal area when watching the ♂ copulate with her. Anyway, perhaps she has not nested yet for this year - if so, why the trip south?
They first saw #205 ♂ moving along trail at 1320 hours. He came up close

Pg. 69.
to them and stopped in a small semi-open grassy patch, watching them. About 10 minutes later #3 ♀ came along same trail, right up to the rear of the male. He soon became aware of her (how no one saw) turned and immediately she turned off of trail into the brush and took off. The ♂ immediately followed her, with his head/neck out straight and his hyoid pumping rapidly, smelling her passage trail from only 2-3 feet behind her. He quickly caught up with her and with no further investigative olfactory behavior around her rear end he climbed on. Then for 20 minutes he copulated with her in the normal way. At the very firs she tried to slip out from under him but quickly gave up and became entirely passive. From their descriptions of the mating it took place entirely "normally", on level ground, in fairly open vegetation, and with apparent success. The male groaned rhythmically with each thrust (and only then!). Also, with each thrust he slipped his trail under the outer edge of her supracaudal and inserted his penis anew into her cloaca. With each thrust's termination he removed his tail and penis from beneath the ♀ - this is looking as if it is a mechanical necessity in most copulations. He had his head hanging low in normal position. After 20 minutes of this aggressive copulating activity, the ♂ voluntarily , while the ♀ was still passive, climbed off.

Pg. 70.
of the ♀ and rested beside her. Within a few minutes she moved off quickly near to a guayavillo trunk - The ♂ immediately chased her, biting harshly at her left hind leg several times in the chase. he caught her quickly about the time she reached the guayavillo trunk. He mounted her at that moment, but was pushed sideways up against the guayavillo trunk and thus in a bad position. The he attempted thrusting and actually groaned each time but did not appear to be successful in obtaining intromission at all. After only a few minutes she began moving a bit and he climbed off and the attempt ended with them sitting side by side.
About this time they (Frank and Ed) heard another tortoise moving through the brush directly toward the copulating pair from the west. #416 ♂ cam into view and approached directly toward the 2 resting animals. When he was within a few feet of #205 ♂, the latter rose up on all 4 legs, stretched neck way up and charged toward #416. The much smaller animal immediately without offering any resistance, turned and headed

Pg. 71.
away rapidly from (to) same direction from which he just came. He was able to quickly out distance the larger male and no contact was ever made. The larger ♂ only chased him a few meters, then stopped and plunked down again. Then, soon both #205 ♂ and #3 ♀ moved off up the drainage separately.
Sometime today, #'s 246 ♀ and 1006 both moved away from Caseta - both burrowed near here last night but were gone when we returned at 1715.
2 August 1970.
This morning at 0800 #3 ♀ came wandering into tent area from small manzanillo pond and drainage pattern slightly to west about 20 m. (painted #18).
[Marginal note: #3 ♀ movements]
Thus since copulation in early afternoon of 31 July about 100 m south of Caseta pond #1 she has moved rather far, rather quickly, up to level of Caseta and has clearly used the main drainage as her pathway of movement.
At 1300 this afternoon, # 376 ♂ (painted #91) came into tent area exactly as #3 ♀ had this morning; certainly came up same pathway. Was way down in mid - lower Region 2 yesterday at 0830 = 0900. Really moved. Moved around tents grazing for rest of the day.

Pg. 72.
About 1100 today went up in mora along Reserve Border to look for mora flower which E. Beals found recently. Went as far as top of first hill - 200 -250 m, west of Forest - Mora border. Saw following animals-
On trail from Caseta to Reserve Border -
#246 ♀ - coming down from upper ponds area, a bit of indicative mud on carapace.
#45 painted -
#49 painted -
Forest - Mora border - #43 painted.
#15 painted (#1006) in mora, 150 m
West of forest - mora border -
#1013 - 30 m further on than #1006 (to west)
#7 painted (#216 ♂) - 225 m to west of forest - mora border - roughly same area (a bit further west) as last sighting.
Back at Caseta -
Note where 1006 and 246 have moved to. By 1600, #246 back to Caseta moving about in "her" open field grazing. Burrowed nearby by 1630. #1006 still moving west along Reserve Border in mora.
Saw one more new animal at Caseta today - #217 ♀ - moved into area

Pg. 73.
from same drainage are where #'s 3 ♀ and #376 ♂ came from. However, can not say whether came from below or above without careful checking of past records. Jan says she saw the same animal in this area, in fact, on 29 July 1970. Apparently has been in the area since. CL 105.8; CW 117.4. No lichens or algae; white growth intervals clear but very thin; this is one of those interesting large ♀♀ with scutes smooth only in very small central parts of each carapace scutes, and only recently acquired scattered f.d patches on

side and tow usual areas. Has very typical short stubby tail and only shallow plastral concavity. i.e. apparently definitely a ♀ but not at all like large old, worn ♀♀ of same or slightly smaller sizes - i.e. #'s 3, 127, 130, 131 and many more.
Caseta Weather - 1900 hours - cool and cloudy all morning, sun out off and on and warm from 1130 till 1700, then clouded up again. No garua save for a bit last night. Max 75.5° F; Min 59.5° F; Rain 1.2 mm; Evaporation 2.0 ml (6.3 reading).
3 August 1970 -
Photos of mora flowers taken yesterday on Roll #154, at location right beside trail as described yesterday.
This morning #376 L(painted #91) grazing on grasses and herbs all around Caseta. 3246 ♀ nowhere in sight yet. #3 ♀ returning

Pg. 74.
to tent area from small ponds area in drainage just to west. Examined her carefully for evidences of nesting. Definitely did not nest or burrow in true red soil characteristic of Zone 3 Nesting Area during past few weeks because no sign of this soil type. But she does have some pale brown soil well ground into skin all over under parts-= tail, legs, feet, skin of leg pockets, etc. Can not of course determine if nested in this soil type, because even if she had all large pieces and coatings of external mud could well have been worn off on the long trip when made up here from Zone 3 Nesting Area or even below there. So question remains moot. Re-painted her because getting very badly chipped.
Painted #217 ♀ as #94 painted - moved own trail almost to Caseta pond #4. Also, collected 4 snails (2 of one species, and 2 of another it appears) from back and sides of upper carapace) of #3 ♀ this a.m. Good garua last night and tortoises carapaces and vegetation nice and moist this morning. Snails fairly common only

Pg. 75.
riding and crawling about on tortoises during this type of weather. Preserved in bottles for identification. 70 % ethanol.
Also at Caseta Pond #4 painted #220 ♂ as #95 painted, and saw painted #88 crawling about on bottom of pond, grazing.
Caseta upper ponds area sample:
In trail near field below ponds - between here and Caseta, but closer to Reserve Border than Caseta -
#376 (#91 painted) - grazing on grass
#529 (#40 painted) - grazing on grass - re-painted.
#62 (#49 painted) grazing on herbs - re-painted.
[Marginal note: all in open]
In fields just below ponds -
#270 (#43 painted) - basking in open - re-painted.
Around Pond #2:
#89 painted - grazing on herbs in open - re-painted. Did not pass Caseta - must have used drainage to come up from Caseta Pond #1 area.
#806 ♂ - grazing on grasses; carefully avoiding *Heliotropium*; in open of pond bed. CL 83.7; CW 86.0. No lichens; dried black-green algae in 2 usual areas; flaking disease in

only a few tiny superficial spots on last marginals and supracaudal. Scutes smooth only in very tine central parts; white growth intervals extremely thin - Painted #96.
Fewer here than on last count also, as in all lower expanded samples - i.e. Caseta Pond #1, Region 4, Zone 3 Nesting Area. - reasons probably same as those already discussed in July 29 notes.
Caseta Weather - 1900 hours - cloudy al day save for a few brief 10 minute periods of sun in afternoon. Occasional light garua Max 73; Min 60.5; Rain 0.95 mm ; Evaporation 1.3 ml (reading 7.6).

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4 August 1970.
To Bud Devine's to search for animals.
Up central manga -
#45 painted - just entering manga from pathway coming from Caseta upper ponds - re-painted - **[Marginal note: up from Caseta area]**
#827 ♀ - CL 85.1; CW 92.3 - No lichens or algae; white growth intervals incomplete mostly and extremely, extremely thin where visible. Eating pangola grass, only 20 m distance up manga from #45 painted. - Painted #97.
#41 painted - grazing on pangola; re-painted - another 30 m up manga; still near Caseta upper ponds in relative sense. **[Marginal note - up from Caseta upper ponds]**
#692 ♂ - CL 104.0; CW 114.2 - ♂ I think; tail intermediate, but tending to large size; scutes smooth only in very small central portions yet a large animal!. Only a few minor scattered spots of flaking disease on rear marginal; no lichens; dryish black-green algae in 2 usual areas; white growth intervals clear but very thin still. At rear of #41 - just starting to investigate smaller one but saw me and withdrew head and legs. - Painted #98.
#274 ♀ - painted #2 - slightly further up trail 30 m; - **[Marginal note: up from Caseta] -** at altitude of 750-760 feet; grazing on Commelina in mora - legume mix - a lot of activity all through this are for at least

Pg. 77.
past 1 - 1.5 months - many turds of 12 months to fresh - really crunching up mora by moving along its interface with herbs and legumes and pangola.
Slightly further up - at 700 feet - 40 m on up manga -
#369 ♂ - CL 89.2; CW 99.2. No lichens or flaking disease; black-green algae (dried) in usual areas of rear of carapace; white growth intervals present but extremely, extremely thin and incomplete; scutes worn but smooth only in very small central portions. In an area like #2 painted - lots of turds and lots of area eaten over and ground up; eating herbs, especially Commelina, along pangola - mora interface - 'almost no eaten pangola here - Painted #99.
#307 ♂ - CL 114.2; CW 123.8. Same area - moving steadily through pangola to north, grazing on intermixed Commelina, not on grass. No lichens; dried black-green algae in 2 usual areas; white growth intervals essentially non existent. Re- marked because cuts fading. - Painted #100.
#117 ♂ - at 800 feet - another 35 m up manga - another very extensive (200 sq feet plus) area of eaten out Commelina - again selecting it over the grass. Painted #101. **[Marginal Note: Moved up from Caseta area]**

Just 20 m further - same altitude - 4 tortoises. **[Marginal Note: all up from Caseta]**
#1190 (#13 painted) - re-painted - confronting #598
#351 ♀ (#14 painted) - re-painted - grazing on *Solanum* with black fruit.
#598 ♀ - confronting #1190; painted #102. Can't tell if it was aggression - looks as if #598 approached #1190; when found both sitting withdrawn, head to head.

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#598 ♀ - has clearly come up quite away from Caseta - same for number 14 painted - will have to check on last sightings there of these.
A lot of eaten out *Commelina* and other herbs in this area - perhaps some of these individual are still climbing.
#791 ♂ - CL 94.6; CW 103.2. No lichens or flaking disease; dried black-green algae in usual areas; scutes smooth only in central 1/15 -1/20 or less; white growth intervals present but extremely, extremely thin - Painted #103. Grazing on *Commelina* and pangola.
#104 (#84 painted) - really moving - (from Caseta pond #1 recently) - at 850 feet - 1/3's of way up manga to first fence. **[Marginal Note: Up from Caseta area]**

Caseta altitude at 0800 hours - 670-680 feet.
First Fence - altitude is 930 feet at 1100 hours.
Banana patch - lower end is 950 feet at 1105 hours.
Banana patch - upper end is 1030 feet at 1120 hours.
#115 ♂ - CL 110.0; CW 120.0. Near upper end of banana patch on its west side grazing on grasses and *Commelina* in open. Altitude here is 1025 feet at 1115 hours. white growth intervals nice and clear and moderately thick; no lichens or algae. too much garua to paint. **[Marginal Note: returned and painted #106; scratches all over top indicating passage through mora.]**
#305 ♂ - CL 108.9; CW 123.4. 1090 feet at 1130 hours - **[Marginal Note: has moved up from Caseta ponds area.]** just above banana patch and to west of it; grazing on abundant

Pg. 79.
Commelina in huge field of it in open. No lichens; black-green algae dryish but plentiful in 2 usual area; white growth intervals clear but medium to thin only. - Painted #104.
#1072 ♂ - same altitude as #305, but a few dozen meters to SW, near west fence line of Devine's land; in open basking; had been eating pangola. Note has moved here from Caseta area. Painted #105.
Completed search all over the western part of Devine's (usual sample are) but from 1100 feet and below only - saw only the above two. Back to banana patch -
#304 ♂ - old friend from this area I think in middle of patch - at about 990 feet; basking. CL 13.8; CW 126.3; Painted #107; white growth intervals clear and well developed and moderately thick. **[Marginal Note: was up here in May.]**
Sign (fresh turds and burrow) of a smaller one in upper half of banana patch, but could not locate - #782 from last month?
Rest of way up central trail to house no tortoises or sign.

Then over by "maternidad" pond and down to 1100 feet area on western side of sample area - no fresh sign or tortoises found at all above '#305 ♂ and #1072 ♂. There is abundant water in pond and a complete growth of Azolla on its surface, but no sign at all of tortoises having been in the area since February, 1970. Pond has had H20 since started filling in mid - late June, 1970.

Pg. 80.
Tortoises are clearly moving up onto Devine's manga and even above onto his land where there are many huge fields and patches of very moist, deep and abundant herbs - especially Commelina and grasses (but also a lot of Passiflora, orange-fruited cucurbid and other herbs locally abundant). Compare this sample with previous one - very striking difference.
June 23, 1970 - saw 4 and sign of 4 more.
Today - saw 17 and sign of 1-2 more. Plus, none of the 4 from June 23 seen today, and have not seen them in lower areas around Caseta and its ponds - thus tempting to think these are still up on Devine's land also!
On return noted several things to indicate a lot of movement along manga, especially upwards -
#791 (#103 painted) - has moved up about 700 -800 feet (closer to 800 I think) and to about 980 feet altitude, even with center of banana patch, but on central open, grass covered manga still. Can see trail straight up manga from where was when saw at approximately 1030 hours this morning (now 1705 hours). Clearly used easy path of central grass covered manga to ascend, thus avoiding mora and *Solanum* brush. Appears to have grazed steadily but lightly enroute, mostly

Pg. 81.
on pangola but some on Commelina when this latter fell in his path.
#104 (#84 painted) - Jan passed at 1250 hours when climbing up to meet me, just below first fence in introduced legume covered area, steadily climbing up hill. (Saw at 1045 hours about 150-200 feet distance further south). Appears to have veered off to NNW a bit into banana patch area. (Was at Caseta on July 28, 1970).
#45 painted - at 1730 found about 400 feet distance further up manga (burrowed now)_ from where first saw this morning at about 0845 just entering manga slightly above Caseta upper ponds.
#827 - (#97 painted) - down a bit from morning location; burrowed on trail through mora just above Caseta upper pond area - on this trail heading from ponds to manga.
Note that nearly all of the animals seen today were recently (June and or July) around the Caseta and or Caseta pond #1 or the Caseta upper ponds area.
Galo Torres says that #'s 83 and #1102 are both up on central manga of Segundo Herrera and have been for past month or approximately that time at least. #83 is up about 400 meters and #1102 about 200 meters from the Reserve Border.

Pg. 82.
Caseta Weather - 1900 hours; cool and cloudy all day except for a few brief sunny periods from 1400 -1700. Garua light off and on in a.m. , none in afternoon. Rain 1.6 mm; Evaporation 1.7 ml (reading 9.3) Max 74.5° F; Min 60.5° F.

5 August 1970.
To eastern side of Devine's land, up eastern manga, looking for tortoises.
#258 (#42 painted) - moving east into forest between manga and Caseta upper ponds. Fresh sign of a 75-80 cm CL animal just 75 m up manga from area directly beside Caseta upper ponds - turds and lots of eaten cucurbid, Passiflora, and Commelina.
#919 ♀ - "CL 99.9; CW 110.0 - 125 feet east of manga at 830 feet altitude (1045 hours); set (altimeter) at 670 feet at Caseta at 10000 hours). Grazing on herbs; from tortoise trails in area appear to have come here from east or southeast and not from manga - thus could have come over from Juan Guerrero's land and gotten to that latter location from Caseta area through Scalesia forest. Abundant black-green algae on rear of carapace, especially on marginals area. No lichens; white growth intervals clear and moderately thick. Very upturned rear marginals, less pronounced on front ones. A small extra costal on left side before first normal one. Took a photo

Pg. 83.
of this - Roll #155 (HSE) photos #25 and 26. - Painted #108.
No sign of tortoise use of the manga since last sample from sign mentioned above just north of Caseta upper ponds to and past where #919 seen to east.
#368 ♀ - at 880 feet elevation, just 150 feet below Devine's first fence where manga ends (east of banana patch but at roughly same level- **[Marginal note: from Caseta Upper ponds! CL circa 105 cm] -** eating Commelina - large area covered with fresh and recent turds and several hundred square feet of eaten and mashed herbs. White growth intervals still very thin, but beginning.
No sign on manga on either side of this animal - either came here through mora from west or SW or SSW or has been here awhile and herbs have grown over old tracks - latter certainly possible because of very rich abundant and ever increasing herb growth since about last week of June (garua commencement).
#695 ♂ - at fence line - 885 feet (1125 hours) **[Marginal Note: from Caseta area also! - CL circa 91.0 cm]** No detectable white growth intervals - situation like last animal - lots of eaten Commelina, grass, and other herbs all around. Much mashed down; plenty of turds; I think these two probably came most of way up western manga and then over here through mora to this manga, but this is a guess - there is enough of the matamonte bean in and covering the mora between the 2 mangas so that such a trek would be relatively easy. Neither animal has many scratches on carapace so could not have come through disease mora - must have used mangas.
Too much garua to paint these two.

Pg. 84.
#267 ♂ - just on other side of fence and 20 m further along manga to NE. Lot of trails, burrows, and eaten out *Commelina* patches; turds, very recent and up to 1 - 1.5 months old - thus has been here in this same area for awhile; now eating *Commelina*; evidence of pathway from Caseta area to here same for this one as 2 previous animals; they must be using one of the 3 mangas or perhaps both (east and central) and the intervening matamonte covered areas. CL 109.1. Painted #109; white growth intervals coming along clear and moderately thick now.

No others seen or any sign all over rest of eastern part of sample area. Came down central manga between 1200 and 1300. Saw all the following animals, in roughly same locations where last saw yesterday except as noted; -
#107 painted, #103 painted, #13 painted, #14 painted, #2 painted, #101 painted, #100 painted, #99 painted, #98 painted, #97 painted, #45 painted; #102 painted (#598) another 100 feet up manga to NE. Every animal grazing, and all eating *Commelina* but #103 and #100; #103 not in an area where *Commelina* nearby. These 2 exceptions eating pangola.
#97 painted - moving back out onto manga near where burrowed last night -

Pg. 85.
but not heading toward Caseta upper ponds as appeared late yesterday afternoon.
Passed by Caseta upper pond and down through field below it -
Around ponds;
#91 painted (#376 ♂) moving along tortoise pathway through mora out of Caseta upper - ponds and toward manga.
#89 painted, #41 painted (was on manga yesterday), #46 painted, #96 painted all around ponds; #40 painted, 43 painted, #49 painted in fields below ponds near Reserve Border.
#11 painted at Caseta - coming into area along trail - recently was at Caseta pond #1.
Caseta Weather - 1900 hours. - cool, cloudy and light garua till 1230; then cool and cloudy till about 1500; occasional sun to 1700 and cloudy from then till new - continuing cloudy. Max 74.5; Min 61.0; Rain 1.15 mm; Evaporation 1.5 ml (reading 10.8).
6 August 1970 -
To Zone 3 Nesting Area to check for nesting ♀♀ and to La Fe eventually.
Enroute -
#384 ♂ - on trail just 20 m below Caseta, moving up it slowly and grazing.
Around Pond #1 -
#93 painted basking on east side.
#1165 ♂ (probably) - CL 80.9; CW 84.7. Basking on east side; white growth intervals not visible; no lichens or algae; red soil of type from La Fe, Zone 3 Nesting Area, etc. well ground into carapace around lower portions; perhaps has just come up form lower zones - Painted #110.

Pg. 86.
#783 ♂ - CL 137.4; CW 137.0. All smooth shell, very oblong and boxy shape - very high in front and rear and sharp "drop-offs" to marginals; basking on pond bed. No lichens; abundant black-green algae in usual areas and all over shell along scutes junctures; flaking disease scattered all over but mostly in 2 usual areas; tendency for it to be confined to scutes junctures. white growth intervals mostly not visible - in a few places can see extremely thin beginnings. Painted #111; from where? Has some deep reddish soil ground into shell on marginals but not much and not the type indicative of location save for being Region 4 area or lower on this trail (but also El Chato and lower down to west of here).
#835 - coming back up ! - at Region 2/3 border passing up drainage in Clerodendron covered areas.
#1135 - coming up also from Region 4 - in Region 3 in central - lower part, moving along trail.

#713 - CL 93.3 for checking purposes) moving north up drainage bed itself - extremely rocky, but clambering along anyway - coming up from Region 4.
Region 4 - while passing along tail -
#73 painted
#79 painted

Pg. 87.
#38 painted! - up from Zone 3 Nesting Area - passing just now over flat rock H20 collection area - Re-painted.
#906 ♂ - probably (this number) I think; 700 mark not clear like others but appears to have grown back in over saw-mark; re-marked as 906 anyway **--- see below**). CL 70.1; CW 72.2. No lichens, algae, flaking disease; scutes smooth only in tiny central parts. white growth intervals nonexistent. Changed my mind think have seen before and called #206 - will not remark till check further.) Painted #112 - moving along tail near H20 collection area.
#1194 - same area as above two, sleeping in soil depression.
Region 4 Weather - 1400 hours - Max 74.5; Min 60.5; Rain 4.20 mm (emptied); Evaporation 15.0 ml (refilled full).
Zone 3 Nesting Area - Weather - 1900 hours; Max 76.5; Min 59.0; Rain 2.1 mm (emptied); Evaporation 16.4 ml (not refilled)

Searched over all main Zone 3 Nesting Area for any new signs of nest or nesting activity. Found #131 (painted #39) over in western open part of central area - i.e. about 125 -150 m straight line distance from where saw on 1 August. Burrowed in, in small soil depression up against a dead log at 1515 hours. No fresh mud anywhere on her so she has certainly not nested or gotten as far in nesting as the release of cloacal fluid. Also, her behavior today not indicative of a ♀ preparing to nest. Grazing and foraging and then burrowed early.

Pg. 88.
Also saw #1144 burrowed in at 1545 hours near 1969/70 nest #12. No sign in any of central area of painted #19 - perhaps she has left after her successful nesting.
Saw only one possible new digging attempt - only 25 m SE of location of #131. However, in an area where many goats recently passed and looks more like goat scratching in soil. Impossible to say one way or the other for sure. If a digging attempt, ♀stopped after only about 2 cm of scratching below surface level.
Finally, ♀ #1033 is looking for a nest. First saw here already in searching process at 1555 hours in open red soil area on southern side of main area (no 1969/70 nests there, but many others from recent rears). She searched carefully for a potential site from 1555 till 1645. This process involved slowly moving about, taking 2 - 3 forward steps at a time, then stopping, pulling all legs in and dropping down to soil. The she would look around in front of her forward and to both sides by swinging her head in an arc, even up to nearly 180°.

Pg. 89.
Then she would most often drop her head and neck and place her nostrils flush on the ground and pump her hyoid area several times. Then, being apparently unsatisfied with

the site, she would perform the looking about again and finally choose her direction of movement and take another one to several steps to a new site - then the smelling process was repeated , etc. This was all in very slow motion; the whole area searched in 45 minutes was about 400 square feet. and she really only passed over about 1/3 of this ; she smelled and investigated only approximately 10 -12 sites. She tested 2 or 3 areas very slightly by scraping with her front feet in a center to side and back sweeping motion but only performed 1 or 2 sweeps and then left these locations also.
At 1645 she performed this whole sequence - looking, moving a few feet, smelled a new site, swept-scratched it twice, and then moved forward over the point she had smelled and began digging almost precisely where her nose had touched the ground in characteristic fashion with her rear feet. She dug here for about 120 minutes and finally gave up after much pushing and hard digging. Within 10 cm of surface she hit

Pg. 90.
a huge plate lava block and could not dislodge it even though she tried to do so by raising up on all 4 legs and really pushing her weight into the one digging rear foot on the rock. Actually by the time she had cleared away some loose surface soil and dead organic debris she was digging on the rock only 4 cm. below where here body was resting, even thought he rocks was 10 cm below the original ground surface.
She never released any cloacal fluid. She then began searching about in same area again and found nothing satisfying and quit searching at 1745. She moved off only a few meters from open red soil and stopped for night on top of some small rocks and dry herbs in complete open (♀♀ attempting to nest often do this in contrast to behavior and time of retirement of non-nesting animals). I watched her in this resting position till dark but she clearly seemed to have quit for the night. Will watch her again tomorrow. Took

Pg. 91.
her measurements just at dark. CL 94.7; CW 107.8. Very old, worn and completely smooth shelled ♀.
7 August 1970 -
Will begin taking nest and control temperatures today at 0800 also will take available soil moisture several times. Took soil moisture once yesterday also.
Available soil moisture -

Nest	1800 (5 Aug)	0800 (6 Aug)	1400	1800	0800 (7 Aug)
5 cm	no register	no register	no register	no register	no register. .
22 cm	20%	20%	20%	19%	18%

Control - soil

5 cm	no register	no register	no register	no register	no register
22 cm	just barely reg	just barely reg	just barely reg.	no register	no register

Also today will make observations on behavior of animals in the area for activity budgets - will write these up in sum later and am recording in a temporary notebook now.
Region 7 sample - "straight line" - of trail for July -August - (will also look for nest; Jan will take temperatures).
#918 - moving around on rocky area just above central Zone 3 Nesting Area.

#1033 ♀ - on flat rocky area in center of Zone 3 Nesting Area drinking from small H20 pockets.
No more fresh sign till nearly to beginning of Region 8 - then a fresh burrow of a smallish one, circa 70 cm CL and tracks (from this morning - fresh in wet soil from last night's garua) in open red soil area at edge of trail. From a large ♀ or medium ♂; could not find either near trail so will probably not count.
New # 1289 - (too small to sex) CL 51.0; CW 52.4. No lichens, algae, flaking disease or smooth scutes; notably oblong shape for an animal of this size; white growth intervals clear but very thin. In red soil Nesting Area on trail near Region 7/8 border - lower Region 7.

Pg. 92 and 93
Table of Nest temperatures Nest #1 - Zone 3 Nesting Area.
[data below originally entered as Vol10pg92-93.xls; note explanation of absence of 1200 data; "had to stop - #31 ♀ in area looking for nest.]

Pg. 92 - CGM Vol. 10
Nest probe - nest #1; Zone 3 nesting area

Postion	800	1000	1200	1400	1600	1800	2000	2200	700	800	1000	1200	1400
1	23.4	29.2		36.5	29	23.6	22		20.2	22.2	26.5	32.4	39.9
2	22	27		33	29.5	25.3	23.6		20.8	22.2	24.6	28.8	36.1
3	21.8	25.8		31.3	29.4	26.4	24.6		21.1	22.3	24.1	27.1	33.1
4	22.5	24.1		27.6	28	26.9	25.8		22.6	22.7	23.5	25.1	29.9
5	23.3	23.9		26	26.7	26.5	26.1		23.8	23.7	23.4	24.2	25.4
6	24.3	24.5		25.5	26	26.1	26.1	26	24.8	24.6	24.2	24.5	25.1
7	24.9	24.9		25.3	25.5	25.7	26	26.2	25.2	25.2	24.6	24.8	24.9
8	25.3	25.3		25.5	25.6	25.7	25.9	26.1	25.6	25.3	25.1	25.2	25.2

Pg. 93 - CGM Vol. 10
control probe in soil in Nest #1 - Zone 3 nesting area

Postion	800	1000	1200	1400	1600	1800	2000		700	800	1000	1200	1400
1	23.4	28.6		35.9	29	23.5	22.3		20.9	23	27.2	32.6	38.1
2	22.7	27.3		32.3	29.5	25.8	24.2		21.4	22.9	25.1	28.9	34.9
3	22.5	26.1		30.7	29.5	26.6	25.2		22.1	22.9	24.2	27.3	32.5
4	23.3	24.7		28	28.5	27.5	26.5		23.6	23.4	24.2	25.4	28.3
5	23.6	24.8		26.4	27.5	27.3	26.6		24.3	24.1	24	24.9	26.6
6	24.7	24.9		25.8	26.4	26.5	26.5	26.4	25.2	25.1	24.9	25.1	25.5
7	25.2	25.2		25.5	26.1	26.3	26.4	26.5	25.6	25.4	25.1	25.4	25.4
8	25.5	25.1		25.5	26	26.1	26.4	26.5	26	25.7	25.6	25.6	25.6

1200 temps omitted - working elsewhere

Pg. 94.
[Marginal note: Photos of rear of #1113 ♀ - #1113 ♀ and #422 side by side - Roll 156 - HSE.]
#1113 ♀ - CL 99.5; CW 109.1. very old, worn smooth completely. Large deep grooves along most scutes junctures, especially on rear of carapace. A few spots of f.d on front and rear marginals and a rather heavy infestation of it on lower half of last vertebrals; no

lichens; lots of algae of both types - perhaps indicative of fact that she has recently been in the much higher areas - i.e. about 450 feet altitude or above - white growth intervals clear and well developed, moderately thick. Painted #113.
[Marginal note: She has black-green algae all along scutes junctures all over carapace; has bright yellow-green type along scutes junctures of supracaudal, 5th vertebral, and last marginal on each side. Latter growing with black-green form in these locals but is dominant - lots of soil and debris in those junctures.]
#422 ♂ - CL 139.1; CW 148.0. Smooth all over save for very worn and very faint growth rings on outer 1/2" border of each carapace scutes; white growth intervals clear but rather thin; flaking disease abundant in 2 usual areas, especially heavy on front and rear marginal; a few other scattered spots of it. Black-green algae fairly dense on rear 1/6 of carapace and front marginals area, especially along scute junctures. No lichens; could also be recently from highlands but algae more dry than ♀ #1113 and not as fresh appearing. Painted #114.
These two animals were sitting side by side when found in the flat rock H20 collection site east of the trail about 100 m where I found #31 ♂ in June 1970 and saw other animals in June and July 1970. This is just east of the large open red soil areas at the lowest

Pg. 95.
part of Region 7. This is also mostly open rocky area with lots of red soil patches - have previously recorded evidence for nesting here - small tortoises, i.e. #1266, many 1969/70 nests destroyed by pigs, etc. About 20 minutes before we found these 2 animals we heard a distant groaning ♂, evidently in copulation from the rhythmic (10 -15 seconds apart) nature of the deep groans. This location is about right for site and direction from where we were 20 minutes previously on the trail.
Clearly the ♂ had been mounted on this ♀ because she has fresh wet, mud smears on upper rear of her carapace and red mud imprints of his feet on her front marginals- clearly he had been clambering about on her back. The fact that he was complacently sitting beside her and not attempting further mating is good evidence that he voluntarily stopped - i.e. mating probably was successful. She was clearly anxious to leave his side, so mating must have just finished because she soon took off away from him to SSW into the open area. He made no attempt to follow her - further evidence that he was through with pursuing her and probably successfully mated.
She shows no sign of having completed nesting or gotten to cloacal fluid expression phase of nesting recently - lack any fresh mud on fee, skin, tail, or carapace. However she does have a lot of red soil on lower parts of legs and pads and nails of feet - could be from digging (or just burrowing, impossible to say!

Pg. 96.
Found a long winding trail ending where she is sitting and passing from one soil patch to another over about 1/10 of this nesting area. Clearly from yesterday because fresh, but rain spattered from last night and early morning. She tried to dig a nest cavity in one area but stopped at about 10 m depth - a small rock in bottom and also very loose, dry yellowish-red-brown soil in this particular spots certainly made digging difficult. She

will probably nest near here soon, perhaps tonight. As best as I can tell this is the first ♀ for this nesting season to attempt nesting in this area.
#422 ♂ - evidently came into this area from the large open nesting like -area (pampa colorada) 100 -125 m to the west along the trail. In doing so he came straight from the trail through 2 other low pampa colorada spots to this water collection site; almost direct ENE path - interesting because all the surrounding areas are rocky and covered with dense Croton saplings. He did this, this morning, as we found a direct trail of his width clearly running along the path described - He then must have encountered ♀

Pg. 97.
#1113 mainly because they both were at this watering site.
This offers further evidence that tortoises know this site of very ephemeral water collection and go to them after light, but reasonable garua rainfall.
Also saw 2 other animals in same general areas -
#1266 - tiny one; in same area where last saw on 27 July only 25-30 m away now in fact from exact former location - foraging.
#312 ♂ k- CL 127.7; CW 139.2. Moving along SSW from some low soil filled depressions where it appears he spent the night. Moving steadily along over very bad rocks and dense Croton. Last saw him down on Region 8/9 border very far south of here in late June/early July sample. No lichens or algae; white growth intervals extremely thin. Note lack of algae on him - he is an animal from this area - perhaps lend credence t idea that #422 ♂ and #1113 ♀ are from higher areas. Painted #115.
While watching other animals #312 ♂ made a deliberate semi-circular turn and came directly toward watering site. We had to leave at this time because of Bennett, but certainly appeared that he was zeroing in on the area - do not think at his level he could see other 2 tortoises because of many brush and rocks.

Pg. 98.
Zone 3 Nesting Area - Weather - 1900 hours - Max 76.0; Min 60.0; reset both. Rain 1.3 mm (not emptied); Evaporation 2.7 ml (reading 19.1) - not refilled.
[Marginal note: Cool and cloudy almost all day - some brief periods of sun from 1030 till 1230 but not much.]
Behavior of #'s 131 ♀, 1033 ♀ and 1144. At 0600 - #1033 ♀ sitting where stopped last night, but soon became active and started moving toward water collection pockets at flat rocks in center of nesting area.
#131 ♀ also sitting in same location where last saw here last night.
0630 - #131 turned out slightly sideways from burrow site and is sleeping, stretched out fully in the rain.
#1033 ♀ - approaching flat rock area.
0700 - #131 - same as last sighting; sleeping in drizzle. #1033 clambering about on rocks looking for H20 and drinking from small pockets.
0815 - #1033 - same behavior
#131 ♀ - same position, basking in weak radiation; garua stopped at 0730 plus or minus.
#1144 - just saw moving onto flat rock area from where was burrowed about 20 m to east. Did not notice or hear moving till now, so from 0600 to 0800 must have been inactive and sitting in or near burrow site.

0930 - #1033 ♀ - on flat rocks, stretched out and sleeping /basking in weak radiation.

Pg. 99.
#131 same as before.
#1144 - leaving flat rocks and heading east again toward where was burrowed last night.
1015 hours - #131 ♀ - same ; #1033 - same.
#1144 moving around in same area as where was burrowed.
We then left the area till about 1400 hours, going in search of other ♀♀ and nests.
On return at 1400:
#131 ♀ - exact same place - still sleeping
#1033 ♀ - exact same place - still sleeping
#1144 - sleeping near last night's burrow site.
At 1500 -
#1144 now burrowed in - looks settled for the night, in exact same site as previous night.
#1033 ♀ - searching about for a nesting site in open area, heavily covered with surface rocks, about 20 m south of flat rocks and 35 m north of where was digging last night So started searching sometime between 1400 and now; probably closer to now- has not dug anywhere yet.
Watched her search for 15 minutes - pattern very similar to last evening; move a few steps at a time then settles down on ground, puts nose to ground and sniffs area.
Then found #131 ♀ at 1515 searching in eastern part of central area, nearby to where she was burrowed. Watched here searching for 45 minutes till had to return to take temperatures. Some very interesting patterns of behavior.

Pg. 100.
She searches by moving along slowly with her neck and head out straight about ¾'s of the way. As she slowly moves along over an area she looks it over immediately in front of her by slowly and occasionally swinging her head from side to side. Also as she is moving, she occasionally (every 4-8 steps or so) drops her head and neck so that her head almost touches the ground at her nostril area; she then quickly pumps the hyoid arch area several times rapidly and thus smells the ground she is passing over. Almost always she sniffs the little open spots of soil among the rocks and dry herbs she is passing over. When she comes to an area of very open red soil or at least where there are not dense surface rocks and only scattered dead herbs, she often stops, look over the area immediately in front of here, then settles down onto her plastron and performs the normal smelling of the soil spot with her nostrils closely pressed to the spoil; she also often smell not only the soil immediately in front of her center line, but smells one or more places out to each side of this area in an arc of about 15 - 45 ° on either side of her center

Pg. 101.
line position. Another interesting fact is that I saw here twice cross stretches of very densely rocky and herb covered areas in between potential nesting areas. Actually these stretches were such that they contained small spots within them where nests or at least attempts could be made, but they had a lot of surface rocks and a lot of dead, dry herbs of 1-10 cm all over them. In crossing these, the ♀ never even sniffed as she was moving. She simply looked about in front and from side to side as she crossed them, but headed

directly from one area of open red soil to another before she began any smelling activity again. Interestingly, also is the fact that in one case, after giving up on one red soil open patch, she turned and headed directly for another area with about only 3 potential digging spots. The fact of note is that from her position she surely could not see the open red soil of this new area and all around it is unsuitable area covered by lots of surface rocks and dead herbs of ½ -1 m in height (especially a mallow). Yet, she appeared to know the area she was in and that this other area was close by and its exact location because she struck off for it by the shortest route and went right to it over the intervening unsuitable

Pg. 102.
ground.
In one area, she found a larger (1.5 m diameter) open red-soil covered depression, sued extensively for goat as a scratching and defecation site. After smelling its center extensively in the resting position described above, she moved into the center of the area and began a twisting and turning motion in the soil patch. Over a period of about 10 minutes she made 3 complete revolutions in the spot and several partial ones of about 90 - 180° back and forth from left to right. She was clearly trying to clear the area of debris (small rocks, organic debris, etc.) so that it would be clear and open for digging. She also tried clearing part of the patch in front of her by center to side sweeps of her forelegs. She soon scraped this shallow layer of 1-2 cm of soil down to bare rock and then gave up and moved on to a new area.
At 1615, after taking temperatures I returned and watched #1033 searching on this occasion she was wandering way out into a very rock-covered rather unsuitable area for nesting. She went out into this from the former

Pg. 103. area she had searched in a big loop of several hundred feet - noted that she simply wander over this area rather steadily simply looking it over, but never did any test-sniffing. She returned to area with some potential nest sites and fell back into normal search pattern: looking, sniffing occasionally as moving; stopping and sniffing more thoroughly at some sites.
At about 1630, she stopped and smelled one spot for about 3-4 minutes then moved slightly forward so that rear of carapace was over spot she smelled and began digging with rear feet in a classic posture. I watched her till about 1650 and then went to check on #131.
#131 was found in furthest east patch of red soil in main Zone 3 Nesting Area, digging already in what had been a fairly open spot - on edge of a goat scratching area. She dug here till about 1720 but then gave up and moved off of the hole which was only 12 cm deep from actual original soil surface and 5-6 cm below where he rear feet rests were located. The site had many small first sized rocks in the walls (especially front one) and bottom. She moved over under a tree (semi-prone one) and appeared to settle in for the night.

Pg. 104.
Went back to check on #1033 and found that she had moved from first hole (now 1730) about 15 feet and begun a new one in a similar area. The first one was only about 8 cm

deep and was hopelessly clogged all through its ides and bottom by rocks embedded deeply in the soil.
She continued digging at this new site till virtually dark at 1830 hours but it was in rather loose soil which kept caving in and had lots of small rocks scattered through it. I returned to camp to get all my observation and photographic gear and snuck up behind her at about 1850 hours when it was very dark and hard to see. She had been still digging at 1830, but now had shifted about 3 dm to one side so that one hind foot was in the hole, the other well beyond its resting position for digging and her plastron (rear half of it) was comfortably sitting on the mound of dirt she had made from her digging activity. She was breathing slowly and

Pg. 105.
rhythmically and seemed to be literally asleep. So I waited for about 25 minutes and noted that she failed to move or dig or do anything during this entire period; so I finally snuck forward and with the flashlight hound that she was indeed sleeping - interesting that after it is rather dark and hard to see, if a ♀ quits digging, (at least in this case), she just moves a bit till she can rest on her plastron and remains for the night right where she was digging. ♀♀ which we have seen quite (including this one last night) before it is really dark and hard to see usually move a few to a dozen or more meters away and actually often burrow at least under a semi-prone log or something equivalent for the night.
Interesting - both ♀♀ sat all day doing nothing except for 1033 getting H20 in early morning.
August 8, 1970 -
0600 - #'s 1033 ♀, 1144, and 131 ♀ all sitting, out wide awake, where last were seen last night.
0630 - # 1033 ♀ at flat rock area again, drinking and clambering about; #1144 out of burrow and moving across rocks toward flat rock are; #131 moving around in brush near burrow site, sniffing ground as she moves (foraging? or looking for a place to dig for tonight?)
0700 - same activity for #'s 1033 and 131; #1144 at flat rocks walking around and drinking H20.

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0800 - #1033 ♀ and #131 ♀ just starting to have an aggression at flat rock area; #131 ♀ moved to here during last hour and is just approaching #1033. #1144 has left rocks and is moving back to east toward his burrow sites.
1045 - #1033 ♀ and #131 ♀ have been sitting for 2.5 hours, head to head after a brief aggression at 0810. They are only a few cm apart. The brief aggression consisted of them raising necks up as high as could and #1033 opened her mouth 2 or 3 times but never did more than mock bite at #131 's head. #131 raised neck out fully and had head tilted up during these mock bites but never either opened her mouth or retreated. She is in a depression and #1033 on a flat rock about 8-10 cm above the depression, so #1033 has a definite height advantage over #131. Thus when both have necks and head out and up fully, even though are similar sized ♀♀, #1033 is

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well above #131 by about 5-10 cm. Yet #131 has not flinched or retreated. After this brief inconclusive encounter, they both withdrew heads and feet and have been sitting like described for 2.5 hours.
1100 - 2 ♀♀ same position - since about 1030 have had rear legs raised almost fully and forelegs withdrawn so carapaces very low in front. #131 ♀ has head almost all way in; #1033 has hers out at same level and is sniffing around head of #131; but no pushing or biting seen.
#1144 is eating very small herb seedling near his burrow site - actively searching them out.
Am going to Caseta to re-supply; Jan will watch these 2 ♀♀ and take notes on them and temps while I am gone. Will jot down notes on tortoises as I go.
#1265 - small fellow; 25 m west of trail in lower - mid Region 5 - very near where I often see #1157. Moving along over large flat boulders.
#668 ♂ - CL 129.0; CW 140.3. Moving directly up trail in mid-upper Region 5, where Zone 1 trail enters N-S running trail. Very large; scutes smooth in central 1/6th or less only; no lichens; black-green algae all over 2 usual areas and elsewhere along scutes junctures but rather dry on the whole; white growth intervals clear but extremely thin. Has bright red soil typical of pampas coloradas well ground into carapace all around lower ½ of carapace - in fact almost shiny with it; has therefore clearly been wallowing on some lower regions for a long time. flaking disease only in a few spots generally scattered all over shell - not severe and very little of it. Painted #116.

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In Region 4 as passing through-
#79 painted and #71 painted - both moving south along trail just below large flat rocks.
#77 painted - near flat rocks; basking.
#112 painted - near flat rocks; same spot where painted on 5 August.
#1194 - eating *Croton* leaves - sitting one a piece of plate lava and stretching up as high as can reach and eating lowest leaves of a sapling.
Region 4 Weather - 1230 hours - Max 73.5; Min 61.5; Rain 4.0 mm (emptied); Evaporation 2.9 ml. (not refilled).
#236 ♂ - leaving Region 4 Clerodendron covered pond area and heading through semi-open guayavillo forest to NNW toward drainage. CL 108.4; CW 122.3. Very domed, short, and "fat" - very bulky shape. Has 11 marginals on each side but 4 on right and 3 on left are tiny low narrow things - others more or less regular or a bit larger than usual. Seems that these kinky ones are there because of extremely short, highly domed shape - very weird! Scutes smooth in central 1/10 or less only; almost no f.d , only a few scattered spots in odd places; white growth intervals clear but rather thin. No lichens, black-green algae light in 2 usual areas. Painted #117.

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#51 ♂ - moving steadily up trail in upper part of Region 3 where it levels off - only about 200 m from Region 3/2 border; was able to follow his clear tracks from today for about 300 -400 meters of trail / drainage up from Region 4 area; clearly following drainage = tracks come on to and go off of trail as it approaches drainage and leaves it again. Took

CL for checking purposes ca 139.0 cm - am sure is same old fellow from west of Region 4.
#665 - approximately 80-85 cm CL - passing under manzanillo grove along drainage to south, 100 m below Caseta pond #1.
#119 - at Caseta pond #1 - grazing in open field on south side.
#384 and #3 ♀ (painted #18) - grazing around Caseta and tents.
On return saw many of same animals in same areas - #236 ♂ up trail 100 feet further; #51 ♂ up trail 150-200 feet further also; others in relatively same spots.
Zone 3 Nesting Area - 1900 hours - Max 77.5; Min 61.0. Rain 2.6 mm, (emptied) therefore 1.3 mm since 1900 yesterday. ; Evaporation 2.4 ml (reading 21.5; not refilled).
Notes from Jan from Zone 3 Nesting Area taken while I was on round trip to the Caseta - Cloudy and cool all morning; sun cam out at 1230 and was out most of time for about 1 hour; then out off and on till 1400. Then cool and cloudy again till sunset. Still cloudy after dark.

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1230 hours : 2 ♀♀ in same position as have been almost all morning long.
1300 - same position for both 131 and 1033.
1330 - @ ♀♀ now separated; #131 in same place on rocks, but turned 180°. #1033 about 20 feet south of her in a shady spot.
Found a small one, #528, actively moving about on flat rocks at this time; but both ♀♀ resting and inactive.
1405 - same
1430 - same
1500 - same
1505 - #1033 began moving to south toward the area where she was digging last night. #131 had her back to the moving #1033, but raised her head and watched her move away. About 5 minutes later #131 began moving north toward big open part of nesting area up trail.
Then watched ♀ #131 move lowly up trail searching all the way for a nest site in typical fashion. She stopped in 2 places for plus or minus 5 minutes (but when I examined these areas later found no digging had occurred p but did scratch surface some).
1605 - #131 ♀ reached a point near weather instruments and after stopping and sniffing one site for about

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3 minutes, she moved forward a bit, turned 90° (pivoted) and began digging at this spot at 1612 hours.
(I returned at 1630 and took over note-taking).
#131 continued digging here till 1650; then she rather abruptly stopped completely after a lot of short breaks followed by loud scratching, attempting to dislodge rocks in the hole. She immediately turned 180° and started digging where her forefeet and head had been while working on the previous hole; i.e. only a few dozen cm. apart.
She dug here till 1717, then gave this up also; she then began searching again in manner I noted yesterday and continued till 1750. Finally at 1750, she moved to a deep soil filled

depression, squirmed down into it a bit and retired for the night while it was still light. She ended up about 15 m from area where she dug the 2 holes.
This makes a total of 1 digging attempt yesterday (and about 2 hours of searching) and about 1.5 hours of searching and 2 attempted holes today.
Her searching behavior today was essentially the same as noted yesterday; in the really open bare soil areas she did a lot of stopping and looking around in a 120 - 180° arc before sniffing and checking any precise spots carefully; she avoided areas with a lot of surface rocks and dead vegetation, but on the other hand did not choose to examine for the most part or dig in the

Pg. 112.
plentiful very open bare red soil areas. Instead she chose a medium situation with a lot of bare soil but some scattered small surface rocks and dead organic matter. She did not clearly examine closely any old nest sites from 1969/70 so can not say if these attracted or repelled her - no test.
Meanwhile, at 1705 I checked #1033 and found she had returned to exact spot where had dug last night. She had clearly tried to re-work the hole from last night late and given it up because of abundant rocks, especially bad ones in the front wall of the incipient nest. She had then moved only 3 feet away and is now digging on a new hole - does not look very good - a lot of rocks in walls and soil of incipient cavity area.
Returned at 1800 and found she had given up on 3rd, hole for today as expected and literally pivoted 90° and moved slightly forward (30 cm) and begun digging

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a new hole at a right angle to the 2nd one. Now working on it and is down about 12 cm already. Hard to tell if will be successful.
At 1930 returned and found she gave up 3rd hole also and moved 5 feet away and has retired for the night in the open - no wallow at all. This 3rd hole was full of rocks, and had a large, unmovable one in the front wall. This seems to be important - they need to dig a under hang or flask in the front wall and a rock there will always cause a ♀ to stop it if it can not be removed.
Once again, neither ♀ dropped any cloacal fluid yet.
#1033 has now dug:
1 hole on 6 August -
2 holes on 7 August- plus many hours of searching
3 holes on 8 August -
9 August 1970 - Toward La Fe as far as I can go - Region 7 already sampled.
Enroute I stopped at new large Nesting Area south of Zone 3 Nesting Area where have found #'s 1113♀, 433 ♂, 31 ♂, etc. - has a nice set of flat rocks and water packet collection sites, mentioned before.
Found #1113 ♀ very near where last saw her on 7 August about 1300. Up on barranca just above Nesting Area. Sleeping beside her burrow of last night. She has definitely not laid because has not mud on tail, legs, feet, lower carapace etc. She could have been digging night of the 7th but not last night. She is clearly by

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her burrow and there is almost no place to dig for 25-30 meters in any direction; also, no digging or even exploring evident in the few soil patches near her. I still suspect she is here to nest and the one test hole in Nesting Area below her from night of 5 August is almost certainly hers - will have to check back here later.
No sign of #'s 312 ♂ or 422 ♂ in Nesting Area where saw them 2 days ago.
But a new and very interesting, very old ♀ in nesting area. Some trails in red soil indicate she may have been prospecting here for a nest also - no digging however. She also lacks mud so has not nested recently.
#829 ♀ - CL 95.9; CW 107.7; could be #869 but I am rather sure that 40 mark is a natural chipping and not a cut. All smooth scutes; very, very worn and old; very deep grooves in between scutes or rear 1/5 of carapace and rather wide junctures elsewhere; marginals very beaten up in front and rear areas- lots of chipping and breakage. Has some very old, deep patches of flaking disease on front marginals, first vertebral, supracaudal, last left costal, and along

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scutes junctures of last costals, 5th vertebral and scattered elsewhere. Patches are deep and involve large pieces of scutes peeling or mostly already peeled off. white growth intervals are clear, well developed and quite thick.
Most interesting aspect of carapace: epiphytes Can't really see anything I would definitely call an alga, but has some rich green colored stuff (lichen or algae??) growing in the eaten out flaking disease patch on her last left costal. Then has a least 2 and perhaps 3 different (I think; of course all 3 different looking morphologies could be 1 lichen species) lichens on carapace rear -
1. The pale - gray -blue - greenish form growing in "liverwort" morphological form is scattered on last 2 marginals of each side in rear; also on 5th vertebral, supracaudal, lower point of 4th vertebral , and last costal on each side. Exception -- on marginals and in patch of flaking disease on last left costal, it is mostly or nearly confined to borders of scutes along scutes junctures. Also same type on first 2 front marginals on each side but not as abundant there as on rear of carapace.
2. A more finely granular and slightly greener form, but less common one is on last left marginal, last 2 right marginals, and along borders of last right costal /5th vertebral and last eight costal /next to last right marginal.
3. A rather green form, could be an algae but doubt it; its extensive in flaking disease patch on last left costals, on last 3 marginals of each side, on supracaudal, and along supracaudal/5th vertebral juncture. This one seems especially to be confined to old flaking disease areas and along deep groves of scute

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junctures. All 3 forms in fact seem most abundant in such areas where more debris (organic matter, soil and deteriorating scute material) is collected and the surface rougher than out on the flat, smooth scutes themselves; on re-examination have discovered a very light almost invisible covering of partly dry black-green algae all over scutes surfaces of rear of animal from lower half of 4th vertebral and backwards. Took some photos of her - Roll #157 - HSE.

#'s 1-10; general shots of whole animal and her rear end showing overall view of epiphytes. #'s 11-14 - right rear last 2 marginals and last right costal/5th vertebral border showing types 1, 2 &3 of lichens above. #15 - intersection of 4th and 5th vertebrals and last costals l- showing lichen type #1 above. #16 - 18 - flaking disease patch in upper center of last left costal with types 1 and 3 of lichens.
Also note above the patch in junctures groove of 3rd and 4th (last) costal some bright yellow-green stuff - algae? Same as collected from #1113 a few days ago (6 August).

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Finally collected some of all types of lichens from rear of her carapace.
Note absence of lichens from most of 4th vertebral where males would be on her during copulation. Painted her #118. Perhaps lichens indicative of having descended recently from higher areas!
#833 ♂ - CL 143.0; CW 137.0. Could be #133 but 700 notch looks like saw marks, thin chipped a bit later on. Extraordinary shape - note comparative difference in CL and CW. Very "boxy"; long oval like most of ♂ of this size from top view, but is very high all along mid dorsal line and then 1st and 5th vertebrals drop and slope to nuchal notch and supracaudal scute (respectively) in a rather abrupt, sharp fashion.
All smooth shell; white growth intervals clear, thickish and well developed; no lichens; no clear algae; black-green algae perhaps all over 2 usual areas - hard to tell because could be a thin coating of debris - anyway is black and dry stuff. flaking disease scattered in usual areas and some bit on lower sides; a large patch of it on right side of 2nd vertebral. Took a few photos; Roll 157, #'s 19-23. He is in a small potential Nesting area with lots of small patches of red soil- scattered trees, and *Opuntia* trees; very open - very rocky surface in general; only about 75 x 75 feet. Rocky areas all around; about 100 m WNW of last area I was in. Painted #119.
**Have decided to explore today and not go to La Fe - took too much time with #829 ♀ to study lichens.
Then proceeded to get lost and ended up having to go directly north to Reserve Border - hit it about ½ way in between Zone 1 and Caseta. Enroute saw many interesting

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things.
1. No red soil, open, large nesting areas. All lower zones were rolling rises and low (places - word not clear) and virtually all lava. Occasionally found small depression with enough soil for 6l-10 nest (literal soil on surface) probably actually many fewer could be laid in each because of sub - surface rocks); these had yellowish-brown soil of loose, dry, powdery type and were very few and far between.
2. Saw 2 unmarked tortoises of about 55-60 cm CL and on unmarked of about 35 cm CL in these lower rocky areas - altitude I would estimate of 175-225 feet - i.e. fairly similar to rocky areas around Zone 3 Nesting Area. The smallest one of these was the highest up in altitude and from terrain and vegetation I would guess was at about 225 feet.
3. Remained very rocky, but got greener and greener all way up to approximately level of Zone 1: then began hitting an are just like Zone 1, then shortly afterward forest up to Reserve Border.

4. Saw # 411 ♂ - large; at an altitude probably same as Region 4 - terrain and vegetation very similar,
5. Saw #16 ♂ (painted #80) moving steadily NE across

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an area of very open forest with very flat lava beneath. This area extended over about 75-100 feet in latitude I would guess and ran directly into area like Zone 1 at its upper end. Had a very green, lush, dense growth of herbs about 1l-2 dm and less in height (almost all new seedlings); otherwise it was just scattered very large trees, mostly *Psidium g*. Last saw this large ♂ in Region 4 on 24 July - certainly a long way from there now and his trail through these herbs shows he is moving very determinedly to NE across this open forest plus or minus toward Zone 1. What in Gods name he is using for landmarks I can not figure out.
Except for these 3 in lower zones and 2 large ♂♂, saw no other tortoises. In lower rocky areas up to where saw #411 plenty of old tortoise turds scattered about and a lot of sign. Then till hit zone which was very similar to Zone 1 saw virtually no sign, old or new at all. Had there been many tortoises in these open forests would have been obvious because trail left by #16 ♂ was very clear; yet he was only one seen.
In area like Zone 1 lots of small manzanillo groove ponds, many *Clerodendron molle* surrounded and filled ponds, and lots of herbs (*Blechum* dominated) pampas - all these had abundant old tortoise trails and turds from recent months. In forest above Zone 1 like

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area to Reserve Border, sign again dropped off to nearly nothing. Since tortoise were so scattered on this entire walk, adds to my impression that animals are mainly spread along drainage patterns and around ponds on these drainages - i.e. Caseta to Region 4 and Chato to Zone 5 and on to Cerrito. In other areas of island they seem much more scattered out over the landscape. This is of course mainly an impression and a generalization only.
Then to Caseta and from it back to Zone 3 Nesting Area saw a few animals to take note of for importance of movements or lack thereof:
#11 painted - crossing from Caseta pond #4 toward Caseta pond #1 through semi open pampas.
#384, 3 ♀ and 246 ♀ at Caseta/tents area.
#111 painted at Caseta pond #1
#1135 - well up in Region 3 - upper middle part - in fact only 200 m or so below Region 2/3 border. Steadily moving north from Region 4 still.
#112 painted - same exact area as past 2 sightings.

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#77 painted
#79 painted
#71 painted - all in Region 4 near flat rocks site.
#116 painted - just entering Region 4 below flat rocks - steadily moving north also.
#1151 - 150 - 200 m below big boulder area - in upper Region 6 now - moving around on rocks.

While I was gone Jan kept records on 2 ♀♀ in Zone 3 Nesting Area.
When I left there at 0815 this morning #131 was still in her burrow site in main, upper, northern part. #1103 was on flat rocks searching for water just where she had been since 0630 this morning. At 1100 - both still in same positions. At 1235 l- #131 began moving up trail to north along route where nest #1 from 1969/70 and several other nests were made in brown soil last year. She is searching in usual pattern.
1255: Discovered that #1103 was digging a new hole down in same exact area where she has been trying to dig for past 2 nights. Jan looked at hole from rear - 8 cm deep plus or minus but in a bad rocky place.
1320 - #1103 quite - too many rocks in hole walls and floor.
(Jan notes that at 1300 air temperature same temperature as yesterday at 1500 when earlier it had been warmer on both days - Taylor Max - Min was 73° F)
<u>They commenced searching yesterday at 1500!</u>
Perhaps air temperature/general macroclimate very important as a determinant of when the begin.

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1330 - #131 still searching around on rocks just above last nights burrow site.
1345 - #1033 has moved to site where dug on 6th August in open red - soil clearing; searching about here; once appeared to scratch at a site with forelegs.
1400 - #1033 still moving around - searching in more rocky areas near La Fe trail entrance to Nesting Area.
1410 - #131 up on trail now just north a few meters of #1 nest (1969/70.) Appears to be digging.
1430 - #1033 has been up all over rocks near La Fe trail entrance and is now circling back, still searching toward clearing where just was awhile ago.
1440 - #131 digging same area exactly.
1505 - #1033 - has moved completely back to original area where first dug today and on nights of 7th and 8th August. - new hole working on now.
1520 - #1033 quite on this hole.
1530 - #131 just quit digging and continuing up trail in typical searching pattern.
1535 - #1033 has turned 90° and is digging in same hole as just quit on! No, same position - mistaken - has repositioned herself in same position after moving away bit.
1600 - #131 now to right of trail in brown soil area where were 2 1969/70 nests (undiscovered ones till recently) - sniffing and searching about.
1605 - 1615 - #1033 quitting this hole and moving off a few feet, searching pattern again.
1630 - #131 in same position - sitting there and not digging - just resting it appears for past ½ hour.
1640 - #1033 now digging in new hole a few feet away from previous site.
I returned at 1730 - #131 had moved off into rocky uplift above potential nesting sites and we can't find her. Certainly can't be nesting up there, because can not have gone far in less than 1 hour and no suitable nesting sties where she was heading.
#1033 at 1600 still digging in same site as last position.
1815 - #1033 has shifted about 1 foot to right of hole and stopped digging. Hole is full of rocks - very poor site.
1845 - #1033 - same position - dark now and has certainly quit for the night.

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So - #131 dug one more hole this afternoon - unsuccessful. I examined it and it has no rocks. Instead, what appears to have stopped her is that the soil is so dry and loose and poor in adhesive ness that it was continually caving into her excavation I suspect she is close by and just resting for the night now. **[Marginal note: Total of 3 nights and 4 different holes to date.]**
#1033 dug 3 more holes. I examined these and found that all were in very rocky places with a lot of subsurface rocks in the excavation bottoms and sides. **[Marginal note: Total of 4 nights and 8 different holes to date.]**
** Note how early they both began digging today, yet still no success. One wonders if they "know" when the afternoon is going to be cool and cloudy and thus can start earlier than the usual searching / digging time commencement of 1500 -1630. Today was certainly the coolest of the 4 on which we have been watching #1033 and the 3 watching #131.
** Also, #131 does not seem to have a strong fixation for any one area, and has tried each of the

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3 afternoons in different areas; whereas #1033 has a very strong preference for that one not so good area, and a secondary one for the open red soil area where she was on the first night (5th) and where she searched again today briefly. But she continues to put most of her time and effort into searching and digging in this one small area of about 400 -500 sq. feet.
Neither ♀ has released any cloacal fluid yet. #131 left 2 turds on her trails today and Jan collected 1 of them; it is very interesting because it is: 1. very dry in comparison to those dropped by tortoises at higher, greener, wetter altitudes like Region 3 and upwards. It lacks the smooth slimy, mucous, outer coating of such turds from higher zones. Internally also it lacks this material and is essentially just made up of slightly moist pieces of vegetation which is partially digested. Almost the entire turd consists of flaky pieces of cactus bark, fibers from the pads of cactus, and many hundreds or even thousands of cactus spines. (Opuntia - all this material). So she has obviously, as expected from previous sightings since June, been feeding recently in these lower altitudes. One of these 2 turds she dropped right at the edge of the hole she was digging - perhaps she was gong to use it in adding material to the hard cap if she had ever gotten that far along in the nesting sequence. Will collect this turd for further examination at the Caseta or CDRS.

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10 August 1970 -
Forgot to take all weather last night - Max was 75.5° F (late morning); Min was 61.5° F; will record other measures tonight at 1900. Min last night was also 61.5° F. **[Marginal note: 9th of August - Essentially cool and cloudy almost all day along; a few very brief periods of weak solar radiation and sunny minutes.]**
This morning at 0630 tortoises were already very active. -
#1033 ♀ was already up on flat rocks searching for and finding H20 - (a lot of garua last night).

#1144 was doing same just east a bit on some other rocks with small pockets in them.
#918 - just north of central area at 0700 - clambering about drinking.
#131 ♀ at 0620 cam bustling through main area right past her burrow of 8 August , i.e. down trail exactly as she ascended it yesterday afternoon. I followed her trail up to north and discovered she had gone up it onto rocks just as I had theorized last evening - at least she returned that way this morning and therefore probably went up similarly last night. Can not find definitely where she parked herself over night but appears

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that she definitely did not nest because no mud signs on her tail, skin, legs, carapace etc.
#130 ♀ (painted #17) - heard her banging about on rocks about 0630 in small dry pond area just 150 feet NW of main Zone 3 Nesting Area red soil area - same area where have often seen her and where painted her. Went to investigate and found her crawling about drinking out of small pockets in rocks. Her clear trail in wet soil showed she had entered the area from the NNW over a large rocky uplift. Do not know where she came from. No mud on her to indicate recent nesting. Perhaps is here to nest?? As of 1130 hours still here messing about on rocks -
#787 ♀ (painted #19) - re-entered area from La Fe trail to south and crossed to *Opuntia* tree where sat for 2 days in July shortly before she nested and where I again found her on 1 August just after she had nested. **[Marginal note: Interesting fact: although more worn off than on 1 August I can still detect mud on feet, tail, skin of legs and lower lip of rear of carapace so can tell she nested. this even after a lot of recent garua.]** Saw her here first at 0900. At 1000 she had left this area and is moving to east SE across toward *Opuntia* tree on rocky uplift where have often seen her and or #131 ♀ feeding on fallen pads. By 1030 she had reached this tree. She is clearly foraging and at a few small herb seedlings on this last trek of about 50-75 m. There were no fallen pads at the first *Opuntia* she

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visited and it looked as if she was specifically looking for such from the way she nosed around specifically under this tree and then when finding nothing she took off immediately toward this other *Opuntia* where she often feeds. This 2nd *Opuntia* is also devoid of fallen pads now, because, as with the 1st, all of them have been eaten recently by tortoises and goats. This foraging pattern of hers is very notable and of great interest in its specific search pattern. Virtually whenever I find this ♀ in this area she is at one or the other of these 3 trees feeding or burrowed nearby to one of them. Will she nest again soon??
#312 ♂ (painted #115) - coming into major Zone 3 Nesting Area along La Fe trail - close behind (2-3 minutes) # 19 painted. Painted him on only 7 August at about 1200 -1230 hours at least 1 - 1.5 km from here straight line distance - in new nesting area mentioned in notes of 7 and 9 August. Really moving. Note

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I did not see him on trail to this nesting area yesterday when using normal La Fe trail - therefore he must go by more direct route. At 1100 still sitting where first saw at 0900 - resting in garua.

At 1100 - #1033 and #1144 still are drinking at flat rocks - lots of garua this morning - almost continuously.
Took 4 photos (#'s 26-29 on Roll 157) of black -green algae along grooves of rear of carapace of #130 ♀ (in garua when algae was very wet - 0700 hours plus or minus); 2 photos ('s 24 and 25) of #131 and 1033 ♀♀ at H20 collection site.
#131 ♀ - very complicated behavior after first seeing her pass by tent at 0630. **[Marginal note: Distance total from 0600 near where I estimate she slept to last sighting at 0920 is about 250 - 300 m by the paths she used (basically 2 long straight lines almost at rt. angles to each other)]** By 0715 was down to flat rocks, drinking here and there. She passed by within 2 feet of #1033 who was sitting on the rocks and paid absolutely no attention to her. Between 0730 and 0815 she proceeded directly past 1969/70 nest #4 and 15 and then directly passed (literally 40 cm from) the exact site where she laid last year (nest #12) - she did not search, scratch or stop on this whole trek and did not even seem to take any notice of her old nest site. By 0830 she was at the *Opuntia* tree described above toward which #19 painted later went and looked for food. (called 2nd *Opuntia* in

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above notes. By 0910 she had turned to ESE and had crossed down through a rocky depression and was clambering up over a very rocky uplift. Where she is going I know not but unless she heads toward the small new nesting area just SE of the central Zone 3 area she will be beyond any very suitable nesting spots in this area.
One curious behavior - between nest #4 and nest #12 (1969/70) at 5 spots, each about 3m from the next, she dropped a large batch of urine - I would estimate about ½ cup - 1.5 cups in each place! Three were no accompanying turds, gelatinous material, or any other material. The urine was rather dark, amber or yelowish-brown in color, but not as dark as often expelled by smaller animals (50 - 80 cm CL) when marking them at these lower altitudinal zones - i.e. it was not as concentrated as I usually see in lower altitudinal zones. However,

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the few times I have seen cloacal fluid dropped in the act of nesting - (once by #131 here last year and several times at CDRS) it was clear and therefore probably less concentrated than this material seen today. (Of course last year was much wetter in Tortoise Reserve up till now even at low altitudes, and CDRS captive beasts have water ad libitum). What this ♀ is doing I have not the slightest idea!
1200 hours -
#1144 - same area - (flat rocks), grazing on herb seedlings now; rain quit at 1130 and tortoises have already drunk most of larger spots dry.
#312 ♂ l- moving now along tail directly, through main nesting zone - still in S end of it.
#1033 - just leaving flat rocks - moving N directly along trail toward upper open area where first 2 nests for this year are located - along roughly same path used by #131 ♀ yesterday - can not tell if searching yet because she is still in very rocky area with fairly dense dry herb cover so is moving steadily along. Jan will watch her while I look for other ♀♀.

#787 ♀ (#19 painted) - has moved from last *Opuntia* - left it and headed along exact same path, it appears as used by #13 ♀. Now about 75 m east of last *Opuntia* visited, up on a very rocky uplift searching about drinking from pockets and eating small herb seedling growing in cracks in and between rocks.

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#131 ♀ - see below - At precisely where #131 ♀ was last seen clambering up onto rock uplift, and where #787 ♀ is now I noted a most extraordinary thing. There is a stretch of about 100 feet of rather smooth lava made up of large chunky blacks, but forming a nice paved pathway of about ½ -3 m width, varying in width along its distance. This runs to the ESE from just where #13 ♀ climbed up onto the uplift, after crossing about 125-150 feet of a rocky rough depression below the *Opuntia* trunk mentioned so frequently above. Each ♀ clearly used this *Opuntia* as a landmark point, #131 coming to it along a SE running line out of the main Zone 3 Nesting Area, #787 by a E running line out of the area. Now, this flat paved highway is surrounded on both sides by rough, tumbled boulders and fairly dense vegetation typical of this area. Where #787 is now drinking, the flat open pavement opens up into an area of about

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900 -1000 sq. feet of flat lava with a large *Erythrina* tree in the center; all around this expanse are small water collection pockets and 787 is drinking from them. but there is clear evidence of at least 1 and perhaps more animals having rummaged about in this area - there are several turds beyond where #787 has progressed thus far and lots of tortoise foot prints in the few patches of soil sitting amongst the boulders. Just beyond the open expanse the highway again narrows to its former variable but narrow dimensions and then makes a sudden left hand turn and continues literally in rolling fashion, like a miniature Georgia state road to the NNE. I began following it and about 200 -250 feet further up it (still beautifully flat blocks forming a neat paved surface) came to two tortoises ambling down literally 6-7 m apart, both moving steadily along the highway Neatest of all was that each was moving in usual pose for a steadily walking tortoise with neck and head out stretched, but about every 15-20 feet each would drop head briefly to the surface and smell the rocks as moving along - could clearly see hyoid pump as did this and each did it several times till finally they both saw me and stopped walking.

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Now greatest of all - #131 ♀ (painted #39) is tortoise in lead; she clearly came to this highway directly from last *Opuntia* just SE and beyond Nesting Area and now she is going up the highway. The second animal (data below) is #412 ♀, also an old worn girl, and she is using the highway also. To regress at bit. I saw her earlier (0930) just 100 feet west of new tiny nesting area which is 200 m SE of main Zone 3 Nesting Area - at that time she was sitting still in a very broken rocky spot, but near what appeared to be a central highway to E which circles around base of up rise (uplift?) on which tiny nesting area sits and then proceeds north. It is not as smooth as this one, but there are turds along this path. **[Marginal note: Found 2 turds laid by #412 ♀ along this trail just 30 m before hub area. Collected and preserved; they are full of Opuntia pad fibers and spines - therefore in lower zones past 1-2 weeks at least.]**

Also there is another clearly used tortoise path running directly from where I saw #412 to NE through same depression (but S area of it) crossed by #'s 131 and 787,

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directly to the superhighway they are all now on. This pathway is rough and broken but are now and I have noticed dry turds of various ages on it even since I saw it last November. Dead vegetation is all mashed down along it. Anyway, returned at a little after 1200 and could not find #412; but thought I could see a path out toward this known path through the depression in form of occasional footprints in dirt patches, going definitely NE from nail and heel position. Followed this pathway and found prints continuing here and there all way till I found #787 and smooth path coming in from NNW to ESE (mentioned above) from 2nd *Opuntia*.
So clearly, these 2 basic pathways converge to this grand highway and just this a.m these 3 ♀♀ used one path and #412 ♀ used the other and all are now on the NNE running main highway. This may be a significant highway running some distance. I do not yet know how far and will explore it as soon as possible. For now should note that it is heavily used by tortoises and goats - it is very open and free of all vegetation save herb seedlings in cracks and trees here and there. There are abundant

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turds of all ages from relatively recent to very old dry, disintegrating ones from tortoises; also abundant fresh and old dry goat shit all along. The most interesting g question is how much further North it runs - it does not appear to go further South - the upper spot with the **Erythrina** is its basic beginning it seems with at least 2 spokes coming in over short flat pathways on the smooth blocks, as noted above. Perhaps other pokes come to this hub. The olfactory behavior of 412 ♀ and 131 ♀ might be indicative of fact that tortoises navigate along this route with vision and olfaction!
I took a few photos - approximately Roll 157, #'s 30 -32 of #131 and 412 moving along a small portion of the highway. Do not know if tortoises and goats actually caused much of the smoothing of these chunky blocks into relatively smooth pave surface but it is rather certain they have added a bit to it if not caused it directly - interestingly, all the

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surrounding lava up as far as I have followed the pathway from the *Erythrina* hub (i.e. about 250 feet) is very rough, broken, tumbled lava on both sides. It honestly looks as if the pathway were also once the same and has been smooth ever, because occasionally the pathway splits into 2 pieces leaving a small area of rough tumbled blocks in between the 2 branches of smooth stuff which then quickly rejoin in a short distance. Of course the area could basically have the structure and the tortoises have just taken advantage of it. Of course all this could be a coincidental meeting of 3 beast in a commonly used are but very unlikely given separate paths used and definite evidence of heavy use of 2 rough pathways approaching hub (many turds, many sightings of #'s 131 and 787 on the one, and heavy use of NNE highway (turds ad nauseum).
#412♀ - CL 101.9; CW 114. Very old, all worn smooth scutes; front marginals badly chipped up; 400 and 10 marks sure; 2 mark somewhat doubtful because chipped but saw mark appears evident on one side. No lichens; flaking disease in deep eaten out patches

here and there on rear ¼ of carapace, and front marginals; abundant, rich, bright black-green algae in all these flaking disease areas and all along scutes junctures all over entire carapace. not on undersides or along lowest borders of marginals - probably combination of lack

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of light (mostly this I suspect because scutes juncture grooves are somewhat protected) and excessive hard abrasion. Because of algae can (not) say anything about white growth intervals - scraped some away - present but extremely thin. Painted #120. No sign of recent nesting (past week plus or minus) - no fresh mud where would expect it. However some red and brown soils well worn into skin of rear legs and tail so could have nested 10 days - 2 weeks or more ago and similar worn off mud by now in travels. Would like to know where she has been and is going. Not in new tiny Nesting Area to SE of main Zone 3 Nesting Area. - checked it yesterday and just now (1230) and no sign of any tortoises in it except for one about 40-45 cm CL which clearly crossed it - can see its tracks.
Total distance #131 traveled between 0910 and 1235 when spotted - about 300-350 feet. Same for #412 between 0930 and 1235: about 550-600 feet.
I took photos of #33-35, Roll 157 of beautiful black-green algae growth along scutes junctures of carapaces of #131 ♀ (33 and 34) and #787 (photo 35). On these 3 females and #130 (painted #17) noted that stuff is blooming all over their carapaces in scutes juncture grooves all over upper lighted, wetted (by garua) surface - also anywhere there are patches of scutes gone due to flaking disease, so that there is a slight depression below the scutes surface which is normally abraded, then the whole thing is thick with the algae in these "depressions" - i.e. growth is heavy anywhere surfaces is not exposed to abrasion normally. But none have it on undersides - no light. It is heaviest on all of them along borders of front marginals area and on rear ¼-1/5 of carapace along junctures. But occur in all other grooves to some extent (but not including) above plastron / marginals junctures.
Should mention that I found this pathway on 26 July and wrote a few notes about it - (page 44 of this volume) - but at that time did not examine it carefully or extensively as today.

Observations on #1033 ♀ k- Jan took till 1430, then me. At 1245 reached area near fire pit where is some open red soil. Stopped after searching here for a minute, turned 360° **(editorial note: CGM apparently means 180°)** to face direction she came from, then 90° more to face west. Began immediately digging here and did so for 26 minutes. Then abruptly quite and entered main zone and began searching some more. **[Marginal note: see volume 11, page 7 for information on holes dug today.]** At

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area of nest #1, 1970/71 (by #127 ♀), she simply passed by without giving it any notice. She entered about very center of region and began digging in a very open spot, but not near any of last year's nest. She made a 180° turn just before beginning to excavate at 1326 hours. For first 30 minutes of digging she was raised well up at front end with her back end low- **[Marginal Note: … but resting rear on rear end of plastron most of the time.]** she was clearly supporting a lot of her weight on her forelegs. Then she ban to

dig with even more exertion as she encountered some small rocks, raising her entire body off of the ground with the insertion of each foot into the hole. Actually from this time on seems to have body elevated much of the time, even when digging foot is in hole. sometimes raises completely up to push with all body weight on digging foot n effort to move rocks in hole.
AT 1416 noticed thumping, as she tries to move rocks is even louder. Loudness continues and is even greater at 1426, one hour since she began.
At about 1500 she took a long 3 minute rest, resumed digging and tried twice to budge rocks loose

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with each foot. Then at 1509 abruptly quit and moved off of hole a few feet. Sat and looked around carefully and then began typical search pattern, passing near nest #9, (1969/70) by weather instruments and worked back over near her first digging area of today about 1545. Here she quickly located a new site a few feet away from first one and began digging at 1555. So already on 3rd hole of the day since began searching pattern at 1200. Noted that searching pattern is largely as before. When she is crossing areas with abundant surface rocks and dense vegetation she just looks ahead and to side, but never sniffs areas closely. Reserves sniffing for more open spots when are soil patches or large expanses of open red soil. On the other hand, although she has passed and seen sites of at least 6 nests from last year and 1 new one (#1) in this area, all being open bare soil now, she has not olfactorally inspected even one. She seems to size these up visually as she passes and does not even noticeably "look them over" - she pays most attention to open and semi-open soil spots with a few or no surface rocks and pebbles and where dead vegetation (both prone and standing stuff) offers only light cover. She also

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however avoids big, completely open well worn patches of red soil where goats scratch - she doesn't even give these a passing glace. She clearly searches out open - semi-open spots which have not been dug in recently (last year or 2 at least) and which are not goat scratching places - What cues she uses per se I can only guess at - at least all hole (11 now) she has dug have been in soil with a light covering of small rocks and rocklets and some scattered dead herbs (i.e. especially mallow stalks).
There is probably good reason that they avoid digging in nest sites from only a year or even several years ago. In this type of soil which is cohesive when wet and forms a very durable hard cap, it must take a few years and maybe even 10 -210 years of wetting, drying out, and rewetting before the old hard cap material returns to the basic soil condition - very finely broken up almost powdery soil. Certainly the had cap material from this

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past year is still mostly in hard chunks and this conditions prevails even though I broke up the large dry clod with my boot heels. Natural nests which are not interfered with by man must take even longer to break up the hard caps and resettle. This process may require a good hard rainy season to ever be completed so that the soil can be wetted and

settle properly to fill in the hollow space beneath the hard cap which is left after the young escape from a nest.
1645 - Quit at this 3rd site; moved 5 feet away and began at a new site but was up against a dead log and kept rapping bottoms of feet on it with each backward digging stroke. Finally, gave up after only 20 strokes plus or minus and moved off down trail toward flat rocks. Soon veered off to left about 40 feet shy of flat rocks, went to small trail leading to eastern open red-soil covered part of nesting area and proceeded directly toward this area. Proceeded slowly because some of going rather rough. She reached this area at about 1890 and simply wandered over under a Pisonia tree and began watching #312 ♂ who is "burrowed" in a soil depression there (really in open largely). She will apparently sleep here because at 1830 still in same position. No further digging or searching by her after first reaching this area.

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She seemed to know exactly where this and all other main open areas of central zone 3 Nesting Area are because in each case when examining one o f these areas for the first time she proceeds rather directly to it from the last by the shortest method possible, that is shortest excluding clambering over big rocky uplifts and rock piles. She went straight to the area where she I s now with no hesitation and we have not seen her here since we arrived on 6th of August. She clearly could not see this area from where she was last digging this afternoon- but she went down the trail to southeast, took a short eastward running shortcut and then went NE directly into the area.
#312 ♂ came into this area from where saw last at 1200 today. Only another 300 feet total from where I last saw him. This is one of main paths out of the Nesting Area I think. It is one by which #3 ♀ entered area also. Have seen other animals

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come and go on it, e.g. #325 ♂, and often find animals at its entrance to Zone 3 Nesting Area, eastern part where #312 ♂ and 1033 ♀ are now located.
About 1730 went up to briefly check on #130 (painted #17) and found her in same area scrunched down into a burrow in soil in open. We heard her cluncking about up here almost all day long.
Found another ♀there - #112 ♀, **[Marginal note: **8th ♀ of laying size in this area!]** large; all smooth shell, very beaten up marginal scutes; large patch of flaking disease on 4th vertebral - old depression caused by it. Otherwise flaking disease mostly not present; white growth intervals rather thin. No lichens; as with other females mentioned in today's notes, has abundant black-green algae along scutes junctures on rear of carapace and front marginals and some of it along all other scute junctures above but no including marginal / plastron junctures. Very rich thick, green color to algae after recent garua. CL 100.2; CW 111.3; No real evidence on her of any very recent nesting - lots of dark red soil ground into skin of legs and tail but that is not indicative of very much. Will paint her tomorrow if possible. Can not tell how she came into this area of small dry pond - perhaps from ENE or from south - are fresh trails in muddy places to pond area from other 2 sides, both of about the ♀'s size. **[Marginal Note: Both of these were burrowed at 1730 and clearly not attempting to lay at all - probably burrowed long before - yet #1033 is till marching about at this hour.]**

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She did not come down our trail from Region 4 - at least its lower part because I went up it about 100 m and found no sign of an animal of her size having come down the trail. This demonstrates that animals come into Zone 3 area from several other main trails and leave by these also other than highway I found today.
Examples: 1. Our trail; 2. Eastern open area trail; 3. trail into dry pond area - i.e. #130 and #127 always seem to use this pathway.
#1144 and 312 ♂ (painted #115) were burrowed before 1600.
Weather - Zone 3 Nesting Area - 1900 hours - Cool and rainy all day long! A lot of garua for this altitude. Max 73.0; Min 61.5; Rain 5.0 ml (emptied) - since 1900 on 8th; Evaporation 2.8 ml (reading 24.3), not refilled; - since 1900 on 8th also.
11 August 1970 -
0645 - #'s 1033 ♀ and 312 ♂ - obviously have been active for some time; both are sitting side by side near his burrow sites of last night. The entire rear half and front marginals area of here carapace are smeared with red mud - the ♂ obviously has been trying and or succeeding in copulating.

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with her. Perhaps he was successful because she is very passive now and he looks to ha e voluntarily dismounted and stopped trying to mate with her.
Went to hub area of new highway (see yesterday's notes) and ascended it - found the following -
#412 ♀ (#120 painted) was about 200 feet further up trail (highway) and off to its (left 50 feet. She had left it on a smooth short side branch to the east yesterday and gone to investigate below a medium sized *Opuntia* tree- clear trail around base of *Opuntia* where she looked about. But no pads - just remains of those eaten by tortoises. Lots of cactus filled turds here - old and reasonably recent. Same area where I saw #37 painted on 26 July 1970. She then obviously burrowed into red soil near the cactus. Can see burrow clearly. Now (0700) she is heading directly back to highway but at a 45° angle to way she came in - i.e. taking a shorter route on the assumption she intends to continue up the highway. She is just about to reach highway.
#1024 - Burrowed near highway - just below it in a small patch of dark brown soil.
Marginal Note: Still resting in burrow at 0710.] Right at point when #120 painted is re-entering highway. CL 58.1; CW 64.8. No lichens, algae, flaking disease or smooth scutes; white growth intervals very thin.
#131 ♀ (painted 39) - another 200 feet up highway from where #120 (painted left it. Was able to follow her trail clearly right to here and several fresh cactus - remains - filled turds and foot prints here and there in small patches of wet soil in amongst rocks of highway.

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surface. She had gone off highway to right, immediately below it where there is an area of about 800 sq. feet of dark brown fine powdery soil. She had clearly just walked though it and burrowed for night where she now (now 0710) is still resting. No sign at all on the area or on her that she attempted to dig at all last night. Very strange it seems - 3 nights

of concerted attempts to lay and then on the 4th day she moves away ½ km and that night makes no digging attempts. Of course, could have moved to this area intending to lay here and is resting for 1 night and 1 day before beginning the arduous task of laying. One thing bothers me - could she have laid eggs on rocks on later afternoon of 8 August just north of where she last dug that day - ? Am certain she has not done so anywhere else because I know all her paths. This could explain, if she did so, why she left the main Zone 3 Nesting Area and then did not attempt digging last night.

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Will try to check her again this evening to see if moves or tries to lay when left her at 0800 she is till burrowed in - unlike #1033 ♀, #312 ♂, and #1112 ♀. However small one, #1024 is still burrowed.
#787 ♀ - (painted #19) - found her at 0800, 200 feet SW of where last saw yesterday at hub. Followed her clear trail (footprints and turds) directly along trail to SW used by #412 ♀ to reach hub yesterday - #787 used it for about 150 feet in other direction, then left it to south for 40 feet where she is now poking about beneath an *Opuntia* tree for fallen pads and fruits - are none, so she is eating small herbs in the cracks in the rocks. This trail to SW is clearly a main access route to the smooth rock highway and its hub, as are the other two from the nest plus or minus from the central Zone 3 Nesting Area. (these 2 run parallel - one by the *Opuntia* mentioned yesterday and down through a small depression, the other along a different depression, 25 m to the north only; both come to hub at same spot).
#'s 130 ♀ and 112 ♀ - up by dry pond just NW of upper Zone 3 Nesting Area open part: have heard them banging about up there since about 0630 - 0700. Looked in on them at 0845; #130 ♀ was up against side of #112; the latter was completely drawn in and passive whereas #130 had her head about 1.2 way out and was [**Marginal Note: Neither trying to lay.]**

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looking over and sniffing along side of #112. Probably an aggression earlier and it looks as if #130 was clearly the victor from present behavior of each. Painted #112 ♀ as #121 painted. While was there and re-painted #130 ♀ (#17 painted). At least last night, neither of these showed signs of wanting to nest. #918 and 1144 were out active by 0700 (probably before) in their usual area, getting H230 out of water pockets and eating small herb seedlings.
So of all these large, adult, smooth -shelled ♀♀, clearly one 1033 is still trying to lay #131 is still a big question mark. To date, #130, 112, 412, and 787 are clearly not trying to lay #130 and #112 are questionable because just recently arrived and may be resting before beginning to lay.
Of course #829 ♀ (painted #118) and #1113♀ (painted #113) from new Nesting Area bout 3/4 - 1 km. south of here may be trying or may have laid. Will have to check further - am fairly certain #1113 tried in that area on night of 6th August. Will check there again soon for ♀♀ and nest.

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This morning we searched all over area where I think #131 ♀ spent night of 9 August, 1970. Found 3 more turds she left, again full of Opuntia spines and internal pad fibers. Otherwise found where we think she may have slept that night - shallow sleeping (oval shaped) in a little soil filled area in rocks. No signs of any mucous or eggs being dropped by her at all.
Will take these 2 turds **[Marginal Note: Preserved]** to Caseta for examination along with other one collected by Jan on August 9th (1970).
This morning examined 2 turds from yesterday dropped by #1144. Were crammed full of dryish leaves and partly digested green herb leaves and stems of herbs. Clearly digested green stuff much more thoroughly than dry type. Vast bulk - i.e. about 70 - 75% was dry material however. Turds were moist throughout but lacked mucous-like consistency internally and externally which is most often characteristic of even very fibrous turds dropped in higher moister altitudes. The dry material was digested very poorly and often found chunks of leaves and stems which seemed hardly changed at all. Green material was mostly just veins and small pieces of leaves - bulk of green leaves apparently were digested.
More on meeting of #312 ♂ and #1033 ♀ - when I returned at about 0815 he was again mounting her and from then till 1000 he was almost continuously mounted on this ♀. For awhile he was mounted on her sideways and from in front - these positions just when he started

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trying to mate with her again at 0815. He soon became straightened out and mounted her properly from the rear at about 0850. From then till 100 he was rhythmically thrusting and groaning with each thrust till he finally more or less slowed down and dismounted. The thrusts lasted on the average about 2 seconds, the groans about 1.5 seconds (varied from about 1 to 2 seconds) and the periods between thrusts were usually 5-7 seconds long, most often being 5 or 6 seconds. Am not sure he was ever successful or not. After he dismounted at 1000 I went up and inspected her rear and the lower lip of her supracaudal scutes and her tail and whole cloacal area (even her right leg in fact) were covered with a thin coating of a slimy mucous - like material which I would interpret as being at least partly seminal fluid. During the copulation I was too far away to observe if he was achieving intromission or not so can not answer this question satisfactorily. The ♀ was passive throughout the entire mating; the ♂ did not seem to have any great problem in fitting onto her carapace properly and in getting his tail under her carapace in the rear. As have noted with other matings, tail went under carapace with each thrust and then

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came back out from under it as thrust was terminated and he rocked back up onto "resting position" and re-extended rear legs to support his rear again. Otherwise mating all normal. We took photos 1-19, Roll 158 HSE of this pair in action (Later Jan took about #'s 20-29 on same roll of same pair).
I left for the Caseta to get some supplies at 1100 - Jan continued notes on this pair and others - first will complete notes on this pair -

From 1000 -1100 sitting side by side; male looking at ♀ but inactive otherwise; ♀ completely withdrawn and passive.
1125 ' same positions.
1130 ' ♂ began to move and sniff ground at rear of her carapace about 1 foot behind her. Then he stopped there and still has head out near her rear end. She remains withdrawn and passive.
1145 - same positions.
1200 - same positions.
1202 - ♀ now has head out as does ♂.
1210 - ♀ now has head out and forelegs extended fully and thus plastron low in rear; ♂ is sniffing her rear end. Can no say if she was doing this in response to him or not. Left then at this time.
1230 - Returned to find them 10 m away from previous sighting with ♂ mounted and groaning and copulation in full swing. Obviously she had tried to leave and he caught her and mounted again.
1245 - Still mounted, and thrusting/groaning.
1250 - ♂ dismounted voluntarily; did not see Jan at all; so perhaps finally clearly successful (also perhaps so by 1000 this a.m. - same basic behavior then also).
During this particular copulation Jan thinks she was how the actual

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sperm transfer probably takes place. something which I have never yet been able to clearly witness; The male's tail goes under the rear of the carapace of the ♀ with each thrust (i.e. rocks backward and downward) and comes nearly or completely out from under it after or as each thrust ends. **[Marginal Note: on further questioning Jan says tail remained crooked even between thrusts and rarely if ever cam completely out from under her carapace between thrusts. Instead some of its length, probably majority of did and end of it remained just under and in front of lower lip of supracaudal.]** This is essentially the same as I have witnessed. Jan got down on ground right at rear of copulating pair, as I have done before, and she thinks that the male's tail was entering the female's cloacal aperture at the "height" of each forward thrust, and not his penis. She says looked as if about 2 inches of the tip part of his tail went in each time. Then just after the tail cleared or cam out of the cloaca, as he was rocking back to resting position in other words, the penis came out of his cloaca very briefly and down the inside curvature of the tail to within 1.5 - 2 inches of the tip of the tail. Then as he achieved the full rest position or about that time or soon after the penis quickly retracted back into the inside of the tail completely and was no longer visible outside of

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the cloacal aperture. Jan says it was hard to see all of this and she may have not accurately seen it all, but this is how it appeared. She did not want to disturb the animals, so was only able to witness this closely for 3 or 4 thrusts.
This is still very suggestive of the fact that perhaps the penis deposits sperm on the male's tail and then the tail is used as the intromitting /depositing tool. Will simply have to observe more of these copulations to say much more.
Continuing this pair's activity -

1315 hours - sitting in dismounted position of 1250; ♂ sniffing her front end a bit.
1330 - same ; both clearly resting; ♀ still all passive and withdrawn.
1345 - male now around behind her with head at her rear.
1402 - ♀ #1033 moving away to NE slowly but determinedly and clearly trying to get away from #312 ♂. He is simply watching her go.
1404 - ♂ turns in her direction and then stops and settles down and watches here go away. His head is way out and up and he is raised on front legs only. He just let her move off.
1410 - She is now about 40 m from him and he is not following. She is in the furthest east portion of the open nesting area where there is still some red soil and nesting sites.
1415 - Now she stops. Then continues but now in obvious nest searching pattern! After all that battering about by the ♂ from before 0700 till 1400, she immediately begins on what she has

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been intent on doing for past 5 nights.
1420 - has moved back a bit west and is now searching about in an area with a fair amount of open red soil- only 20 m east of copulation site. Lots of old nest here. She is roaming about in typical searching pattern.
1430 - same; roaming in small circles
1450 - same; must be in sight of #312 ♂ now but he is sitting, "contented", doing nothing.
1515 - #1033 ♀ - no clearly digging in open red soil area which has scattered, small, low dry herbs and small surface rocklets - very near or on old nest sites. Not sure if # 312 ♂ can see her - probably not clearly if at all now because a large prone Pisonia tree with many leafy vertical trunks is between them. He could see her where she was formerly searching, but probably not now.
1545 - same conditions for both 1033 ♀ and 312 ♂.
1615 - #312 ♂ moving around a bit now in same area and to north a ways.
#1033 quit her hole sometime in past 30 minutes and is now searching again in same area (note: after returning to the

Pg. 157.
area, I checked this hole; it is a nice and fairly deep one, 16 cm deep from surface in good compact but dry soil. Much like one she dug yesterday afternoon up in central part near nests 3, 6, 7, 9 etc from 1969/70. No caving in problem at all here. <u>But</u>, she hit a small but spread out flat, horizontally -placed rock right in floor in very front of nest cavity just when she was beginning to hollow out the flask overhand - apparently this topped her - as have noted before, this particular part of the cavity seems to be very important to a ♀ and they are very sensitive to any disturbing objects in their way here. The rest of the cavity all around this area is deep good soil; if she had dug literally 3-4 cm further back than where she chose she would have completed the nest probably - virtually no rocks anywhere else in this hole and immediately around it in the soil. Also, this was dug almost precisely on an old nest site - the soil she brought out of the hole was full of old tiny and pulverized egg shell fragments. I , in fact just removed the old collapsed M. Castro style corral from this very site and cleaned the surface of large unnatural rocks

about 3 weeks ago. This of interest because the old nest could not be more than 7 years old more less because Castro did not begin the corral protection business till then. Also, I noted when cleaning this site that except for partially pushing the wall

Pg. 158. down they had not apparently examined this site further after first protecting the nest. **[Marginal Note: they never tried to help along resettlement of soil by breaking up hard cap and filling in cavity!]**
So in 7 or less years the soil at this site had resettled and the cavity, soil clods from hard cap, etc. were all not in evidence any longer. So, at least in this time period, the soil in an old nest site is capable of returning to essentially its normal, compact condition!
1645 - #312 ♂ burrowed now up against semi-prone Pisonia in lose soil; apparently did so in past 30 minutes some time.

31033 still searching; now has returned to furthers east area of main Nesting zone - last red soil which is exposed. Was there earlier - only 209 m from where as previously digging.
1805 - Apparently #1033 did not attempt digging again. She is now only 10 m east of flat rock area and we were able to follow her trail all the way back through eastern red soil covered area to where she was searching at 1645. This about 75 m total distance. She clearly moved to present location in past 1.25 hours. Now still

Pg. 159.
slowly moving along but completely up on rocks now. By 1815 she had stopped here in open and is clearly going to remain here for the night. Note she is active very late whereas non-nesting animals of all sizes and sexes mostly are burrowed by or before 1600 or soon after. So 1 more hole today, and a nearly good one, for #1033 today. Up to today, in 6 afternoons of trying, she has dug in all but 2 of the obviously often used areas of central Zone 3 Nesting Area. - i.e. areas with lots of open red soil and old nest. Very extensive attempts and travels - the above notes from 5 August to these detail her activities She has still not dropped any cloacal fluid at all.
Activities of other ♀♀:
#709 ♀ - (painted #72, painted her in Region 4 on 25 July! Have seen her in Region 4 her usual area of activity off and on almost every sample period in fact since Nov. or Dec. of last year - will check for exact locations / times).
Jan first saw here at 1615 in center of trail, moving SSW, in eastern part of central Zone 3 Nesting Area; i.e. she cam right past #312 ♂ and he apparently paid no attention to her - she was not here 30 minutes before when Jan checked - but she apparently did come down over rocky, uplift from approximately north because Jan had been hearing an animal thumping regularly in this area

Pg. 160 (un-numbered).
since almost or after noon. She remembers hearing this thumping from north over rocky area fairly frequently around 1200-13-- when 312 ♂ and 1033 ♀ were being watched copulation and being checked on for activity and location. It therefore seems possible that it was #709 moving down from north along route by which I have previously seen other animals enter and leave eastern part of Zone 3 Nesting Area (e.g. #3 ♀ came in

from north this way also we think on basis of trail she left). Thumping seemed away off to her at that time. Theoretically at least she could have moved close to Nesting Area in the period, then rested and just now in past 30 minutes moved down onto level soil-covered area and started south through Nesting Zone.
There is one confusing element in this argument. I now know that #112 ♀ was moving north along roughly same route during this period so thumping could have been her instead (see below for more info on #112).

End of notebook.

Isla Santa Cruz Volume #11.
Field Notebook of Craig MacFarland

Pg. 1.
August 11, 1970 – continued.
On this argumental line, #709 ♀ could have still come in from N along pathway proposed, or from e via main highway just recently discovered, or between these two areas or still another path I have seen tortoises use to NNE and NE (this latter path may join main highway further E – have yet to explore the possibility). Anyway she certainly came from region 4 and to S along some close by path – which one is less important than fact that she did it and has come here to nest. Continuing time sequence for #709 ♀:
1620 – moving S along trail still. She saw Jan but does not appear disturbed.
1645 – moving off of red soil path from eastern part of NA and over rocky damn to open and semi-open red soil areas in SE part of NA. (i.e. nests 4 and 15 from 1969-70 locale).
1715 – searching in last area mentioned – typical searching pattern.
1735 – still searching;
1805 – I returned; #709 clearly digging in a rather poor rocky area just W by 20 and above where nest #12 1969-70 was located.
1830 – Still digging in same area; was able to approach her from behind without her seeing me; getting rather dark and difficult to see. She has managed to get only about 10 cm . . .

Pg. 2.
. . . down into soil and has (audibly from many dozens of meters away) been trying with great force to dislodge the many and abundant rocks in this hole. It is clear she will never be able to dislodge them now that I see the hole. There are rocks all over the bottom and sides of the cavity. At 1840 after a short rest and then a few more attempts with each foot to dislodge the rocks she moved forward a few steps from the nest, turned 180 º and walked over the hole without investigating it and almost right over me and then 1.5 m away to W. Then settled down here on rocky surface with a bit of scraping and swiveling (to no avail as far as loosening up a burrow of soil goes); will clearly spend night there in open. It is very dark now and was while she was leaving hole. They clearly do not see objects well at all in dark or semi-dark (there is a bit of moonlight coming through clouds now – enough so I can distinguish rocks and trees and branches' . . .

Pg. 3.
. . . shapes and can walk without a flashlight). She could have passed from hole and where she is now sitting more directly and easily and by avoiding all obstructions. But instead she bumbled right through and over some branches, dead tall herbs (mallows) and old dead sticks to get there – she did not seem to see them and drew in and hissed out her breath twice while enroute when she crunched into some of these objects. Anyway will watch her tomorrow. Do not know from how far away she came today but she certainly traveled some distance, even if only a few hundred meters and immediately began searching for a nest site with little or no rest period evident (of course she could have rested for a couple hours this afternoon in rocky area above eastern part of NA where she entered).

#131 ♀ - (painted #39) – has returned to Zone 3 NA from Rocky New Highway to E. We do not know by what route but probably at least in part along highway and then to WNW over rocky tumbled lava and rocky depressions to eastern part of Zone 3 NA where #'s 312 ♂ and 1033 ♀ have been all day. There are also some obvious old tortoise pathways (turds and matted dry vegetation) through these rocky unpleasant areas leading off to ESE to highway. (Have noted these since November, 1969). Anyway, Jan found. . .

Pg. 4.
. . .here at 1700 just 20 m E of furthest W red soil patches of eastern Zone 3 NA part – i.e. part where she dug a hole on night of 7 August, 1970. She clearly is attempting to "burrow" here in a very small patch of soil in rocks – about size of here in fact. Is swiveled down into this soil a bit. When Jan saw here (by accident), Jan got within 15 feet of her by accident and noted she was raised fully up on all 4 legs over this soil patch. Jan left quickly but is afraid she disturbed her. At 1810-15 I checked her and found she has moved either because of disturbance by Jan or dissatisfaction with this small site (probably latter) directly W to eastern part of NA, right past #312 ♂'s burrow site to her own burrow site of night of 6 August, 1970 before she had begun (at least as far as we know) her nesting attempts. She clearly was not searching for a nest site or trying to dig . . .

Pg. 5.
. . . since we saw her today. Her behavior still seems a bit weird. After 3 nights of digging in earnest she has wandered quite broadly and now spent 2 days/nights without trying to nest. Perhaps she has returned here to try to nest again after her excursion (and rest, if wandering around for hundreds of meters for 2 days is really resting).
Activity of a quite small tortoise - also today, at 1215 hrs Jan found my little friend #1193 walking about up on flat lava block rise just above and E of weather instruments. She again saw him in same area at 1400 hrs. On both occasions he was eating small green herb seedlings which are now quite abundant in small cracks and crevices in and between lava plates, blocks, and boulders all over at these altitudes. This is of interest because he has moved his area of activity from that partly rocky and partly open soil covered are (SE of where he is now) in the eastern part of the Zone 3 NA. He is now about 200 feet plus or minus straight line distance from this pervious area of activity; all of the area directly in between the two areas being a very rocky broken area with lots of dry vegetation (Pisonia, Croton, a few Opuntia trees, etc.) on it. Of course he could have worked his way to his present area via the more open, level, mostly flat soil-covered areas which run on either side of this . . .

Pg. 6.
. . . rocky rise to the N and NE of his former activity area. His 2 little burrows in the former area appear to have been in disuse for some time and I have not seen him in either or in the general area for quite some weeks (will check notes to be more exact). Appears that he has therefore shifted his area of activity to the flat lava plates just above the weather instruments where there are now lots of herb seedlings and lots of small pockets in the lava which collect garua for his watering purposes. Will check this area more

thoroughly tomorrow for his new burrow sites. Note: I did find some recent small turds of his size about 20 m from where he now is to the E toward the open red soil of the NA – perhaps he came along the trail there from his former area and then up onto the rock pile and to these lava plates. This is certainly an easier route if longer (circa 300 feet) one, than to directly cross the whole rock pile of broken, terrible stuff from one activity area to the next.

Pg. 7.
Zone 3 NA – Weather data – 1900 hrs – Max 75.5 ºF; Min 62.5 ºF; Evap. 2.0 ml, reading 26.3 ml, not refilled; Ran 0.5 mm, emptied.
Earlier this morning before leaving Zone 3 NA I examined the 3 holes which 31033 ♀ dug on the afternoon of August 9th.
1 – First one was only about 6-7 cm below surface. She had very quickly struck solid rocks, and large ones, right in center of where she was attempting excavation. Soon quit trying to dislodge these. Clearly an impossible site.
2 – Second and most extensively excavated hole in main nesting area here (location of Nests 3, 6, 7, 9, 14, and 17 from 1969-70) She clearly might have had success with this if she had dug only a few cm to left of where she chose. She had gotten the nicely shaped hole to 15 cm below the soil surface and had virtually no caving in problems at all. Soil is very compact and solid and makes nice digging in this area. At 15 cm she ran into a flat immovable rock lying horizontally in the floor of the nest to the left side and front. It was preventing her from digging deeper in about the right 1/3 of the hole and from forming the normal overhang – undercut of the flask in the front right part of the cavity. Otherwise the soil was free of rocks and deep and very workable. Took a few photos of it – Roll 158, #'s 20-24.

Pg. 8.
3 – Final hole was only about 10 cm deep when she ran into rocks in sides and front of cavity and gave up. She tries diligently for long periods to dislodge these rocks but has just chosen unlucky sites to date. Most sites appear OK at the surface and then become poor below.
I went up to Caseta between 1100 and 1800 today to get some supplies; enroute I saw a lot of interesting things – to wit:
#112 ♀ and #130 ♀ (painted #;s 121 and 17 respectively) were both just leaving dry pond area near Zone 3 NA where have been for several days. Neither has shown any nesting activity signs to date. Just came into this area, #130 definitely from NNW and #112 probably from S (not sure) to get water in collection pockets. Have had enough garua to provide standing H20 each morning for every night we have been here , 6th – 10th August inclusive. #130 ♀ was moving out to NNW same way she had entered (and has entered and left before!) on 7th august, over lava piles and plate lava. #112 ♀ was leaving directly to N over one rock uplift and then moving down onto more level smoother . . .

Pg. 9.
. . .area with lots of small open yellowish brown soil patches along one trail (beginning of it) to Region 4. Decided to check on these 2 as possible on return today or tomorrow.

At 1750 on my return, found #112 in flat area with lots of soil patches and a lot of flat rocks near nest #12 from 1969-70. she used either our trail or flatter, more soil covered area slightly to E of our trail to come up here I'm sure. Will check tomorrow to see if can find here trail clearly. Anyway she was burrowed in at 1750, in a small soil depression in open. Inactive and asleep. This area is highest we have found any nest and its about 200 meters plus or minus N of Zone 3 NA.
Right beside here in another soil depression found #528, also burrowed and inactive. Saw him at 1100 when leaving NA just slightly above it, at about 50 m from Central area and campsite moving N along trail. Jan saw several days ago in central Zone 3 NA at flat rocks and then later up on rock pile between E and W parts of central NA. CL 62.7; CW 67.5. No lichens, algae, flaking disease, or smooth scutes; w.g.i.'s nonexistent. Was able to follow his trail from burrow site clear back to where saw at 1100 – clearly followed our trail over rocks and flat soil, covered patches as well. So went up a good 150 cm straight line distance. Certainly 200 m or more by . . .

Pg. 10.
. . . time twists and turns are included in his travels today.
Then in Region 5 central area where have often seen #1157 -
#1157 - walking around and foraging.
#1249 – moving S over rocks – CL 68.3; CW 69.5; W.g.i.'s nonexistent; no lichens or algae.
One unmarked of same size and color as #1157 in upper-mid Region 5 just below Region 4 border about 100 m. No time to mark.
Region 4 – at drinking site –
#77 painted; #116 painted;
#112 painted – same area as all recent sightings.
#71 painted and 79 painted along trail just W of weather instruments.

Weather – Region 4 – 1200 hrs – Max 73.5; Min 61.0; Evap. 27 ml, reading 5.6 ml, not refilled ; Rain 7.7 mm, emptied.
Region 3 - #1135 about 200 feet further up trail (1230 hrs)l than last sighting (9 August) moving up through forest just E of trail. On return at 1715 hrs, 150 feet higher.
#835 – in Region 2 near Region 2-3 border; moving steadily down trail – came onto it out of drainage to W about 200 feet further up trail and then has been following trail. Suggests she may have gone to Caseta pond #1 and be returning toward Region 4 . . .

Pg. 11.
. . . since it lacks H20 – she certainly has been traveling lately!
375 painted (#460 ♂) from Region 4 – same area as #835 – certainly has moved up – painted in Region 4 on 25 July, 1970. Burrowed in here in same area on return at 1710. Almost to NA just where saw #528 at 1100. At 1755 found #1248 in trail, burrowed into soft soil in open. Will try to find and get measure and data tomorrow. From where? Did not see #130 ♀ on return!
Other data for this p.m. and evening on previous pages.
12 August, 1970 – Will check as many animals as possible for activity.
0600 - #1144 still burrowed.

#1193 still burrowed – has a small little soil burrow beneath some dead herbs and a low Pisonia branch up on rock plates where Jan saw active yesterday. Several of his tiny turds in the area. He is clearly capable of finding food comfortable burrows. This site is the only one with soil and the protection of overhanging vegetation on this whole area of plate lava on the rock pile for about 20 m radius circle around.
#312 ♂ - still burrowed.
#709 ♀ - still burrowed.
#131 ♀ - still burrowed.
#1033 ♀ - has just moved from where was sitting in open to flat rock site where H20 usually collects – sleeping with limbs and neck out on ground now there.
0700 – all the same.
0800 – all the same except #1144 . . .

Pg. 12.
. . . and #131 ♀ have turned out of soil burrows a bit and are awake and looking about; still passive and resting however.
1000 - #1144 now active and moving about a few feet from burrow; clearly just getting going.
#1193 just leaving burrow and moving out onto lave platform. All others the same.
1100 - #1144 and 1193 foraging for small herbs; #312 ♂ just moving about a little now – sometime during past hour left burrow but still close to it.
#1033 has just moved off of lava plates in past hour and down to site of many diggings just to S. She certainly likes this area. By 1115 it is clear she is searching through this area in typical pattern. #709 had moved a few feet by 1100 hrs and is alert. After watching #1033 go by she herself began to move and by 1130 was searching down through same area that #1033 just passed through. Clearly also in typical nest searching pattern – slowly moving and looking, occasionally sniffing. . .

Pg. 13.
. . . soil or making full stops and smelling soil well in certain spots.
#131 ♀ is moving down trail to SW out of eastern part of central NA by 1115; #312 just watching her go.
Weather has an interesting relationship t all these activities up till now. Was cool and cloudy all morning with not even any detectable warm weak radiation till about 1045. Just about time weak radiation out and beginning to feel warm almost all animals finally getting active. Only #'s 1144 and 1193 really very active before this. (By the way, #918 has moved several hundred feet – about 700 plus or minus minimum, perhaps more, around camp and nesting area, on lava piles whole time to area of cactus tree (Opuntia) near where #2 nest (1969-70) in early morning two days ago – eating herbs in new location at 1100). Also, on first 5 morning we were here had been plenty of garua in night or early morning so was H20 collected at various sties all over NA, especially in central flat. . .

Pg. 14.
. . .rock area. On all those mornings most, actually virtually every animal we saw, was active by 0700, and usually before (0600 – 0630), all actively searching out and drinking

H20 form lava pockets in rocks. Then after drinking the larger ones, ♂ and ♀, resting or otherwise, would often spend one to several hours sitting about basking and sleeping. One is led to the unmistakable conclusion that the available and very ephemeral H20 causes them to get going at or soon after daybreak, thus cashing in on its availability, before it can dry up and disappear (as it quickly does even on a cool cloudy day if it is not raining – strong radiation and wind of course only speed the drying; garua puddles rarely last till even afternoon even on cool cloudy days; of course competition for H20 is important, at least for the larger ♂ and ♀ who can not get there heads into the tiny holes which small beasties can use for drinking. Almost all the bigger animals noticeably headed for the big flat rock . . .

Pg. 15.
. . . areas like those in the Central Zone 3 NA, at the wheel hub on the highway just discovered and the area in Region 4. The smaller ones like #1193 do not need to go to these sites and easily get H20 all over on almost any kind of reasonably flat lava surface; even 1144 sized animals (circa 60 cm CL) do OK at sites other than the main ones sometimes (see behavior of 1144- sometimes he drinks in holes inaccessible by big animals to E of flat rocks and sometimes at latter site and sometimes he check both places!) Today, when there was no H20 collected because no garua last night, the animals waited to get going till much later in the morning – they woke up, basked, and when finally started foraging, nest searches or whatever – no early periods of searching for H20. Smaller beast like 1144 and 918 seem to just keep on going (foraging after drinking) in very early daylight hours (0600-0800 or 0900) whereas big ones wake, drink, and then bask till mid or late morning. All this probably varies with other factors- for ♀♀ nesting or not; for all beasts, . . .

Pg. 16.
. . . availability of food.
1200 – all animals active –
#'s 1193 and 1144 and 918 foraging.
#312 ♂ - moving around slowly.
#'s 1033 and 709 searching for nests.
#131 ♀ - moving to central nesting zone area on N side – where searched on 8 August.
#1033 ♀ - searched "favorite" area in rather quick time of 15 minutes, then proceeded directly to open area of read soil to S where dug on 6 August. Started a hole there at 1220 hrs but quit it again at approximately 1250. Now (1300) moving N again towards where just previously searched in favorite area.
#709 ♀ - searched #1033's favorite area and then moved S (never digging and only stopping once to sniff carefully in 1033's are) – she headed toward where 1033 was digging but then skirted around the area, staying on rock piles which surround it to E and S, moved over and at 1245 entered La Fe trail and is now apparently moving slowly down it to the S.

Pg. 17.
At 1300 #131 ♀ is still moving steadily toward Central NA N part – is at 1200; almost there now! Followed her up and discovered that she stopped and dug at one point along

red-soil covered trail (actually 5 m off of trail). Jan says she was stopped here only 10 minutes sometime around 1230. She hit rocks only a few cm below surface and gave up. Then she searched here way over to near weather instruments and at 1327 began digging only about 2 feet from where last tried in this area on 8 August. She seems to have a strong fixation on this particular area, much as #1033's on that area below the flat rock, H20 collection site area.
1415 – am leaving 3131 ♀ in Jan's care while I go check on other ♀♀. She is continuing to dig in same hole although seems to be hitting rocks for last 25-30 minutes; is trying but not bringing up soil or foot scoops at all now. Just doing a lot of scraping on rocks it appears. Snuck to within a few feet of her rear – she is down about 12-15 cm below surface and look like lots of small rocks in bottom of hole. No cloacal fluid yet.
1417 - #1033 digging virtually in same exact area as dug in so much on 7 and 8 August right in midst of about 4 other holes which she gave up. Was able to get right behind her – typical oval cavity which she makes - long way orientation front to rear. . .

Pg. 18.
. . . to down about 10-12 cm below surface; ground is solid. Not getting much soil out with each scoop attempt though – maybe 2-3 teaspoonfuls at most. Lots of hard dirt in hole and sounds as if lots of small rocks in bottom l- can't tell exactly now. No cloacal fluid yet at all.
Early burrowing - At 1416 - #1144 is already burrowed in same burrow has used every night since and including August 5 except for one when burrowed about 35 m from where now is in for the night. He was active till at least 1300 because saw him foraging up till that time.

Checked little NA to SE –
1425 - #787 ♀ (painted #19) is there in central part of it in red soil; sleeping with head on ground; is swiveled down into soil a tiny bit. Perhaps thus burrowed for night. No sign of any nesting attempts here. She is not far above and S of rocky area where last saw yesterday morning; about 35-40 m at most.
#1269 – little guy – at other end (E) of NA from where first saw and marked; still active at . . .

Pg. 19.
. . . 1445 moving about in open. About 25 m from former sighting. Am sure it was his tracks I saw all over this little 5000 sq ft NA a few days ago. Right size and location anyway.
Went over and up highway to check for animals –
#414 ♂ - CL 79.9; CW 84.4; no lichens; no clear black green algae, but some dry stuff on rear looks like it; w.g.i.'s clear but extremely thin. Scutes smooth only in small central portions or not at all. No flaking disease. Grazing on herb seedlings in area where #131 ♀ was burrowed on night of 10 August. Painted #122.
Lots of tortoise wallowing in this soil filled area – darkish brown sort – very fine and powdery; no sign of previous nest, egg shell fragments etc. No signs of digging; about 18-20 clear wallow sites used recently in loose soil here from both large ♀ sized animals and 70-60 cm CL ones also.

Could not locate #412 ♀ or the smaller animal, #1024, which saw here other day. No real evidence one way or the other where they went. Large ♀ clearly came out onto highway from beside it where I last saw her (trail is present), but could still be close around here; in fact I can hear a tortoise thumping of to E a bit but have no time to locate it.
Along highway notes that most of droppings along first 800-1000 feet are mostly from larger animals – i.e. adult smooth . . .

Pg. 20.
. . . shelled ♀ size plus or minus and larger. Are also a scattering of 60 cm CL and larger animals; also are a very few and scattered droppings of small animals – 30-45 cm CL plus or minus. [Marginal note: all this true of recent as well as older dry droppings.] Most of traffic is probably thus larger animals, with lesser #'s of others crossing here and going along one pathway and using the abundant lava pockets for drinking. Also noted a few old mostly disintegrated turds with manzanillo apple cores in them Also scattered piles of the apple cores all alone where rest of droppings material has rotted and or washed away, so animals from considerably above here must have passed along this route in the March – early May period. No Manzanillos more or less from about 275 feet altitude to coastline. Since few tortoises go right to coast's edge probably bought here by animals descending form area like Region 4. [Marginal note: Also have seen numerous but scattered dry and mostly disintegrated droppings with manzanillo apple cores in zone 3 NA and al through Region 7 of Caseta – La Fe trail – quite a few on New NA ½ km S of Zone 3. Also same thing in NA (new one) below Cerrito- now all this in play, June and July.]
Most adults (and 60 cm CL plus sized) droppings, old and new, contain plenty of Opuntia spines, fibers from pads of same and Opuntia seeds. Also normally and sometimes exclusively a lot of fibrous herb stems and leaves with only veins or pieces of undigested leaves. Most of these droppings are probably from February-March or more recent except . . .

Pg. 21.
. . . for the most disintegrated ones, which could be older. Also on highway found a small 1969-70 hatchling dead and mostly rotted away. Nearly all scutes present, some vertebrae, 2 large leg bones, lower jaw, skin from most of head, bottom half of a rear leg and other assorted small pieces. Can't say what tilled it but probably starvation. No real sign it was killed or dismembered, i.e. by something like a cat since I think if so all legs at least would be missing. Not killed by a pig certainly; probably died less than 1 week – 2 weeks as fly swarm from maggots which were on the carcass are just now out and swarming in the area. No evidence of any paint on scutes so not one of my releases probably. Carapace scutes have large portion of their surface area still whitish in color. Scutes very thin and soft. One very interesting aspect. Lots of bright red nesting zone type red soil on lowest carapace parts – lower costals and marginals. This means animal probably from nesting area and since definitely a hatchling from this recent spring is quite some distance out onto what is entirely almost pure rocks. Nearest known nest to this beastie's location (thus probably really nearest nest since I know this area well) is

about 100 m straight line distance over some severe lava. Of course, if used highway then distance even a . . .

Pg. 22.
. . .little greater but no reason a priori to expect a small hatchling to use this pathway unless did so by scent and some "instinct". Also, no carapace or plastron bones found – probably virtually all cartilage at ends. Only bones which seem reasonably solid except for normal growing points are back bone (vertebrae) and tail and neck vertebrae.
At 1600 back to NA – found # 1033 has recently given up on last hole she was working on (2nd today) and is now searching just E of that area about 5-8 m.
#131 ♀ gave upon 2nd hole at 1455 (i.e. after 1 hour and 28 minutes of digging.) Then began searching back down trail to S and just on other side of fire pit, very near to where #1033 dug on 10 August. She started a new hole at 1520. Dug here till 1623 and gave up – both holes had abundant rocks in floor and front of nest cavity. Will measure tomorrow. At 1625 began searching out in a small loop further S in typical looking sniffing fashion; she returned back toward and to weather instruments . . .

Pg. 23.
. . . but this time only smelled several new spots around where she has dug previously today and on 7 August, then moved on to center of this part of NA and is now (1705) searching carefully there near where nests #'s 7 and 14 were in 1969-70.
In process she came upon hole made by #1033 on 10 Augusts and tried to eat my Swiss army knife which I had mistakenly left there after taking some photos. She finally left it alone and moved on. Continued search; did not pay any notable attention to dug hole made by #1033 on 10 August. Passed by nest #1 from this year and sniffed its surface at side of hard cap as was passing but no special note taken of it. Continued on to weather instrument area again and started a new hole (4th today) just 3 feet from previous diggings. Began at 1724. Still digging 1 hr later – leaving her alone except for spot checks to allow here to get started well. Still has not seen us all day.
Jan took rest of Roll #158 (5 shots) of her searching and 3 of in resting position in hole (digging # 3 hole today) All of Roll # 159 was of her digging with both feet at hole #3 from today (only 14 shots; rewind problems after first putting roll in).

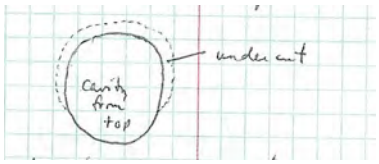
Pg. 24.
#1033 still searching at 1717; when checked her again at 1800 now digging on hole in favorite area. At 1830 approached to her rear unseen and still digging. Watched for 15 minutes; still same. Has a huge hole (upper surface area – wise) but large flat rocks (2-4 x fist size) all around hole, one loose on has fallen in hole at front and another is lodged in soil all along left side. She is diligently (at 1845) still trying to dislodge this embedded one. No cloacal fluid yet. This site is very poor but she has dug at it and around it so much on 3 separate nights that it is well cleared out around top and she may yet be able to lay in it tonight, if she can get rocks out – will not be a normal flask-shaped nest, but will perhaps be large enough space in total to dump eggs inside. Will try to check later if #131 does not use all our time.

Pg. 25.

At 1847 as I was returning Jan saw and heard #131 dump a great gush of cloacal fluid in nest. Will now try to photograph and take notes on her for the duration –
We are not watching her dig – beginning at 1900. Jan watched earliest stages when she began digging-pattern then some so I will describe below exactly except for one movement – i.e. when she brings new digging foot up off of its resting position she sweeps it slightly forward as she raises it, thus pushing loose soil in pile to front and outside of foot forward and away from hole; at these early stages before she has dropped any cloacal fluid this is important in aiding the process of keeping the loose dry soil from falling into excavation to any great degree – works rather well in fact. Later on when hole is larger and after cloacal fluid has been dropped this loose soil problem doesn't exist to same degree. The this fancy extra movement diminishes greatly in intensity; it still occurs to some extent to continue keeping very wet sloppy mud to side and in front of foot rest by movement is much less pronounced than earlier. When we approached at 1900 it was obvious that sometime between 1835 and 1l8476 she had dropped some cloacal fluid before Jan saw this latter batch – this we know because. . .

Pg. 26.
. . . she already had a great pile of mud around each foot rest at 1900 and more than she could have gotten out of hole in 10 minutes between Jan's observation and our final approach. At 1815 she had not dropped any cloacal fluid yet because I was there then and she was still digging in dry soil.
Now 2005 – just dropped about 1-2 cupfuls (closer to 1.5 probably) of cloacal fluid in last minute in hole. Biggest gush cam just at end of a rest period when she had left foot in hole, right on rest position and was resting on extended forelegs and right plastron side just in front of leg pocket. [Marginal note: All was dropped when one or other foot was in hole, thus spraying side of cavity in part; not dropped when over center of cavity!]
Now 2045 – she has been digging for exactly 3 hrs and 21 minutes and still going strong. About 1 hour in dry soil and rest in muddy muck after dropping cloacal fluid At least 3 main cloacal fluid drops to this time. [Marginal note: Cloacal fluid is clear – not like amber urine she dropped the other day!!!]
During entire 1 hour, 45 minutes we have been watching carefully she . . .

Pg. 27.
. . . has dug with 2 rear feet alternately and precisely - never twice in a row completely in and out with same foot. When we arrived she had main cavity well hollowed out and some of flask undercut underway. Since then she has continued to enlarge undercut and also dig at central cavity floor.
The undercut-overhang is clearly made on the right side to the center midline by the left rear foot and vice versa. To now the undercut extends for abut 1/3's of the cavity's circumference, the front 2/3.
[Diagram of approximate circular nest cavity (slightly elongate front to back) with slightly expanded area of undercut on anterior and lateral sides as described in text above.]



Will try to measure these things later if I can slip in between her legs briefly.
Now 2100 – Jan has taken all of KII (36 exposures) rolls of #160 and 161 digging sequence from various angles and distances. Will now wait for eggs for more photos.
Digging pattern notes: basically all same as I saw and described last year – have seen nothing really new or different. Alternates feet every time – so far for 2 hours of watching; rest only with one foot in hole, other in rest spot, with plastron down on ground just in front of leg pocket on side of leg which is . . .

Pg. 28.
. . . digging, (i.e. in hole). Remains raised in front on extended legs at all times and when changing legs. Elevates entire body up on all 4 legs. Begins raising next digging foot from it rest spot only when and just as previous digging foot touches down solidly on its rest pile and dumps mud down. Then, still all raised off of ground, she inserts new leg and just as it goes fully down into the hole she slowly drops down on same side, plastron finally touching soil on digging side as resting leg folds up under carapace slightly on the other side. (see photos).
Note: She digs sometimes on opposite side of the cavity with foot of opposite side and sometimes however on same side. Especially makes more head way on undercut when digs "oppositely". But uses same side foot for this also,, especially for overhang along side vs. that on front part of nest. Uses opposite digging more for front undercut. But none of this is cut and dried. Does dig in all parts virtually, front, . . .

Pg. 29.
. . . rear, and undercut and center of nest both on same side as digging foot which is in and oppositely also.
2130 – She clearly has flask as deeply undercut as her reach will allow now. But could dig deeper in central part of nest; but are some rocks in bottom now and she has managed to dislodge only on (a flat one 1.5 x fist-size), and get it out in last hour of trying. Since 2030 she has not really enlarged virtually any of cavity, even undercut, at all; but she continues to scratch on rocks and try to pry others (at least 3 more) loose. The are well embedded in floor. She clearly could dig deeper in central cavity if rocks were absent.
Leg movements are really beautiful. When lifts digging foot out, she rises up on all 4 legs well off of ground (whole body) and brings leg straight back and up, forming a small cup with elephant like base of foot and toenails which are turned "down" relative to foot base or bottom. Mud (or loose dirt earlier) is thus trapped in cup. As brings leg and foot up it just neatly clears side and back of cavity by only about 1-2 cm (especially close to sides). Just as foot gets above soil surface she swings body to that side (digging foot side) and bends leg up a bit and swings it once with body and neatly puts it down on foot rest and dumps small bit of mud or soil on rest pile.

Pg. 30.

As inserts new foot – she swings elevated body to opposite side and neatly pulls leg and foot well up in nook under rear of carapace, over and then neatly inserts the foot and whole leg into cavity again just barely clearing rear and sides of cavity.
2135 – New movements suddenly - Stopped characteristic digging movements.
[Marginal note: 2-4 per leg; 4 x with each leg]
Put left foot in as usual but did not dig. Just touched bottom of nest in center with nails; then brought leg up rubbing against left side of cavity about ½ way; then back in till nails touched again. Did this twice more. Then withdrew leg normally and shifted to put right leg in. Same sequence – 3 test motions into nest. Then withdrew leg.
Then she did this same thing 3 more times with each leg in hole in each case partially withdrawing leg 2 or 3 times, rubbing its outer edge along side of nest and touching bottom of nest in center or to side with nails each time. Nails extended so points straight down in each of these sequences. After finally pulling leg out for last time, standing up on all four legs with whole body slightly off of ground. Tail centered over center of nest cavity. [Marginal note: appears to be testing nest for depth, shape, and or construction ?!!]

Pg. 31.
2140 – wiggling tail just slightly form side to side – first mass (few cc's) of gelatin drips out and into cavity – very, very thick (2-3 x egg albumin it appears) – continuing wiggling. [Marginal note: positional certainty over hole; no more digging or testing of depth.]
2146.50 – first egg- OK – hit rock in bottom but OK! Bit oval shape.
2149 – second egg – OK – hit first – both OK. Round.
2150.5 – 3rd egg – OK – hit soil in bottom – Round also.
2154 – 4th egg – OK – hit others – Round.
2154.75 – 5th egg – OK – Round – hit others.
2155.5 l- 6th egg – broken as came out – too big for cloaca I guess.
2158 – smoothing out of eggs begins after 2.5 minutes of rest upon all fours with no more eggs or gelatin; body and tail still centered over hole. Five smoothing motions with each foot (see descriptions below) – 2-3 per entry.
[Marginal note: Moved only 2; got eggs all in one layer!]
2203 – Starts filling in with wet mud from foot rest piles. Raised up on all fours now; bracing with one foot, pushing 1-3 scoops of dirt (mud) in with opposite foot; then changing feet and continuing; not rest at all; doing this very rapidly. Eggs no longer visible by 2210. No tamping yet at all. See notes below for first filling movements.
2215 – continuing – central part of cavity well filled in now – almost no mud yet up under front ½ of overhang however, Occasionally now getting both feet in . . .

Pg. 32.
. . . mud over nest cavity – effectively causing some minor tamping down by pressure but not extensive yet. Swinging out a bit more now to get more mud but only slightly more than when began filling in.
2235 – Now has whole cavity, including overhang filled with wet, but loose mud; still no packing down really. She is now stretching way out almost to edges of foot rests to get mud. Putting one foot way out to one side and back. Then, using his as a brace, is

reaching to side and rear on other side with free foot and bringing in mud over center of cavity's position. Still up off ground completely on 3 or 4 legs all the time; when 3 obviously is scraping in soil with 4th. Breathing very deeply all through this covering activity so far – obviously taxing her greatly.
2243 – Just starting testing movements now to determine height of covering; keeping one foot in close, near side of what was cavity opening or about at former foot rest; then reaching way out with other foot by swiveling whole body to that . . .

Pg. 33.
. . . side to bring in soil from as far away to that side as can reach given stationary position of bracing and opposite rear foot. Sometimes before and sometimes after reaching out with this foot, she brings it in and using nails feels top of nest up under her carapace about over what was very front of cavity. Appears to be checking height of mud pack in doing this. Does 1-3 checks and 2-3 or 4 sweeps for mud with each foot then changes feet.
2250 – same basic activity continuing; now occasionally rest down flat on rear of plastron (front feet and legs still up and extended) and scrapes a bit with rear feet to bring in soil from sides and rear – but not much of this; activity still basically raised up on all 4 legs most of time; still no real rests at all.
2310 – Noticed two other aspects of this height checking. As brings foot up under her carapace and forward to check height she also drags nails (pointing straight down into mud) over rear area and to checking position; This effectively moves a small bit of mud from rear area where is hauling it into with side and rear sweeps, and spread I out more evenly under carapace to forward areas. Other aspect is that when get foot forward to checking position, presses down a bit with toenails and is . . .

Pg. 34.
. . . thus causing some compaction of mud over front 1/3 plus or minus of original nest cavity.
2350 – same basic pattern continuing; for past half our has continually swung more and more out to left and right to bring soil in from further and further. Has worked out and completely used soil pile which were foot rests except for small amounts which are still sitting in front of foot rests. But has swung past foot rest now and is bringing in soil from a few inches beyond foot rest on each side. Has gotten most of really muddy soil in and on top of nest cavity area and beyond it. Now still mostly getting wet, muddy soil, but also bringing in rocks, small bits of organic debris and some dryish and dry soil from beyond foot rests.
2400 – Still same activity; mostly up on 4 legs raised up and continually active. Once every so often - every 4-5 minutes stops and settles down on rear of plastron and rest for 20-60 seconds (variable), but quickly resumes . . .

Pg. 35.
. . . activity of bringing in soil from sides. Is working hard now at tamping down surface by a variety of techniques and positions. Is still using foot up under carapace to test height of hard cap mound but also pressing down every few strokes with nail to compact the soil. But also is using base of foot at times in same areas for compaction process.

Also is using "top" of foot and fore-side of mails to tamp down rear slope of hard cap and even occasionally brings both feet together in center to do this. Uses full weight of raised up body on all legs for these compaction techniques.
2415 – Through all this is keeping forefeet in same exact fixed positions where they have been since all this began at 1724. Have never yet seen her really relax forelegs and get down off of them throughout entire process – she has been elevated at front end and in this fixed position for over 6.5 hours! Her head has been out straight at front end about ¼ - ½ of way through entire process; every time we checked on her front end same conditions evident.

Pg. 36.
2440 – For first time just saw her center herself over nest, settle down on rear of plastron (front still elevated) and raise both rear legs simultaneous and then slowly drop them till nails of each foot touched the ground. Then immediately raised both feet again and repeated process – feet are about over very center but to sides of nest cavity position when she does this – apparently testing height of hard cap mound for adequacy. Then immediately resumed sweeping soil from way out to sides, really pivoting now – about 8-10 inches out beyond where original foot rests were located.
0110 – Same basic sweeping motions to bring soil in form sides. Is swinging way out now in an arc, about 10-12 inches beyond position of old foot rests. Goes out usually once, sometimes twice to one side and then changes feet. Has also added a new digging motion – spreads both rear feet way out when is more or less centered over nest and then crapes with them both, L(down on plastron in rear as brace point.)

Pg. 37.
This usually results in one foot bringing in soil first from side and then raises up on it (foot turned sideways and outward) and brings other to meet it at center. Then raises fully up on these 2 feet in center rear of nest and then compacts soil using 2 feet put together but on sides – like "patty-cake" game of children is simplest way of describing position of feet.
0200 – Continuing wide sweeping motions, central compacting with both feet, and very occasionally, about once per 20-25 minutes checks height by resting centrally on plastron and raising both feet and lowering. Another notable motion for past ½ hour plus or minus swings way out – 15 inches – to one side beyond former foot rests with that side's foot, then brings other foot over very near it and uses the two to scrape around all over the area on side of hard cap and beyond – usually several strokes and compacting movements with each foot, Still using nails for compaction at virtually all paints on hard cap now – also using base of foot too with nails at times.
0125 – Has begun a series of stepping movements – first one foot way to one side in big arc swing, then other close to it by swinging foot and whole body in swivel motion.

Pg. 38.
Then works back to other extreme swivel position at opposite end of full arc but in a series of step movements of one foot over a few inches, then other to it, then test height with two feet gently feeling all around with one foot while other 3 support body; or feels with both feet while rest on rear of plastron; finally compacts soil on outer slope of hard

cap in whatever part of area is one with both feet near together – using nails and side of foot. Then on to new position, ultimately to opposite extreme; then may come back repeating whole operation or just begin wide sweeps again. All very variable.
0230 – For past hour has been slowing down; continuing all these basic motions described above under 2350 and one. But has really sharply increased # and length of short rests. By now resting about 1-3 minutes per time and then digging, testing, and distributing earth for . . .

Pg. 39.
. . . 4-8 minutes; then rest again. Up till 0100 almost no resting at all since began covering at 2203; only very rarely stopped before 0100 and then only for 30-60 seconds. This only during period form 2330 to 0100, roughly – before that no resting at all except during digging.
0300 – All same basic motions continuing. Sweeping out to about her maximum now – 1.5 feet beyond old foot rests. Nothing remains of any piles of soil l- all distributed over nest. Not getting any organic litter because all is beyond her reach. Top of nest is entirely muddy within almost her entire work area and garua for past 2.5 hours is increasing mud. But has moved about 6 rocks of ¼ - fist sized onto hard cap and is clearly tamping them into mud a bit and not at all trying to move them. Clearly wants them as part of hard cap because she pulled tem in from way out to sides and rear of nest and then is trying to install them solidly in hard cap. Has not moved front feet yet at all; swiveling tremendously, but keeping those legs extended all the time and in original position.

Pg. 40.
0330 – For past 1.5-2 hours has noticeably been concentrating now on one part o nest, then on another. Testing, bringing soil from sides, even bringing soil from rear by pulling feet forward over soil and letting nails drag, tamping, retesting. She is clear dissatisfied with conformation of hard cap in rear and side slope. Front part has been well built up and solid for over 3 hours., She only now and again reaches forward under her to tamp front part a bit and test its height. Also it is getting considerable smoothing and tamping by rear of plastron during wide side swings and when both feet are off of the ground in testing or scraping in rear or side areas.
All her activity has been so similar for past 1.5 hours – all same basic patterns that I am not going to try to take further notes in this garua unless something new or strange appears.

Pg. 41.
0400 – rest periods long now – resting 1/3 – ½ of the time since about 0330 (of course this was not sudden l- gradual increase all the time) – Resting 1-4 minutes per stop now and then working 2-4 minutes; then rest again.
0507 – Just quit finally. Has stopped maneuvering and scooted a few cm forward on nest – finally has broken fixed position of forefeet for first time since almost 12 hours ago.
0515 – Turned 90 º to side facing S. Plastron still covering most of nest.
0530 – begins moving S down trail toward flat rocks; barely visible light and objects now.

0600 – just burrowed by swiveling a little up against a tree, 225 feet down trail from nest site! To bed!
13 August 1970 – 0700 - Up again to start day; I am very clear–eyed! We concentrated on photographing this sequence rather than extensive note taking. Took following rolls; all KII, 36 exposures.
#160 – digging sequence; cloacal fluid dumping.
#161 – digging sequence; Craig watching ♀.
#162 – transition testing; gelatin dropping; egg laying; beginning of covering and transition to this.
#163 – covering nest.
#164 – covering continuing. Finished this roll by taking some shots of completed nest in daylight and its position relative to weather instruments and vegetation; also one shot of ♀'s rear next a.m. (grazing at the time).

Pg. 42.
0750 - #131 ♀ after sleeping just under 2 hours is moving down trail toward flat rocks area now! What incredible energy after her 12 hours labor. By 0800 she is only a few feet from burrow site but out on small rocks, eating abundant herb seedlings in cracks and soil spaces with great gusto.
I have many additional notes to write about the nesting and certain parts of her behavior in particular. [Marginal note: see pg. 102 ff of this volume.] For now will put this off till we get to Caseta. Have a few other notes to make this morning and some observations which must be clarified before we leave.
Garua was reasonably strong again last night, like first 5 nights. And, significantly at 0700 this a.m. #'s 1144, 1193 and 1033 were already at flat rocks and in fact 1144 had already completed searching for water and was energetically eating herb seedlings; 1193 was also after herb seedling sin same area where he has been seen for past 2 days. I already mentioned activity of #131 ♀ at 0800.

Pg. 43.
#312 ♂ was still sitting beside his burrow drowsing and basking at 0800. Still some light garua and cool till almost 0900.
At 0800 and 0900 #'s 1193, 1144, 1033 and 131 and 312 all basically same. At 1030 hrs #'s 1193 and 1144 have sought shade burrows because sun has been out off and on (most of time in fact) for past hour. #1033 still in same spot sleeping and drowsing as since 0700. Interesting that larger animals OK in heat and solar radiation whereas smaller ones already seeking shade. At 1030, also #131 has moved another 200 feet and is now sleeping in open about 20 m W of her 1969-70 nesting site (nest #12). #312 ♂ at that hour has moved E 100 feet and is poking around in furthest red-soil, open spots of eastern part of Zone 3 NA. Perhaps he will head E for highway.
We will head for Caseta now and I will return tomorrow to check on whereabouts of #'s 130 ♀, 112 ♀, 131 ♀, 787 ♀, 1033 ♀, 709 ♀, 312♂, 1113 ♀, and other ♀ (829) in far S new NA of Region 7, 412 ♀, and other ones – i.e. smaller ones like 538, 1024, 1193, 918, 1144, 1248, 1269, etc. simply can not check on all these and for possible nests laid by 709 ♀ or 2 females in new southern NA today (#'s 1113 and 829 ♀♀).

Pg. 44.
Couple of other notes –
I checked for #709 ♀ down trail toward La Fe yesterday afternoon about 1700 plus or minus but did not see as far as I went (100 m); she is no where in central Zone 3 NA for certain – also no other ♀♀ for certain save those in above notes for yesterday afternoon.
Last night about 2030 plus or minus I checked #1033 ♀ to see if she had dug any more since last sighting at 1845. Now she is not digging at all; but in exact same position over messy hole, asleep, in open, where was at 1845. So she will not next tonight for sure.
Zone 3 NA weather on leaving (1200hrs) – could not check last night. Max 75.5; Min 60.0, (certainly last night – clear at times); Rain 0.9 mm; Evap. 4.3 ml, refilled full, reading 30.6 ml.
#1248 just above camp area in Zone 3 NA – in open are near dry pond – CL 52.5; CW 58.4; w.g.i.'s clear and thickish on top (vertebral scutes); elsewhere vary from very to extremely thin – weird variability! No lichens algae, or flaking disease. In shade of a Pisonia, inactive.

Pg. 45.
Enroute to Caseta –
#112 (painted #121) – abut 100 m further along trail (1245 hrs) than where last saw at 1750 on 10 August moving over rather rough rocks all the way. Checked – no sign at all that has nested – In shade now.
Mid Region 5 near #1157's hangout or area –
#1104 - moving in open.
Just above last area 50 m – one small unmarked animal, same size and color as 31157; certainly same animal as saw right here exactly on 10 August; moving in open.
Region 4 Weather – 1315 hrs – Max 73.0; Min 60.0; Rain 1.8 mm, emptied; Evap. 2.9 ml, reading 8.5 ml, not refilled.
In Region 4 –
At rock water collection area -
#77 painted; #116 painted; #71 painted – all in open.
Just W of Weather instruments –
#112 painted and #79 painted.
Aggression - #79 eating small herb seedlings, and twice #112 (smaller of two) butted his rear; first time ignored; second time moved away a few feet and began grazing again. Then #112 started for his rear again , #79 raised head and saw the other coming and took off; went about 8 feet away and #112 quickly gave up pursuit and turned away at right angle. Both now grazing in open on small herb seedlings. Interesting that smaller one won that aggression easily; but larger one certainly did not run far or with apparent haste; appeared more irritated than anything, that feeding was being interrupted.

Pg. 46.
#37 painted – In steep ascent part of Region 3 toward its lower end; near drainage but above it to E and about 12-15 m to W of trail. Clearly moving up to N from Zone 3 NA quite some distance.

#835 – really descending again – in area just below mid Region 3 in steep descent part; just 30 m distance plus or minus below where sat in trail for 10 days to 2 weeks in July. Really "running" up/down between Region 4 and Caseta area.
#42 painted (moved down from Caseta upper ponds) and 3413 side by side just at Region 2-3 border in open – perhaps aggression or attempted copulation recently but hard to determine; now clearly both just sitting; #42 with legs and head out; other one drawn in most of way.
At Caseta Pond #1 – Painted #88, Painted #93, Painted #111, #119.
Around Caseta - #94 painted; #18 painted (#3 ♀); #384.
Reeder kids were up on Mora today and saw painted #'s 7, 15, 43, and 50 . . .

Pg. 47.
. . . between upper ponds area and Camote patch. Also they came down from Devine's very late (1730 hrs) and noted 97 painted along central manga somewhere below banana plantation. Probably many more painted animals in manga but they missed them because came down after virtually all animals were burrowed.
We completed corrals around nests #2 and #3 today.
14 August, 1970.
Writing and working at Caseta today. Julio went to new nesting area below Cerrito today and back to Caseta.
In new nesting area he found no new nests – but many tortoises –
Three unmarked "small" ones.
#61 ♀ (painted).
#68 ♀ (painted).
One unmarked ♀.
#200 ♀ (perhaps just a chipped place – he was not sure – thus maybe unmarked.
One unmarked ♀ copulating with #63 painted ♂.
All these ♀♀ were large, smooth-shelled, worn, old types.
Then he went down to SSE of Na to smaller area where were nests #10 and 11 last year. About ½ way to it in an area with dry ponds saw #1063 ♀, also old and smooth – shelled. Just beyond this area one nest new for this year (therefore #4 for the year) in yellowish brown soil in very rocky area – laid in a small . . .

Pg. 48.
Soil patch. He says hard cap well made, not dry, but not extremely moist either – therefore recent, but maybe up to 2-3 weeks old. No pig signs or problems all through the NA (but some pig droppings in Zone 5. He put a corral around the nest.
Then at lowest nest (310 and #11 from last year) - #64 painted, all smooth, old, worn ♀.
Then near coast (he guesses only 200 m distance above it) #628 ♀ also large worn adult ♀.
He says none of these ♀♀ had clear mud indicating made this nest #4. also, only #200 ♀ had clear sign of possibly digging in red soil NA or any kind of soil in fact. But no obvious mud on her so can not say if she had nested yet or not.
Copulation – Group at Caseta saw #205 ♂ copulating with #3 ♀ just below Caseta in drainage bed just W of trail. W. G. Reeder took notes on this and . . .

Pg. 49.
. . . will get from him. Was on 11 August 1970. So #205 ♂ is still up high in this area. Also – Julio took Zone 6 Weather on 6 August, 1970 – 1000 hrs – Evap 35.8 plus (dry), refilled full; Rain 1.76 inches.

Caseta Weather – 0700 hrs – Max 72.0; Min 60.0; Rain 2.4 mm; Evap. 1.5, reading 17.7, evaporimeter refilled full at 0700.
1900 hrs – Max 70.5; Min 60.0; Evap. 1.5, reading 1.5; Rain 0.1 mm.
15 August, 1970.
Returning to Zone 3 NA to check on ♀♀, nests, and other things.
Near Caseta –
**Note - #31 ♂ - has finally made it up here from well below Zone 3 NA at 150 feet altitude plus or minus; 0900 hrs – moving along drainage and right up into tent area.
¾ way to pond –
#386 ♂ - CL 117.1; CW 127.9. no lichens; abundant black-green algae on front marginals area and all over rear ¼ of carapace; flaking disease rather general and in same 2 areas; also a lot of flaking disease scattered in small strips along growth rings all over other carapace areas. W.g.i.'s non-existent; scutes smooth in central 1/6 – 2/3 plus or minus. On trail, sleeping in open, in last night's burrow. Painted #123.

Pg. 50.
By Caseta Pond #1 – 3 animals –
#111 painted – sleeping and basking in open.
#1138 ♀ - (no clear sign of recent nesting) – but has bright red soil typical of nesting area below on rear of carapace, skin of legs, and tail, and feet. Well worn in CL 92.1; CW 99.9. No lichens or algae; flaking disease very scattered in small spots in 2 usual area (hardly any) and a few odd spots on side and top. Scutes smooth in central 1/5 – 1/8 or less. W.g.i.'s intermittent and extremely thin where present. Grazing on small herbs. – Painted #124.
#70 painted.
New #1290 ♀ (prob.) – CL 70.9; CW 73.0. Just in mid Region 2, just about open Clerodendron area; was about 100 feet distance below here on 23 August but did not record then (recognize by bird feces pattern on carapace). Clearly moving up a bit; now E of trail moving N through semi-open Guayavillo forest. W.g.i.'s non-existent; no flaking disease, algae, or lichens; scutes smooth, not at all or only in very tiny central areas – Painted #125.
#835 – same area where last saw – central Region 3 – steep descent part – just . . .

Pg. 51.
. . . where forest gets notably dry – Painted #126.
#42 painted – another 20 feet lower in altitude – along same area – near drainage; still Central Region 3, definitely going down.
#135 ♀ - CL 93.3; CW 97.9. Has bright red Pampa Colorada soil well worn into feet, skin of legs, and rear of carapace and its lower parts. But no definite sign of recent nesting. No lichens or algae; scutes smooth only in central 1/20 – 1/8 or less. W.g.i.'s

incomplete and extremely thin when present. Another 15 feet lower in altitude from #42 painted. Painted #127.
New #1292 (1291 marked long ago because mistake – intended to be 1219). CL 59.6; CW 64.4. No lichens, algae, flaking disease, or smooth scutes; w.g.i.'s none-existent. Saw same fellow in exact same area (mid region 5 twice before in past 7 days (see notes of 11 and 13 August) – marked him on top (scratches with knife on 13 August. ♀ maybe but too small to accurately determine sex. Sitting in open in a rocky area. Some lightish red- brown soil typical of Region4 and below in other areas round into lower carapace.
#1265 – near #1157''s stomping rounds – lower mid Region 5 in shade.
#133 ♀ - Eureka! – At big boulder area of Region 5-6 Border. Last saw her months ago in Zone 3 NA; moving steadily N through area along "drainage" such as it exists – in sun at 1245 – hot! No clear sign of recent nesting; has bright red soil characteristic of nest areas all on under parts but old and ground in; no recent mud (so must question as to nesting having or not occurred).

Pg. 52.
Has reddish mud and yellowish-brown mud in thin dry coating all over carapace on top. Certainly from ♂♂ or ♂ having recently copulated with her. CL 97.2; CW 109.2. No lichens. Dried algae of both types along deep wide scute junction grooves all over carapace; can see bright green form only on rear 1/5 of carapace grooves. W.g.i.'s present but very thin. Re-cut notches – getting poor. Painted #128.
Zone 3 NA – arrived and searched following – all of open central NA portion; dry pond area; along our trail and parallel tortoise trail just to E of our tail from the #13 nest (1969-70) to central NA.
#918 bock up near #1 nest (1969-70); just above campsite area along trail – also in dense shade resting.
#114 painted, large ♂ (#422) [See August 7 notes – from NA quite a ways S of Zone 3 NA central part] – in shade resting near flat rocks in Central NA. NO sign of #'s 131 ♀, 1033 ♀, 112 ♀, 412 ♀, 130 ♀, 709 ♀, or 312 ♂. One more digging spot but no more new nests (will discuss this further in following notes).

Pg. 53.
Will now expand my search for animals to further areas.
First – over to ESE to highway.
#422 ♂ - (painted #114) just leaving burrow site (15 min ago plus or minus) at 1430 and heading straight down same path used by #131 on her jaunt to highway few days ago. He clearly is moving along exact same path, head up and looking from side to side.
#131 ♀ (painted 39) – just 10 m before hub center at S base of highway [Marginal note – only 250 feet plus or minus further than last sighting at 1100 on 13 August – probably resting a lot] – under a Pisonia in shade, sleeping. Evidence of her nesting (mud) still very clear – took 2 photos of this - #'s 1 and 2, Roll #167 (KII).
#412 ♀ (painted #120) – over just E of highway near cactus where was burrowed one night last week (see previous notes). Now burrowed and asleep in shade under a big semi-prone Pisonia.
#122 painted (#414 ♂) – moving around on highway in semi-shade, heading into dirt depression where marked (painted) and saw on 12 August.

#423 ♂ - on highway under a Pisonia, sleeping in shade (photos 3-7, Roll 167) – very near same dirt depression. Number in question – 400, 30 marks OK – but 1, 2, and 4 scutes of units marked. #4 most poorly – obviously a mistake – probably #433. CL 75.3; CW 78.3. No lichens, algae, or smooth scutes; w.g.i.'s clear but very thin. Painted #129.

Pg. 54.
Continued to top of highway where becomes rough – no sign of any new tortoise movement (foot prints in soil patches) or droppings along here above dirt depressions. Nest attempt – In dirt depression is a fresh hole dug either last night or probably the night or 2 before – has muddy soil on two piles which were ♀'s foot rests so dropped a bit of cloacal fluid. Surface ½ cm of this is now dry so probably night of 12 or 13 August and not last night to allow drying in this "semi-shady" area. Hole OK – no obstructions and not very much caving in but for some reason quit at about 16 cm depth below surface. Is dark brown–grey soil and not very cohesive so perhaps this entered into factors which caused quitting. Was near or on top of an old nest because egg shell fragments plentiful in soil. So nests here before definitely.
I rechecked ♀ #412 but am reasonably certain she was not one – no mud - except for a tiny bit in scale junctions (but pick this up from wet soil surface after garua even light garua) on her feet at all of any type and none on rear of carapace. But, of course, since relatively little cloacal fluid used here could be explanation for no mud on tail or carapace edge and that on feet could easily . . .

Pg. 55.
. . . be worn off in a day's traveling about. I was last here late on afternoon (1500 plus or minus) of 12 August and no digging for this nesting season in this area at all up till then. Question is moot as to what ♀ was involved.
Checked all main pathways to hub from Zone 3 NA. No fresh sign since last checked them on 12 August.
In new tiny NA slightly SE of Zone 3 NA – no digging or even rasping signs at all. No sign of #787 ♀ save where she was sleeping on afternoon of 12 August.
#1269 there near where originally saw when marked. Munching down small herb seedlings with tremendous drive –at 1530 hrs.
Continued down La Fe trail to first open soil area several hundred meters from Zone 3 NA central part. There found that first area with yellow-brown dry soil and over just e of it with red and brown soil had been extensively used by at least one large . Not sure in which order or from which direction she came but used both. Afterwards where she went is a guess; no sign that she went on down our trail toward next yellow-brown soil depression (nest #5 1969-70 was located there). If this activity was by #709 ♀ as I suspect, then she probably used yellow-brown first area, then red soil area to E, then went off SE toward new red –soil NA which is close by (location of #31 ♂, 829 ♀, 1113 ♀, 422 ♂, on various dates recently. The ♀ was clearly large as can be seen from nesting holes she attempted. All clear attempts were in first yellow- . . .

Pg. 56.
. . . brown soil area – 4 clear digging attempts and about 5 scratching and prospecting attempts. Several burrows (night or on sunny afternoons) and several scratching attempts

and trail all over eastward red-soil neighboring area. Three of clear digs very shallow and quit rapidly (no rocks in them, but much caving in). One other was a full scale attempt with much cloacal fluid used. Foot rests all muddy and cavity all muddy. Just now dry at surface. Therefore probably within past 2-3 nights ago – i.e. August 12 or 13; thus could have well been #709 ♀. Hole in one she gave up after using cloacal fluid is 13 cm deep from surface; floor of it is OK but had problems evidently with caving in till dropped cloacal fluid in this type of soil. Main thing causing desertion was 3 large solid rocks lining entire front 1/3 of cavity in a curve. She clearly had tried to move these much and nail prints were there, but they didn't budge and blocked her . . .

Pg. 57.
. . . from making flask undercut completely. One wonders why dropped cloacal fluid given this . Can not say for sure, but looks as if perhaps dropped fluid when central cavity was deeper by 5-8 cm and then mud caved in it as she was deserting – there is 5 cm plus or minus of mud settled in it now. I would guess at least 1 liter of cloacal fluid. Was dropped. Poke about area but have not seen ♀ around yet anyway. Took photos of this Roll 167 - #'s 8-13.
There on to new NA (location of #;'s 829 and 1113 ♀♀ -
Saw one large ♂ unmarked, just beyond all digging previously mentioned. Already burrowed at 1615. The a lot of searching sign and a digging attempt very near Nest 35 1969-70; in same soil depression – yellow-brown soil again. Only 10 cm deep and full of rocks around sides, embedded; deserted with any cloacal fluid being dropped.
Then in open red soil areas just t S along trail –
#1132; #872 ♀ - both burrowed.
Then still along trail, 250 feet further #709 ♀ - 1700 hrs – clearly searching for a nest – sniffing, pacing along slowly etc. (on return at 1720 same behavior).
In new NA - #829 ♀ digging a hole – has it only about 10-12 cm deep and can hear her scraping rocks, yet she has already dropped cloacal fluid – about 1.5–2 cups plus or minus. Just now dropped it however. Perhaps will make it, hard to tell yet. Now 1715. I will return along same route tomorrow morning to clarify all of this and make . . .

Pg. 58.
. . . it less hurried and more accurate.
One clear fact is that #1033 ♀ has left the Central Zone 3 NA without every successfully nesting. Can find no nest of hers at all anywhere and only one more clear digging sign. This is new hole **[Marginal note: only 8 cm deep – full of rocks on sides and floor – not at an old nest site but on completely bare soil]** in northern area where trail enters, (near campsite), and it is just about 50 inches away from a hole she dug on ____ August. Am fairly certain then that she dug here on either 13th or 14th in afternoon. This makes a seemingly incredible minimum of 8 days and ___ faulty holes that she has put in here in this area alone. Am rather sure we saw her on her first night of digging in Zone 3 because no other holes present which were new on August 6th when she began searching. Anyway, one clear fact is that she is gone. There is no clear sign that any animal of her size used our trail to N to leave (in fact certain none did) but that does not narrow things down much. Will be interesting to see if she returns here later in month or this nesting season.

Pg. 59.
16 August, 1970 –
Returning to new NA to S and to check more thoroughly on animals seen last evening. No clear sign of movement of 709 ♀ or any other tortoise from Central Zone 3 NA to first area where digging attempts were recently made. But his is all rocky so lack of sign is virtually meaningless. In the area itself, it looks as if it was entered from S and other animal worked all over it, for at least 1 afternoon and night and perhaps 2. Then could have moved slightly E and examined the neighboring red soil area. Then moved over rocky pile and along a dirt covered area to next main yellow-brown soil filled depression where I noted more digging yesterday (i.e. another 100 m from first area). There is a definite trail of a large ♀ leading along our trail through soil into the area where #5 nest 1969-70 was located. Also of the digging, animal clearly went up over rock incline and on to large red-soil open areas along trail to s to La Fe. More on this below.

One large male in first area where I think #709 ♀ made wet digging attempt. (Forgot – saw thus can't mark) – CL 133.0; CW 145.3. Large, all smooth shelled; old. W.g.i.'s clear and moderately thick flaking disease severe in usual two areas and scattered elsewhere; no lichens; scattered black-green algae in usual areas, especially along scute junctures – very dried out now just after 3-4 nights with garua at these altitudes! Painted #130.

Pg. 60.
He has a fine coating of dried smeared soil (both red and yellow-brown) on tail, feet, skin of legs, and underside of plastron - certainly has been mounting ♀♀ recently. His trail leads clearly into this area from open large red-soil ones to S.
In open red soil area where saw last night –
#1132 ♂ - (prob.) – CL 62.8; CW 67.5. No lichens, algae, or flaking disease; w.g.i.'s clear but thin. Scutes smooth only in very small tiny central part. Soil of the color of this area well ground into his carapace marginals and feet.
#872 ♀ - CL 93.9; CW 102.9. No lichens; a very few spots of flaking disease and light dry black-green algae in 2 usual areas. W.g.i.'s clear but very thin; scutes smooth in central 1/15 – 1/5 or less; bright red soil well ground into carapace all over lower portions in front and rear and along marginals of side; also on skin, feet, legs, tail, etc. But clearly has not nested recently, or at least gotten to stage of cloacal fluid dropping – no mud on her. Also behavior last night not indicative of nesting. Painted 131.
Followed trail to 3709 ♀ and can now tell that it goes all through red soil covered open area along La Fe Trail – it . . .

Pg. 61.
. . . comes from exact direction of yellow-brown soil depression (nest #5 1969-70 locale) where I think she last dug. Can not say to be absolutely true because she had to cross a rock pile to get up onto pampa colorada plain and am not sue if she did – no way to see any tracks of course.
Anyway found her where left her last night. She had dug in 3 places, all within 5 feet of each other in an area of general open red soil, but not in extremely barren goat scratch

areas. Instead, places she picked have about 102 cm of dense litter (leaves and dead sticks). Bad place because lots of rocks near surface she left rocks in all 3 within 3-8 cm (one is 3 cm, one 5 cm, one 8 cm deep from soil surface). No cloacal fluid dropped. Can find no sign of her having dug anywhere else along this trail she left so would suggest she just got up onto this pampa now.
Therefore, probably, - since has been digging for 4 nights - probably since last saw in Central Region 7 (Zone 3 NA) - spent night before last (14-15 August) in nearest yellow-brown soil depression and one or 2 nights in first one where wet dig is (13-14 and 12-13); could have simply been on trail and not dug on 12-13 – i.e. in transit). This all would fit together nicely and it is very likely probably that this has been her progress and the diggings I have found are hers. She certainly does not seem at . . .

Pg. 62.
. . . all particular about where she digs is digging all along as moves S along trail in effect. She has clearly recently been mounted. Could have been by painted #130 or painted #114 or painted #119, anyway, important thing is that a copulation or at least an attempt was made on yet another ♀ in the nesting area without apparently at all affecting her drive to nest. Copulating really scratched up numbers so I repainted her.
#119 ♂, painted, is stomping about plus or minus 100 feet W of her – i.e. he is about 150-200 m due W of where I painted and first saw him.
Went to new NA just to E of trail. –
#829 ♀ did not complete her nest. Also appears tat she did not drop any more cloacal fluid since that dropped which I saw yesterday afternoon. Nest cavity in front part is 15 cm deep; but in rear is a large rock embedded in floor which stopped her. It is only 10 cm down and she was resoundingly hitting it yesterday when she dropped fluid so she "knew" it was there then. So just . . .

Pg. 63.
. . . what are cues to drop fluid? And when do they really drop most of it - i.e. shoot there wad so to speak?
She has clearly been mounted recently – almost all of new paint is worn off; and most important, a lot of her lichens - in fact almost all except for a few patches in most protected spots - were worn off. Admittedly I collected some of these lichens but I did leave the vast majority on her. The ♂ in mounting clearly knocked most of more exposed ones off and covered others with mud. Also the recent dry days have clearly damaged the algae – mostly dry, and even lichens are a bit withered. Took several photos of her for comparison to earlier ones with lichens – Roll 167 - #'s 14-21.
** Really amazing – another nesting ♀ copulated with – repainted her.
Found 2 more holes around here probably accounting for 2 other nights of her digging attempts. [Marginal note: both of these in very rock sites, despite abundance of open soil all around.] Of course some could have been by ♀ 31113 – have not yet located her. No nest definitely in the central area here. So will have to return here to see if #829, or 709 lay. Looked further E 100 m through al sol spots – 2 more diggings only 35 m away from others but all shallow (rocks in holes, embedded ones). No sign of #1113 ♀ or #1033 ♀!!

On return: took one photo (Roll 167 - #22) of #709 ♀ (painted 72) near litter covered nest sites. She is sleeping.

Pg. 64.
Also saw #1146 ♂ (probably) – CL 58.2; CW 60.2. Small guy right where #119 painted had been one hour ago. Really a long way from just E of highway area, Zone 3 NA central part, since last saw this one! W.g.i.'s clear but very, very thin.
#131 painted (#872 ♀) is moving S now through red –soil pampas plus or minus along trail.
#119 ♂ painted is about 75-100 m further along moving steadily N more or less along our trail and also not on it over to right of it – heading directly toward Zone 3 NA central area. (and perhaps thence to the highway?).
#130 ♂ painted almost to Zone 3 central area on my return – at 0940 he is at least 200 plus meters from where saw at 0720; clearly moving steadily and determinably along a tortoise path running all way from at least open red-soil areas at lowest part of Region 7 (where #709 now is and where #119 ♂ painted just passed through) on through two yellow-brown soil depressions, on to flat rock H20 collection sites and on into Zone 3 central area. Obviously same path now been used by #130 painted and #119 painted was recently use by #115 painted (#312 ♂), #114 painted (#422 ♂) and #72 (#709 ♀).

Pg. 65.
There are several short stretches along this route where lava rocks are smoothed down, almost certainly from tortoises passing over. This path is not = (the same as) our trail but crosses it many times, is same for short stretches and runs at least parallel most of the way.
Went up highway to check on animals –
#131 ♀ - same area; sleeping and foraging for her seedlings; definitely not digging now in evenings.
#1112 ♀ - same area; sleeping and basking; definitely not digging now in evening.
No new digging at small brown soil NA along highway.
#114 painted fooled me – went out #131's path toward hub a bit then turned and went more or less same as my trail to area around new tiny NA to SE of zone 3 NA; i.e. near where he was seen for first time a few weeks ago.
#1195 – small one, cutting across S end of Central Zone 3 NA.
#1194 - active when returned at 1000 – eating herbs; at 1105 sought shade (sunny most of time since 0900).
#130 painted – now at campsite – 1105 – another 500 feet plus or minus has moved since 0940.
Zone 3 NA – Weather - 1030 hrs - Rain 1.2 mm; Evap. 11.1, refilled full; Max 77.5; Min 59.5.
Region 4 Weather – 1200 hrs. – Rain 1.3 mm; Evap. Reading 15.5, Evap. refilled full; Max 74.5; Min 59.5.
Enroute – saw the following animals (moving fast so not looking carefully)
#116 painted, #79 painted: both in Region 4. #1104 (Region 5 mid): all in same areas where last seen.

Pg. 66.
#42 painted – still descending – only 150 feet distance from Region 3-4 border now.
#127 painted – plus or minus same area as yesterday.
#38 painted – ascending – well up in Region 3; about halfway between middle of Region and Region 2-3 border.
#76 painted – half way up trail to Caseta from Pond #1.
#246 ♀ and #31 ♂ at Caseta – aggression see notes below.
#3♀ - also at Caseta.

Caseta Weather – 1900 hrs – Max 76.5; Min 60.0; Rain 0.75 mm; Evap. 4.7, reading 6.2.
When I arrived at Caseta at 1400 hrs noted #31 ♂ and #246 ♀ already engaged in a substantial aggression. The ♂ is much bigger but the match seemed to be a draw because they were sitting on an open herb-covered, rather steep slope of about 15 º with the male in the downhill position. They were face to face with fronts of carapaces only a few cm apart when I first saw them At his time and through all the rest of the aggression. . .

Pg. 67.
. . . the ♂ had his forelegs stretched out and laying relaxed on the ground an his rear legs out and supporting shell and raising it off of ground in the rear. The ♀ was in effectively the same position except her forelegs were not out sideways and relaxed, but drawn largely into the shell.
The aggression continued for only about 30 minutes after I first saw them – what went before is impossible to say. Interesting thing is that these 2 are certainly of breeding size but absolutely no sign of any mating activity or interest. During most of the time I watched both animals sat with carapaces either touching or almost touching in front and heads withdrawn. Occasionally one or both would venture to puts its head out near the others and take a "mock-nip" at the head or head region of the opposite animal. Also, occasionally one would lunge forward and try pushing the opposite by ramming with the front of the shell and using the rear legs as driving forces. Most of this activity amounted to bluff and threats and little real contact was made at all with the heads. Neither animal really won or drove the other off and no real change of position occurred through the whole sequence. As far as I could determine, the only reason the ♀ was able to hold her own against a ♂ of this size was because he was at such power disadvantage in being. . .

Pg. 68.
. . . downhill and pushing up against her. Finally, after sitting and doing nothing for 10 minutes after the last mutual pushing even in which the ♂ had been moved a few inches downhill, the ♀ turned sideways, then passed around and behind the ♂ and began grazing. He simply sat there all through this and paid no attention to her that was evidenced by any active behavior. Then he moved off to E 90 º from her direction and began grazing. They both wandered around camp the remainder of the day but nothing further occurred.
El Chato Weather – 16 August – Julio checked weather for me yesterday at El Chato – 1000 hrs – Rain 1.15 inches, emptied; Evap. 20.0 ml, refilled full.

Notes from 12 August – Other notes – started taking nest and control temperatures of nest #1 in Zone 3 NA but had to give up. Anyway they are interesting as indications of minimum temperatures reached at the level of the eggs in the nest after about 5 days of very cloudy, cool weather and garua every night and . . .

Pg. 69.
. . . often in the day; i.e. very little sun for 4 days at all.

Nest temps – Probe 1			Control in soil – Probe 2	
Position	0800	1000	0800	1000
1	21.3	24.7	21.5	24.6
2	20.6	23.2	21.0	23.2
3	20.6	23.2	21.3	22.6
4	21.8	22.4	22.2	22.2
5	22.7	22.6	23.2	22.9
6	23.9	23.4	24.0	23.7
7	24.3	23.9	24.6	24.1
8	24.7	24.3	24.9	24.7

Soil moisture availability – 0800 – 12 August –
Nest 5 cm – NR
22 cm – halfway between first line and 20% - i.e. close to 20%?, but less.
Control – 5 cm – NR
22 cm – NR

Copulation – W. G. Reeder and Frank Irwin (check spelling) and others saw #205 ♂ (painted #76) and #18 painted ♀ (#3 ♀) copulating again just a short ways below the Caseta at 200 m altitude, just W of the trail along the drainage.

Pg. 70.
They were mating for some time (1 hour plus) as before. W.G.R. took notes so will get elaboration from him. Date for this was 11 August, 1970.

17 August 1970.
To CDRS early today – enroute saw only #'s 4 and 94, (both painted #'s) near Caseta Pond #4. Plenty of sign all along and especially in Zones 1 and 6 areas but saw no more animals actually.
21 August 1970.
Return to Caseta – from about 0.5 km E of Zone 6 turn off on to Zone 1 area and even on to Caseta scattered tortoises and plenty of sign of recent activity - trails, grazed areas, fresh turds.
Animals I saw:
#707 ♂ - (perhaps 407 because first scutes is a tiny extra one – 12 right marginals) Cut is in actual 4th scute in hundreds area but in 3rd normal sized one. Just before Zone 6 turnoff – grazing on Reserve Border.
#114 ♂ - just after Zone 6 turnoff; also grazing in trail.

Pg. 71.

Near pond by manzanillo pond just on Reserve Border short ways W of Zone 1 turnoff: #1023 ♀; #32 ♂ - both grazing on opposite sides of a tree, about 8 m apart.
#94 painted – at Caseta Pond #4.
Copulation – Jan and Heather Reeder saw #1023 ♀ and #32 ♂ engaged in a copulation attempt earlier at about 1500. they were already mounted when they approached and the rest o the attempts lasted till 20 minutes later. Did not appear successful up till time they left – 5 different mountings and never any successful intromission of tail or penis and usually not even correct mounting position achieved. Perhaps was successful later on when they left but can't say. When I passed at 1600 it was clearly all over.
Copulation – Sue Reeder saw #3 ♀ and 331 ♂ in a copulation attempt near tents at 1630 hrs on 19 August. This lasted about 20 minutes and from what she was able to tell me sounds as if it may not have been successful. Did involve groaning, but otherwise went rather poorly.
Caseta Weather – 2145 hrs – cool and cloudy all day.

Pg. 72.
11 August 1970. – Enroute to La Fe area to finish WGR (W. G. Reeder) group's vegetation sampling. Enroute saw a few animals of note –
#'s 3 ♀, 31 ♂, 246 ♀ at Caseta
#111 painted and #12 painted at Caseta Pond #1.
#126 painted (#835) in Region 3 – middle.
A small unmarked one in lower–mid Region 3.
In Region 4 – painted #'s 77 and 79.
Region 4 Weather – 1330 hrs – Max 75.5; Min 59.5; Rain 72 mm, emptied; Evap. 12.3 ml, refilled full.
Region 7 (Zone 3 NA) Weather – 1600 hrs – Max 77.5 ºF; Min 58.5 ºF; Rain 5.5 mm, emptied; Evap. 15.0 ml, not refilled; reading 15.0.
Checked all over Central Zone 3 NA for animals; found the following ones:
#130 ♀ (painted 317) – up on rocky rise just above dry pond near N part of nesting area. Burrowed in at 1615; no clear sign that nested recently although possibly could have if did so in brown type soil; has dried mud on tail, legs, and feet but not much; none on lower edge of rear of carapace.

Pg. 73.
The amount present could easily have come simply from poking about on rocky and muddy area near dry pond as have seen this ♀ doing often; thus evidence as to nesting recently is inconclusive. #919 – same area generally; a little E of dry pond area on rocky plain above nesting area. Burrowed at 1620.
#787 ♀ (painted #19) – half way between 2 cacti she so often visits – now in southern part of Central NA; inactive and burrowed at 1645; she still retains clear evidence of having nested but sign (red mud) worn away enough now that would not be able to definitely say she had nested were I to encounter her for the first time during nesting season in her present condition. Clearly has not re-nested yet – mud pattern same as before.
#1020 – just N of Central NA about 150-200 m along pathway just E of our trail which leads into NA through a series of small soil-covered areas.

** Second nesting of single ♀ - #127 ♀ - back in nesting zone ! First saw her at 1500 sitting in open on soil just E of trail just above northern part of Central NA. This is not far (35 m) from Nest #1, 1969-70, and in same small area of brown soil where was 2 other nest last nesting season. Later at 1610 checked and found she had moved from this site sometime . . .

Pg. 74.
Between 2 sighting and down onto trail. At 16110 was obviously prospecting for a nesting site, (typical moving, looking, and sniffing-of-soil pattern). Was then just beside Nest #1 1969-70 site, and where 2 unsuccessful hole had been dug earlier this year (1 by #131 ♀, the other very recently by an unknown ♀). At 1700 she was still searching about in this area; left and returned at 182 and discovered she had since gone back up and just past where had first seen her at 1500. Now resting and presumably "burrowed" – really just sitting in open beside a tree on some small rocks. Ten feet away from her and only 1 m away from a 1969-70 nest, she had just attempted to dig a hole getting it well excavated to about 15 cm before quitting. There was a large and immovable rock occupying the whole front wall and floor of the nest cavity; presumably this stopped her; she had dropped no cloacal fluid at all. This new nesting attempt is very interesting because she laid nest #1 of . . .

Pg. 75.
. . . this year just about 2 months ago, not far from present digging site and had returned to Caseta pond #1 area in between that nesting and this new attempt. Saw her heading S from tent area in July sometime (will check) and is just now getting here. She bears no clear signs of having recently nested at all or even haven gotten to stage of dropping cloacal fluid. She appears to have entered this area basically along the pathway just E of our trail because I found 2 fairly recent digging attempts along it and saw plastron impressions of a tortoise of her size moving S into nesting zone. This all could have been done by her recently. Frank Irwin (check spelling) is fairly sure he saw here one day recently (between 18th and today) on trail a few hundred meters plus or minus above here, moving S. This would corroborate evidence of where she came from and pathway used; he recognized her then and again today by her size, smoothness, and notable concavity on upper rear of her carapace.
Other digging – only other new digging I would find anywhere in central NA was one hole mentioned above near nest 31, 1969-70 – rather shallow and not clear why animal quit – perhaps poor because of caving in of loose . . .

Pg. 76.
. . . brown soil.
Finally, found a new nest, #5 for year (#4 is in NA below Cerrito); it is right in middle of the trail just above and a bit to NW Of nest #1's (1968-70) location. Is in trail only a few feet from a hole dug there in mid June of this year by #127 ♀. Also a brown soil area. Has a well formed hard cap and is covered by a ½-1 cm layer of loose organic debris, dry soil and small rocks. Certainly was laid here since I was last here at 1100 hrs plus or minus on 16 August. Frank Irwin (check spelling) has been by this site every day since 18 August, including morning of 21 August and he does not think it was here. If this is

true must have been laid last night. From examining it, it does not appear quite wet enough for that. I would suggest is 2-3 nights old but can't be sure. Anyway is a moot point. He is a good observer and has seen others tortoise nests and has spotted some . . .

Pg. 77.
. . . hole and potential nest without my aid. But this nest is well camouflaged so impossible to say. Only nearby ♀ who could have laid it is #130 ♀ but as noted above no clear decision can be made on that . No other obvious digging attempts anywhere around it.
Shot a ♂ cat (feral) in Central NA today. Adult, tabby-colored variety. Examined is stomach and found that it had the following fresh content (certainly all today's feedings, hardly any digestion yet at all – shot at approximately 1500): 3 large Scolopendra (centipedes) and 12 medium and large sized Tropidurus (lava lizards). No small tortoise parts inside at all.
Also found #1193 back in old stomping grounds in eastern part of Central NA. Grazing on herbs. At 1530 still active there; at 1630 burrowed into one of two favorite resting places in this area where first saw him approximately 1 year ago – where marked him last November.
23 August 1970 – Helping WGR and Frank Irwin and crew cut a new trail (from where my trail turns ESE toward La Fe) to S directly to sea so they can complete vegetation sampling. Will only note tortoises occasionally as I have time and will examine this new trail more thoroughly later one and take notes then on habitat, etc.
Tortoises noted:
#428 ♀ on La Fe trail at first rocky . . .

Pg. 78.
Water collection site about 200 m S of Zone 3 NA Central part. No sign at all of having recently nested or gotten to stage in digging of dropping cloacal fluid.
#325 ♂ - In last yellow-brown soil area, near nest #5 1969-70 – sitting beside trail – perhaps moving toward Zone 3 Na. (Could be #125 but 200 unit seems clear – confused because old hole from tag in this scutes obscures cut partially).
#1056 ♀ - along trail in last red soil NA on La Fe Trail in lowest end of Region 7 – exactly where I saw #709 ♀ digging approximately 1 week ago. No clear sign of having nested but reddish powdery soil on feet and legs could indicate has been trying to dig and simply has not yet gotten to stage of dropping cloacal fluid.
I cut my nose severely this p.m. on a cut off Croton stem and thus can not take more notes today or make observations ; will continue tomorrow.

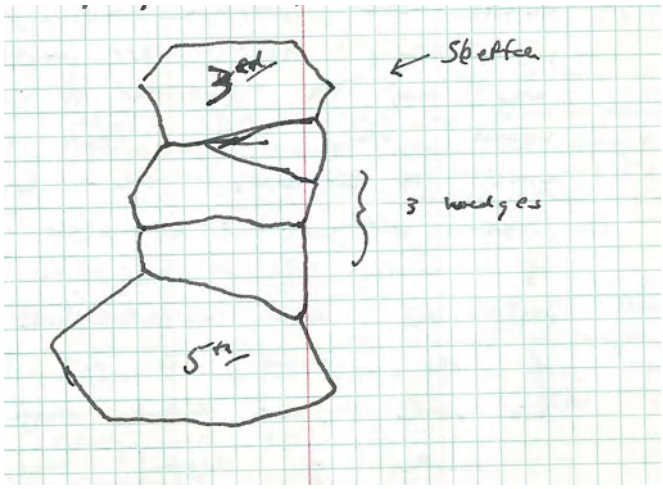
Pg. 79.
24 August 1970. – Group of toward coast again. Am going to Caseta to rest, but will check around Zone 3 NA today a bit before leaving.
#130 ♀ (painted #17) still in area of dry pond this a.m. - #127 ♀ there also; they are now side by side k- perhaps a recent aggression. #127 clearly moved to this area yesterday (trail clear from resting spot on 22 August – 23 August (night). She dug one hole right in pond bed in an open site surrounded by Clerodendron bushes. But very loose yellow-brown soil an she hit rocks within a few inches of top of ground (i.e. approximately 10

cm) – did not drop any cloacal fluid. No sign at all that she ever entered NA where tents are located near her first nest of this year (#1 1970-71). Not unlikely that tents and human activity are keeping her away from here.
#918 – also at dry pond area.
#1144 – same old burrow site – moving from it to flat rock, H20 collection site in nesting zone Central area (Zone 3).
#787 ♀ (painted #19) – in "woods" just beyond Central NA – no digging sign at all; still sitting, looking around at last night's burrow.

Pg. 80.
#709 ♀ - (painted #72) – now only 100m plus or minus down La Fe trail from Central Zone 3 area – off to E to trail a few dozen feet at a burrow site. Perhaps moving back to Zone 3 NA. Can not tell clearly if she laid –lots of yellow-brown and red soil on feet, nails, tail, and lower edge of carapace – but not clear – could have laid a week or so ago and be in present condition in regard to mud on rear area if can use #131 ♀ and 787 ♀ as guides. Thus probably did lay in Region 7 to S somewhere. She is only about 40 m from flat rock H20 collection site to S and thus probably is moving from it toward Zone 3 – there is a fresh turd from this a.m. between her and this site.
At site of H20 collections 2 ♀♀ - #428 ♀ - CL 88.0; CW 99.4. Almost all worn smooth; very faint worn old growth rings around outer margins of scutes; small old patches of flaking disease on rear of shell (supracaudal and 4th vertebral). Black-green algae on rear 1/3 of shell and all along all scute junctures of carapace; w.g.i.'s thick. No lichens; No sign of recent copulation or nesting even digging.
#269 ♀ - CL 104.1; CW 113.1; all smooth scutes completely; very old flaking disease patches on rear of carapace but none is fresh. Black-green algae in usual places, especially dense all over carapace along scute grooves. No lichens ;w.g.i.'s present but thin Has very . . .

Pg. 81.
Clearly recently been copulated with – fresh brown mud all over top of carapace. No clear sign of recent nesting or cloacal fluid drop stage having been achieved. But both brown and bright red soils on feet and tail so could have been digging recently; or could have laid 5 days ago plus given mud in between scutes on feet and around nails. Very striking carapace scute anomalies – 12 marginals on each side, last one on rear in each case slightly smaller than usual. Supracaudal quite a bit smaller than usual; 7 vertebrals – first 1 more or less normal, 3rd normal except rear right portion cut off sharply at an angle then 3 wedge-shaped ones – all abnormal, take up place of all of 4^{th,} back part of 3rd and top part of 5th. Fifth normal below but top part distorted and partly missing.

[Diagram showing 3 abnormal vertebrals wedged between two larger ones]



Pg. 82.
Interesting size difference in the 2; #428 clearly younger because scutes not as totally worn and smooth, and grooves between them, especially in rear area not as deep and well developed. Sitting side by side at site on flat rocks; perhaps an aggression before I arrived.
Painted #428 ♀ as #132.
Painted #269 ♀ as #133.
Went on just over next rock pile to first yellow-brown soil NA. Just to right of it up on small planada is a small red soil are – a trail come clearly from it along to flat rock area. By measuring its width where plastron hit ground and because of rain last night it was easy to see that #428 ♀ moved along this route this a.m. to flat rocks. She voided 2 large patches (1-2 cupfuls each) of amber urine enroute. Place she was last night look as if she tried to dig but hit rocks just below surface- thus another ♀ digging here. Went back and checked fresh . . .

Pg. 83.
. . . turd just mentioned above and found from its shape that ♀ who'd dropped it was moving south toward flat rocks – thus probably left by #269 ♀ on way to rocks and not by #709 ♀. This fits as a better explanation. Given this could be that #269 ♀ is responsible for new nest #5) in Zone 3 area – at least as likely as #130 ♀ given mud on each – simply a moot point now given probable age of nest. If Frank is right about where nest was laid then #130 is best bet because of her proximity. In this nest yellow-brown soil area are 2 ♂♂ (were there last night at 1715 when I passed by):
#125 ♂ (called #325 yesterday; am now fairly certain that 200 cut is only ring hole and not a notch) - He moved a bit (100 m) N since yesterday's sighting. CL 124.4; CW 138.0. No lichens or algae; flaking disease light on front and rear marginals; scutes worn but smooth only in central 1/20 – 1/8 or less; w.g.i.'s not complete and extremely, extremely thin. No real red soil on skin, feet, carapace, et. Painted #134.
#776 ♂ CL 114.0; CW 127.0. Dense flaking disease in usual areas; no lichens or algae; scutes smooth in central 1/15-1/5 or less; w.g.i.'s present but extremely thin; also lacks really red soil. Painted #135.

Pg. 84.
#56 ♀ - just E 50 m of where saw her yesterday – sitting beside a hole she tried last night No cloacal fluid – hole about 12 m. Full of rocks so quit. Still has fairly bad flaking disease in 2 usual areas; black-green algae in usual area. And especially along scute junctures; in latter case all over carapace in these grooves. Also bright yellow-green algae on rear of carapace along scute grooves in supracaudal, last rear marginals and last vertebral; no lichens; w.g.i.'s clear and moderately thick; no signs of copulation attempts with her recently. CL 97.3; CW 111.2. Painted #136.
Nest #6 – In new NA just beyond where saw #56 ♀ found another nest - #6 for 1979-71. Fairly fresh – within past 3-7 days I would guess – hard cap still moist and with about 1 cm of loose red soil and rocks and debris over the cap. Almost certainly laid by #829 ♀ (painted #118) – very near (2 m) from where I first saw and painted her. Near where I saw her digging a week ago plus. In red soil covered area – completely bare open soil – near 2 nest from last year.

Pg. 85.
#1132 – now in this area – near flat rock H20 collection site.
On return saw #428 ♀ heading off to NE toward Zone 3 and small NA to SE of it.
#709 ♀ moving along tail steadily toward Zone 3 NA Central part still.
Checked all over Zone 3, along highway and tiny NA just SE of Zone 3 – no other tortoises than those noted above.
Zone 3 NA Weather – 1230 hrs – Rain 2.3 mm; Evap. 2.3 ml, refilled full, reading 17.3; Max 76.0 ºF; Min 59.0 ºF.
Enroute to Caseta
#128 painted, moving S only 200 m above nest #13 from 1969-70.
In Region 4 - #'s 71, 79, 77, and 42 all painted. #1255; #1157.
Region 4 Weather – 1330 hrs – Rain 2.8 mm, emptied; Evap 2.8, not refilled ; Max 73.0 ºF; Min 60.0 ºF.
Enroute to Caseta:
#126 painted (#835) – going back up – just below Region 2-3 border.
#1135 – just above Region 2-3 border.
#255 – mid Region 2, moving N along trail.
#111 and #12 – both painted) at Caseta Pond #1.
#3 ♀, #31 ♂, #246 ♀ - at Caseta area.
At Caseta on 23 August Jan saw an approximately 2-hour copulation between . . .

Pg. 86.
#3 ♀ and #31 ♂. She tried to twist away from him during early steps so lasted a long time; he groaned as usual. Finally it appeared successful because he eventually groaned rhythmically in the proper position for a long period with her passive. He climbed down voluntarily eventually. Jan watched her and him from very close and determined that during the successful period he had the tip of this tail definitely in her cloaca. It remained there slightly in all the time, even between thrusts; then when he thrust it went further in. Jan never could see the penis – could not tell if penis even came out – could not even definitely see it. The tail was bent and curved so it had a concavity falling upwards. Jan could see that his concavity was wet with fluid, presumably seminal fluid. Often when

he thrust during this successful period the ♀ would jerk a bit and struggle briefly as he thrust – thus perhaps he was hurting her a bit.
Julio San Miguel went to the new nesting area below Cerrito again and to Cerro Gallina again recently. On August 19, 1970 in the . . .

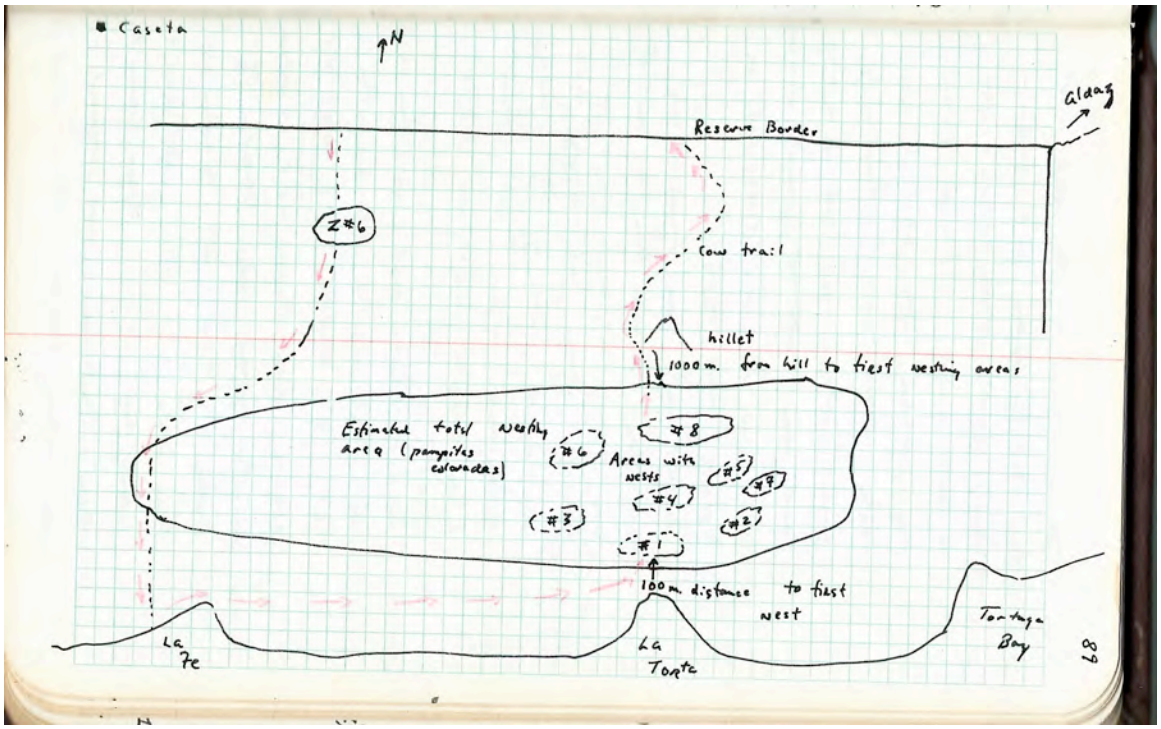
Pg. 87.
. . .nesting area and its vicinity he saw the following animals (♀♀).
#61 painted ♀; #68 painted ♀; #628 ♀; #60 painted; #464 ♀; #1000 ♀.
Two large ♀♀ with paint or permanent numbers. He noted a number of recently dug hole, i.e. uncompleted nests, but found no new nests yet.

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25 August, 1970.
Resting at Caseta all day to allow my nose to heal. Jan and Heather Reeder went up to Devine's for a chat and saw some animals enroute:
Along central manga between Reserve Border and first fence – painted #'s 2, 15, 98, 91, and 7.
Painted #101 between fence and banana patch.
Painted #104 at Maternidad Posa (pond) thus up higher!.
Caseta Weather – 1900 hrs – cool and windy all day and some rain off and on – Max 73.5; Min broken recently, will repair; Rain 4.3 mm (first since 22 August); Evap. 2.3 ml, reading 13.3.
26 August 1970 – to CDRS with Bill Reeder and company. Saw many tortoises enroute. At Caseta Pond . . .

Pg. 88.
#4 (#94 painted); #86 painted; #2 ♀ - CL 84.9; CW 94.2 – clearly fairly young because scutes only slightly smooth in very centers – permanent # is definitely probably wrong but I can not detect any other notches or their sign at all.
50 meters W of pond on Reserve Border near Zone 2 turn off : both on Reserve Border - #356 ♂ - CL 116.4; CW 125.5.
One unmarked animal circa 70 cm CL – not worn at all on carapace (hardly any that is).
At this pond on Reserve Border – #1023 ♀ - CL 93.1; CW 100.0.
½ way between pond and Zone 1 turn off - #810 ♂ - CL 100.7; CW 112.0.
Then clear recent sign – trails and droppings scattered to about ½ km on other side of Zone 6 turn off.
30 August, 1970. Information from Julio San Miguel of his trip with Galo Torres to La Torta on 6-7 August, 1970. A map of their traverses is as follows; The red arrows show where they went roughly.

Pg. 89.
[Editorial note: Entire page is diagrammatic hand-drawn map showing route S from Reserve Border to La Fe and then to La Torta and through a nesting area proceeding N to Reserve Border via a small hill mid distance between La Fe and Border.]



Pg. 90.
They went down to the coast on 6 August, 1970 to approximately La Fe crossing almost all rocky areas and seeing no nests enroute. Then on 7 August they proceeded along coast to La Torta, turned N and found a large general nesting area made up of many small areas with nest (pampitas coloradas). They saw no new 1970-71 nest or signs of recent digging.
The first nest was found at only "100 m" distance from the coast. It was from 1969-70 and obviously all the hatched young had escaped. Inside it had 1 rotten egg with an embryo of very small size. (Note: from Julio's description must have been 1st cycle).
In first (#1) area, found 2 nest from 1969-70. In total in the 8 areas they think the counted 49 nests from 1969-70 from which most or perhaps all the young had escaped. Of course they did not examine all these nest so I will have to return here for closer examination. Also, they may have confused old digging attempts with hatched-out . . .

Pg. 91.
Nest. All of this remains to be seen. In fact most turned out to be nest destroyed by pigs – see later notes.
Tortoises they saw in these nesting areas. Marked - #725 ♂; #842 ♂; #482 ♂; #635 ♂; #928 ♀; #797 ♀; #190 ♀; #4 ♀; #1100 ♀; #415 ♂.
Unmarked – 3 "small" ♀♀; 1 large ♀; 5 "very small" ones; 2 "small" ones; 1 "medium" sized one; 1 large ♀ with a hole in the first left rear scute. Thus 23 tortoises in total.

They also found a killed ("4-6 months" dead) tortoise, possibly a ♀, in transition from dry to green vegetation area on cow trail to N toward Reserve Border. Julio says many people go down trail to hunt as far as the small hill indicated and certainly take tortoises occasionally along the trail.
4 September, 1970. Returned to Caseta today; enroute noted tortoise sign beginning about ½ km E of Zone 6 turn off on Caseta trail. Saw sign from there off and on all way to Caseta - #407 just at Zone 6 turn off
#1023 – 200 m W of pond beside Reserve Border just W of Zone 1 turn off.

Pg. 92.
#4 and #94, both painted, at Caseta Pond #4
Caseta Weather - 1900 hrs - cool and cloudy all day; Max 71.0; Min 62.0; Rain 1.3 mm; Evap. 1.3 ml, reading 1.3.
5 September, 1970 – To Zone 3 NA to check for nest, tortoise movements, and weather stations.
Enroute saw following –
At Caseta Pond #1 - #'s 12, 88, 49, all painted.
#255 ♂ - in mid Region 2 in open, basking in center of the trail. CL 122.5; CW 136.3. Scattered minor spots of flaking disease on rear of shell, front marginals, and smooth centers of vertebrals. Scutes smooth in central tiny spots to a maximum of 1/6 only. No lichens; black-green algae in dry form in 2 usual area; w.g.i.'s present but rather thin. Painted #137.
New #1293 – too small to accurately determine sex. CL 58.0; CW 59.9. No lichens, algae or flaking disease. Scutes smooth only in very tiny central parts. Region 2-3 border; in open basking.
New #1294 – short distance (40 m) S of last one; on trail, also basking; no lichens, algae; scutes smooth as in above animals. W.g.i.'s virtually non-existent; flaking disease extensive on front . . .

Pg. 93.
. . .and rear marginals only. CL 64.9; CW 67.6. Too small to determine sex accurately.
New #1295 – short way (100 m) above Region 3-4 border, moving S directly 15 m W of trail – i.e. along drainage. CL 59.9: CW 60.0. No lichens, algae, or flaking disease; scutes smooth as in previous 2 animals. W.g.i.'s clear but very thin. Too small to determine sex accurately.
Region 4 Weather – 1130 hrs – Max 76.5; Min 59.0; Evap 33.0 plus (dry), refilled full; Rain 5.7 mm, emptied.
New # 1296 – too small to determine sex accurately; CL 47.5; CW 50.4. In region 4 ambulating about. No lichens, algae, flaking disease, or smooth scutes. W.g.i.'s clear, well-developed, and moderately thick.
#129 ♀ - small –medium sized – just below region 4-5 border; grazing on herb seedlings. Number doubtful? – small for this #, i.e.
#528 ♂? – CL 62.8; CW 67.6. No lichens, flaking disease or smooth scutes; thin coating of dry black-green algae all over rear and front marginal area. W.g.i.'s present but extremely thin. In mid lower Region 5 crossing directly to E.
Two animals just below 1969-70 Nest #13 –

#133 ♀ (painted #128) k- resting on very rough rocks; pointed toward Zone 3 NA along path which runs just E of our trail; am rather sure she has not yet nested since no red soil at all on feet, nails, scale junctures , etc. of legs and skin of rear area and none on lower carapace lip. Same old bright red soil worn into carapace above and or upper 1/3's of tail but this . . .

Pg. 94.
. . . probably months old and she had it on tail and carapace when last seen. Does not appear to have been copulated with since painted her.
#1139 ♀ - CL 64.7; CW 69.5. No lichens, algae, smooth scutes or flaking disease. W.g.i.'s clear, well developed , and moderately thick; moving due W over very rough rocks.
#1105 ♀ - CL 70.4; CW 74.5; moving due N over very rough rocks and through thick Croton bush in same area. Carapace conditions all same as #1139.
Zone 3 Na – Weather – 1300 hrs – Max 79.0; Min 59.0; Evap. Dry 35.8 plus, Rain 2.1 mm, emptied.
#1144 – in shade of Pisonia on very western edge of N and upper part of Zone 3 Central NA.
Nest 10 – New nest, #10 for year (#'s 7-9 below Cerrito). Is in trail in brown soil area just near(a few feet away only) from Nest #1, 1969-70. Is precisely in area where #127 ♀ was looking and digging on 22 August, 1970. Nest almost certainly made by her since she was still in this area when left on 24 August. Nest not very fresh – hard cap dry on surface and a few cm into it despite a covering of 0.5 cm loose dry soil. In brown, . . .

Pg. 95.
. . . fine, loose, dry soil typical of this area. No other ♀♀ have been around here that we know of through August 25 (Reeder group left that day at 1300). Only other new digging attempt in northern area of nesting zone is in small dry pond bed right beside where #127 ♀ dug on night of 23 August.
Both nest #10 and #5 were protected with corrals of 1.5 m diameter today – Will build one around #6 today if we have time, all others except Nest #1 have walls already.
Julio and I checked though al the rest of the nesting area of central Zone 3 - no more new nests or attempted hole since last here on 24 August. Then went toward La Fe on trail – no new diggings or nest all along till we reached pampa Colorada of lower Region 7. There we hunted diligently for nests especially for any made by #709 ♀ (painted 72) who I am rather sure nested here about 2 weeks ago. Only found 3 holes which I had seen previously which she dug and 3 more shallow attempts nearby which I am rather sure she also was responsible for making.
Just below here to S about 50 m found some more red soil patches and #755 ♀. Nearby to where she is resting in shade, is an area with shallow superficial scratchings, so she may be going to nest here soon. CL 86.5; CW 95.2. No lichens; . . .

Pg. 96.
. . . black-green algae in dry form all over normal 2 areas and a lot of it along scute junctures all over carapace. Light yellow-green algae mostly dry abundant along scute junctures of rear marginals, supracaudal, last costals, and 5th vertebral. Deep, old, large

patches of flaking disease in 2 normal areas and one on 2nd vertebral; w.g.i.'s present and moderately thick. Has definitely not nested recently as usual muddy signs in rear areas are not at all present. Algae and lack of worn in red-soil give impression she recently came down from higher altitudes. Painted #138.
Nest #11 – In new area to E of above part of La Fe trail we built a corral wall around Nest #6. then found a new nest, #11 in a small depression in a very rocky area on edge of the pampa Colorada here. Soil seems to be a mixture of red soil typical of pampa Colorada and yellow-brown soil usually found in these depressions. Nest very obscure, because had about 2 cm loose dry soil over compact hard cap. Cap is large and durable and absolutely chuck full of fecal matter – probably 1/3 of material (in its upper layer at least) is tortoise turd material. I could have missed this nest in my more cursory checking of August 24; simply . . .

Pg. 97.
. . . hard to determine. I do not think this spot was as disturbed as it seemed today but simply can not be sure. Nest gives no real hint of age but is certainly 5-7 days or older because cap is dry on surface. Can't tell how dry it is below; thus can not say much as to which ♀ laid this. We built a corral around it. No other fresh digging or nests all through this area.
#1132 – in this area near H20 collection site.
On return to Caseta noted that #133 (#128 painted) had moved down trail and then into soil filled spots just E of trail and above Zone 3 NA. There at 1530 and look as if may be beginning to dig. Very probable that she will lay here soon.
Weather – Caseta – not taken tonight; forgot till after 2000.
Julio San Miguel visited new nesting area below Cerrito on 4 September and reports the following ♀♀ and new nests –
#61 painted; #628 ♀ - both in new nesting area, central part.
#7 Nest – there also; he thinks #61 laid it because she was nearby it and had red mud on feet.
In between new nesting area and lowest corrals (from 1969-70) found another nest, #8 for this year. Fairly fresh, maybe . . .

Pg. 98.
. . . even from night before and #463 ♀ beside it; in a very rocky area, not an area which one would even consider normally possible for a nest. Nest crammed right down into a tiny soil spot in rocks. He is sure this ♀ laid it – soil on her feet and carapace.
#9 Nest - found near the lowest corrals and very possibly laid by either #1019 ♀ or another large unmarked ♀, both of whom were in this area. But can not determine for certain, because nest is a bit older and can not determine from soil on rear areas if either of these ♀♀ recently laid.
Julio checked el Chato weather twice recently –
21 August, 1970 – 0900 – Rain 0.47 inches, emptied; Evap. 4.5 ml, filled.
4 September, 1970 – 0800 – Rain 0.70 inches; Evap.. 23.0 ml, broken tube. Will replace tube on 6 September (tomorrow).
6 September, 1970 – To El Chato to begin sampling there.

Pg. 99.
Enroute –
#40 painted – just above Caseta at Reserve Border.
#97 painted – at entrance to Devine's central manga; coming on Reserve Border.
#7 painted – 50 m E of top of first hill.
#43 painted – top of first hill.
#1013 – just other side of first hill.
#50 painted; #15 painted; #450 – all in " valley" half way between first hill and right turn.
#97 ♂ - at right turn – with ticks (4) collected by Dr. Grossmann. Three on rear legs, 1 on foreleg; all 4 appear to be same species.
#37 painted (♂) – at right turn – no ticks. Repainted.
#327 ♂ - at Camote patch – collected one hug blood –engorged ♀ tick from skin near base of tail (Dr. Grossmann collected).
Also collected a whole fauna on underside of plastron and on rear legs area – spiders, snails, cockroaches, jumping insects, etc. Some living on turd remains on plastron and skin area. CL 152.0; CW 162.5. Scattered flaking disease and black-green algae in usual areas; all smooth scutes; w.g.i.'s clear and well developed and moderately thick. No lichens; grazing. Roll #172 - #'s 1-5 of ticks and snail on #327.
#545 ♂ - at 100 m E of El Chato turn off on Reserve Border. CL 138.0; CW 151.5. Abundant flaking disease in 2 usual areas and scattered elsewhere on top of shell; scutes all smooth; no lichens; black-green algae in faint spots on last costals and 4th vertebral. W.g.i.'s clear, well developed, and thick. I collected a large number of ticks from front and rear leg pocket borders and along plastral midline in concavity.

Pg. 100.
Also 1 snail from plastral concavity also.
#54 painted – same area, grazing; same area where last seen.
#653 – same area; grazing ; very little one. Lots of ticks also.
In turn off area –
#58 painted.
#10 ♀ - CL 104.5; CW 113.0. Scutes smooth only in central 1/5-1/2. Severe flaking disease in 2 usual areas; no lichens; extensive black-green algae (rather dry) in usual areas and all along scute junctures. W.g.i.'s clear but rather thin. Scutes grooves not deep and extensively worn yet as in most large ♀♀ of this size. Only a few ticks.
[Marginal note referring to entry for #10 ♀ - Duplicate or perhaps even triplicate (number) – painted #149 on 9 September, 1970.]
Region 1 – in forest on way down –
#139 ♂ - about ¼ of way; moving up; off of trail 5 m.
At Chato not enough time to sample so will look for parasites, etc.
#685 ♂ - at Pond #1. Extensive flaking disease – See roll #172, photos 6-14. had only 1 tick, collected by Dr. Henning Grossmann.
#1121 – at Pond #2 – no ticks.
#1228 – on top of Chato! Grazing along. Shot 1 goat (♂, large) – took 2 photos Roll 172, #'s 15 and 16 of incredible amount of green food in 1st stomach.
El Chato - Weather – 1600 hrs – replaced Evap. tube Julio broke on 4 September, 1970 and filled it full; .01 inches rain; gauge emptied.

Pg. 101.
On return – doing new trail out of Chato –
#281 ♂ - at forest – mora border where tail heads ENE toward Reserve Border.
Enroute to El Chato and at El Chato we examined many tortoises for ticks or other ecto-parasites. Tortoises examined and results were as follows (see previous notes for locations of animals):
#450 – no ticks.
#1006 ♀ - (painted #15) – no ticks.
#97 ♂ - 4 ticks; all collected by Henning Grossmann.
#37 ♂ painted – no ticks; note that just arrived in this are from below along drainage below Caseta; perhaps this reason no ticks yet.
#327 ♂ - 1 tick on rear area just in front of base of tail; very engorged with blood – a ♀ tick probably. Collected by H. Grossmann. I preserved a varied animal fauna from this one. #545 ♂ - Many, many ticks; all along scutes – skin border of rear part of foreleg pockets; also around tail base; also a lot along plastral mid-line and scute junctures between abdominal scutes and pectoral and femoral scutes. H. Grossman collected many; I also did so – preserved min in 70% ETOH; also preserved 1 land snail in same bottle.
#653 – also many ticks on undersides in leg pockets; these collected by H. Grossmann.
#10 ♀ - A few ticks in leg pockets; collected by H. Grossmann.

Pg. 102.
#685 ♂ - 1 tick in center of plastral concavity along scute juncture; collected by H. Grossmann.
#1121 – very small; no ticks present.
Yesterday, the Grossmann's examined a number of tortoises in the Caseta area but saw no ticks on any of them:;
Near Caseta Pond #1 –
#12 painted; #49 painted (#62); #88 painted; #137 painted (#255 ♂).
Caseta upper ponds area – field below them:
#93 painted; #18 painted (#3 ♀); #40 painted; #51 ♂; #95 painted; #89 painted; #117 painted; #246.
Completion of notes on nesting of #131 ♀ on night of 12-13 August, 1970. These were written in temporary notebook on 17 August at CDRS and am just no recopying in this book. Did not have this notebook at CDRS then so . . .

Pg. 103.
. . . failed till now to recopy.
Items:
1 – Movements and wiggling of tail and gelatin:
Noted movements of tail in pendulum fashion from side to side just after positioned tail centrally over nest cavity as was beginning egg laying sequence. Movements were at first weak, then rather strong, increasing to an arc of about 70 º just before first egg was laid. Prior (circa 60-70 seconds) to appearance of first egg stopped pendulum swinging of tail. Then some globs of gelatin came out and soon (20-30 more seconds) the first egg was laid. Soon after each egg was laid, she would again commence with the pendulum

swings of the tail. These would soon halt, and usually (but not with every egg) a bit of gelatin would come out, then finally the egg itself would be laid. These tail movements were rather rapid swingings and involved only the tail, not any other body parts. It is tempting to suggest that the swinging is associated with a straining and movement of muscles in the attempt to get the egg out. Each egg is surrounded and embedded in a mass of the same gelatin so that it is thus partially protected and cushioned when it is laid. This certainly helps prevent cracking when an egg strikes a rock or another egg when being laid.
2 – Noise accompanying each egg: As an egg is laid, or rather just a few seconds or none before the egg actually emerges from the cloaca, one hears a loud . . .

Pg. 104
. . . "crack". Just what this is we have not yet determined; perhaps it is a sound made as the egg passes from the ovarian tube into the cloaca, but can not say for sure. It is definitely not made by the egg actually emerging from the local opening because sound occurs before any of egg is ever seen. Sound is heard with each and every egg so is definitely not the actual breaking of an egg. In fact, both with one which broke before emerging last year and one which did same this year with this ♀, there was not a notably louder sound with the broken eggs than with hose other (15 total) which had no breaks or cracks.
3 – Movements of carapace with each egg: Between eggs each time, the ♀ sat in the resting position; i.e. forelegs out and mostly extended, rear legs partly extended and supporting body as well; plastron not resting on ground at all. The rear of the plastron was about 2-3 cm above the ground at this time and the ♀ was sloping slightly downward from front to . . .

Pg. 105.
. . . rear. Just before each egg emerged from the cloacal opening, and as the ♀ was obviously straining to push the egg out, she relaxed the rear legs slightly and dropped the rear of the plastron smoothly and slowly just so it almost touched the soil surface at the front of the nest cavity. However, just as the egg emerged, she slowly raised the rear of her body back toward the resting position. This resulted, in the case of all 6 eggs, in the egg actually emerging from the cloaca and dropping into the cavity when the cloaca was at or nearly at its resting position. Thus the ♀ did not drop the body in the rear area the 3-4 cm lower which she could have dropped it so that the eggs would be that much closer to the bottom of the nest cavity when they emerged. Yet in 2 nest, of a total of 17 eggs, we have seen, this ♀ lay, she has not yet had even one egg break after it left the cloaca – i.e. by striking nest bottom, rocks, or other eggs. Only 2 breakages occurred somewhere inside the ♀'s body.
4 – Breathing heavily: noted her breathing very heavily during 2 periods – once during entire egg laying period; again during earlier parts of covering – up of nest (see previous notes). Breathing notably rapid and deep during these 2 periods.

Pg. 106.
5 – Movements to spread eggs out in cavity: The eggs were all laid with the cloaca in essentially the same positions. This resulted in them landing each in about the same

place, i.e. about in the center of the nest cavity. Of course as one landed on another they rolled off to the side. After the 6 eggs were laid this finally resulted in 4 in a group on the bottom of the nest, with 2 others on top of these, of course, fitting down into spaces partially, formed by the 4 on the bottom of the nest, all which were flush against other eggs in the same group.
Only 2.5 minutes after last egg was laid, she rose up and inserted right hind leg into nest cavity. This was executed very gently and carefully. The leg was lowered very carefully with nails extended and pointing downward till the nails were about 8-9 cm above the floor of the nest cavity in the center line but slightly behind the very center of the nest and egg mass. Then she very slowly and carefully swept leg forward (keeping it, foot and nails at the same level) so that front side of nails swept gently over tops of upper two eggs, . . .

Pg. 107.
. . .just barely touching them. Then partially lifted foot up and out of hole, returned it to former position and made sweep again. On this sweep she rolled one of 2 upper eggs over and off of lower 4 and onto nest cavity floor in forward part, just beside other 4. Then made one more return of foot and one more sweep. Then changed foot and made two sweeps with left foot. In total she made 5 insertions and 2-3 sweeps with each insertion with each foot. Second egg was moved onto cavity floor, thus achieving stage of all 5 eggs in one layer, sometime during insertion of left leg for second time (failed to record just when). Despite this she made 3 more insertions with each leg and kept keeping movements up even though made no contacts with any eggs during these last 3 insertions of each foot. This entire behavioral sequence is quite incredible and impressive because it is executed so gently and smoothly and carefully with such plundering, elephantine rear feet. In this case (as with nest of 11 eggs she laid last year), it resulted in all eggs being on one level at very bottom of nest. She did this maneuver each year with absolutely no damage being done to eggs and without ever observing . . .

Pg. 108.
. . . what she was accomplishing. This once again points to importance of front foot holds as positioning devices. Also seems to really demonstrate desirability of all eggs being on one level if at all possible – probably related to necessity of making certain all eggs are below level at which heat damage could occur in hot season. Is also possibility that all eggs being on one level increases chance that all will hatch as close together in time as is possible. Raised. [Editorial note: not sure of significance of this last word "Raised"]
6 – First movements in filling in soil into nest:
Transition from egg moving movements to first scraping in of soil not clear at first. After end of 5th insertion and its last sweep with left foot - see section above (5), simply changed feet and in moving right foot as if getting ready to insert it again to move eggs, instead swept it lower than usual and pushed some mud in on top of eggs. Then made 2 sweeps forward as if shill moving or attempting to move eggs as in . . .

Pg. 109.

. . . previous movements. Then changed legs and again brought some soil in with left foot. Did this about 3 times with each foot. Then simply began to fill in as described on Pg. 31 of this volume.
7 – problems in covering nest: Can not be sure that was actually having trouble but length of covering time and fact that ground was getting wet all around original foot rests (making bringing in of additional soil difficult) suggests that she was not having an easy time of it. Also, lost of small surface rocks covering soil all around original foot rest prevented her from getting additional loose soil easily in large quantities to cover mud of hard cap. In fact she never did get much loose soil and nest remained largely the muddy hard cap exposed at surface of soil after she was finished with nest.
8 – Cavity size in relation to number of eggs and their final placement: Cavity was extremely large relative to 6 eggs laid. Clearly could have held about twice that many or even a few more than that, even all on one level, if one assumes the ♀ could have effectively spread them out into one layer covering the floor of nest cavity. Only 2 of the eggs ended up at all covered by the overhang and then they were only about 1/3 . . .

Pg. 110.
. . . covered by the overhang; the rest of them and all the other 4 eggs were in the central nest cavity and not under the flask overhang. From all of this it seems that the ♀ digs the regular, "normal" large sized nest, whether or not she in fact has enough eggs to actually cover its bottom. This point of course needs further verification. Never did get a chance to adequately measure nest cavity dimensions. But my estimates which should be reasonably close were as follows:
Depth of soil surface to center of cavity floor on bottom - 25-28 cm.
Front–back width of cavity on floor - 23-25 cm.
Side-side width of cavity on floor – 20-22 cm.
Underhand of flask in front – about 4-5 cm at deepest.
9 – Summary of stages and time periods:

I. Digging 1724-2135; 4 hrs, 11 minutes.
II. Transition – testing of depth and shape 2135-2140; 5 minutes.
III. Egg laying – 2140-2158; 18 minutes.
IV. Moving of eggs – 2158-2203; 5 minutes.
V. Covering of nest – 2203-0507; 7 hrs, 4 minutes.

Total time – 11 hrs, 43 minutes.

Tremendous exercise and fortitude of ♀♀ is incredible!
10 – Summary of number of days she dug and number of holes:
Four nights (7, 8, 9, 12 August) and 8 holes; 8th one successful one – see notes for these days for details.

Caseta Weather – 1900 hrs – cool and cloudy till 1500 – but no garua; from then till sunset clear, sunny, warm and pleasant, but only off and on – cloudy 2/3's of time. Max 76.0; Min 62.0; Rain 0.3 mm; Evap. 3.1, reading 5.4 ml.
7 September, 1970 –
Working at Caseta all day on notes and weather data.

Caseta Weather – 1900 hrs – cool and cloudy till about 1530; then warm and sunny till sunset. Still clear at 2000 when I retired. Max 75.0; Min 62.0; Rain 1.15 mm; Evap. 1.5 ml, reading 6.9 ml.
8 September, 1970 –
Working at Caseta a bit - am very ill so not accomplishing much. Saw few tortoises in the area of interest today –
#'s 92, 111 – both painted #'s at Caseta Pond #1.
#'s 81, 124 – both painted #'s at Caseta.
#3 ♀ - at Caseta again after a 1.5 day trip to Caseta upper ponds.

Pg. 112.
#'s 98 painted, 13 painted, 81 painted, 101 painted, 2 painted (had 1 tick), 40 painted, #246, #225, #625, #31 ♂ - These all seen by Grossmanns on a walk up to Devine's first banana patch along his central manga. All were seen below the first fence and along manga except for #246, #40 painted, and #225; these latter 3 being just up near Caseta upper ponds. None had ticks except for one on #2 painted.
Caseta Weather – 1900 hrs – rain 0.3 mm; Evap 0.7, reading 7.6; Max 70.0; Min 62.0; cool, cloudy, and semi-rainy all day long.
9 September, 1970 –
To areas to N and NE of El Chato to sample; Grossmanns accompanying me to look for ticks on tortoises.
Enroute –
Saw #246 ♀ just above Caseta on trail; #31 ♂ at junction of Caseta trail and Reserve Border. All other tortoises seen till just before El Chato turn off were same ones seen on 6 September, 1970.
#1270 ♂ - just before El Chato "woods" along Reserve Border. Furthest e tortoise or activity from El Chato area; all of way between Camote patch and this point . . .

Pg. 113.
. . . no tortoise sign or activity at all.
In and around small pond near El Chato turn off –
#54 painted; #57 painted; #58 painted; #159 ♂ (or #59 ♂); #545 ♂; #205 ♂; #653; #1177; #976; #144 ♂; #303 ♂; and one unmarked medium male.
Details of these animals-
**#205 ♂ - surely a duplicate number; CL 134.5; CW 141.9; light flaking disease scattered all over; no lichens; black-green algae in 2 usual areas; W.g.i.'s extremely thin and incomplete. Very noticeable long and flat shape, ever-widening from front to rear, i.e. "wedge-shaped front to rear; scutes all smooth; at pond. Special behavior with finches (see notes below). Painted #141. Ticks present along carapace – skin borders in same regions. Also same along mid-plastral line in concavity. Two ticks on underside of foreleg, 5" from plastron; one tick on underside of neck, 8" from head-neck juncture; all ticks appear to be of common species; collected ticks, snails, insects, spiders, cockroach, grass seeds, and Armadallidium's all on underside of body. Grass seeds were plentiful all over skin of legs and tail and leg pockets.
#57 painted – (repainted) – 1 tick of common type on front plastron-skin junction.

Pg. 114.
#58 painted – (repainted) – common species of tick present in great abundance along plastron-skin junction on rear of animal (20 plus or minus). Only 2 could be found in front area in same locations. No ticks on legs at all but grass seeds plentiful. Also special behavior involving finches (see below for notes).
3159 or 59 ♂ - (probably former number correct) – CL 13.7; CW 145.5. Scutes smooth only in central ¼-1/2 or less; flaking disease light in usual areas and along scute borders on areas where growth rings still present. Black-green algae in usual 2 areas. W.g.i.'s extremely thin. No lichens; at pond in mud wallow.
#545 ♂ - also in mud wallow. Painted #140.
#1177 – grazing near pond; CL 83.1; CW 88.3. Black-green algae on rear and front marginals area – fairly extensive. No lichens; w.g.i.'s extremely thin. Painted #143.
#653 – grazing near pond. Painted #142.
** Finches and tortoises – When first approached pond noted # 205 ♂ standing up on a grassy, low-grazed bank, up on all 4 legs stretched-out fully, with neck and head out to fully extended length and pointing straight up in air at a right angle . . .

Pg. 115.
. . . to body line. Noted 2-3 (varied from moment to moment) Geospiza ~~fortis~~ fuliginosa hoping around on fore and rear legs looking at animal's legs and occasionally pecking something off or at least pecking at some unknown objects. After we arrived this behavior only continued about 1 minute and then animal lowered, turned 90º and started lumbering off l- so not sure what finches were getting and if tortoise originally responded positively to their presence – he certainly was symbiotically aiding them in searches over the skin of his legs by his posture. Not sure if they were even feeding around his neck or head because could not see. Anyway they could have been removing just grass seeds, but also may ticks- or at least even if they only occasionally removed a tick, the posture of the tortoise could be advantageous.
** Then a few minutes later #58 painted was walking along near Pond and 3 of same finch species landed near him. He very quickly rose up on all 4 legs and extended neck fully straight out at a 45º angle and became stationary. Three birds then hoped all about alternately on his legs, neck and ground and noticeably were removing objects from between scales on skin. Could not tell if grass seeds, or ticks, or both (later examination showed virtually no ticks present except in areas where birds could no easily reach). So in this case definitely a positive behavior on part of each species involved – definite probably symbiosis or mutually advantageous behavior.

Pg. 116.
More tortoises in same area, near ponds:
New #1297 ♂ - CL 104.8; CW 111.9. Painted #147. Grazing and basking just W of pond. A lot of black-green algae on rear ¼ of carapace and front marginals area, not elsewhere; flaking disease light, same distribution as algae; no lichens; scutes smooth in central 1/10 – 1/5 or less; w.g.i.'s non-existent. Collected some of black-green algae in FAA preservative; with dry, whitish, flaking disease scute material.
#976 ♀ - CL 68.3; CW 73.5; Painted #145; flaking disease only on marginals in rear on underside and a few spots on front (upper) marginals. Scutes smooth only in very tiny

central parts; black-green algae in 2 usual areas, only a thin coating; not complete. Grazing on yellow-stemmed common vine-like cucubrid (formerly called Echinopioppon).
#144 ♂ - Painted #146; CL 130.3; CW 143.9. Flaking disease, old patches, and new light stuff, scattered all over, but mostly in 2 usual areas; no lichens; black-green algae in 2 usual areas also; scutes smooth all over save for outer 1.5-2.5 inches around border of each scutes. W.g.i.'s clear but rather thin. Moving into pond area from N. Briefly aggressed #205 ♂, but latter offered no resistance and moved . . .

Pg. 117.
. . . away quickly; typical head-up and biting down attempt by #144; #205 did not get head out even; moved away only.
#303 ♂ - CL 134.0; CW 143.7. flaking disease in 2 usual area – scattered in small splotches all over top of carapace; black-green algae in same areas; no lichens; scutes smooth save for outer borders of scutes (1-2.5 inches). W.g.i.'s present but extremely thin and incomplete. Moving into pond from N. Painted #144.
Starting up toward Moreno's.
#948 ♂ - CL 111.6; CW 116.6. Just above pond 75 m distance; basking beside trial. Scutes smooth in central 1/6-1/3 or less; flaking disease and black-green algae in 2 usual area; flaking disease also scattered elsewhere, especially on remaining growth ridges. No lichens; w.g.i.'s non-existent. Painted #148. A lot of common type of ticks on skin of legs and mostly carapace-skin junctures.
#10 ♀ - (see 6 September notes) = has moved some distance from pond area below – 250 m distance plus or minus. Now at about 900 feet elevation, grazing on grass; Painted #149.
Slightly above last animal and out into area where saw so many 2 months ago (painted "#;s in upper 20's and low 30's):
Starting at upper end of this large open area and working downward.
#35 painted – repainted – at upper end (actually where I began last time – open herb fields continue above here to higher altitudes.)
#772 ♂ - CL 130.0; CW 140.6. Extensive flaking disease and black-green algae all over usual 2 areas.

Pg. 118.
No lichens; w.g.i.'s clear but rather thin; scutes smooth only in central 1/15-15 or less; a lot of ticks of typical common type along carapace and plastron junctures with skin. H. Grossmann also collected some of same ticks. Painted #150.
#53 painted – slightly lower down, but in same general, large open area. W.g.i.'s clear and moderately thick. Very little black-green algae on rear and front marginals; no lichens.
#211 ♂ - slightly lower down – basking in an open spot; trail from below coming up to where he is from direction of pond below – Painted #151.
#341 ♂ - CL 143.5; CW 155.0. Slightly more lower down; eating Commelina; small old patch of flaking disease scattered all over; no lichens or obvious algae; black-green algae could exist in 2 usual areas but if so very thin coating and dry. Scutes all smooth; w.g.i.'s clear and moderately thick. Painted #152.

Abundant ticks on body – skin and carapace-plastron junctures; also on legs.

Pg. 119.
#958 ♂ - same general area as previous animal; CL 107.6; CW 119.7. W.g.i.'s very clear and thick; flaking disease and black-green algae scattered in 2 usual areas; scutes smooth only in central 1/15-1/5 or less. No lichens; grazing on Commelina.
See end of day for comments on these animals and this area. Now on up toward Moreno's and higher elevations.
#608 ♂ - at about 1000 feet altitude – basking in open – has been here some time grazing on Commelina; lots of turds and eaten out areas. CL 102.3; CW 112.3.
#142 ♂ - CL 107.3 (for checking purposes) – same area; basking in open. A lot of activity in this area for past 2-4 weeks and certainly was not here in late June and on last trip here. Abundant ticks – on skin-plastron and carapace junctures. See end of day for further comments.
More sign – one animal, at 1050 feet altitude.
More sign – 2 animals, at 1100 feet altitude.
At 1120 feet altitude –
#621 ♂ - CL 111.0; CW 116.5. W.g.i.'s clear and thick. Has been up here awhile; large areas at 1100 feet of eaten out Commelina and other herbs; lots of turds from past 3-4 weeks. He has been here awhile. Trail from today leads from these areas at 1100 feet to this male. Scattered flaking disease all over, Black-green algae in 2 usual areas; no lichens – scutes smooth only in Central 1/15-1/5 or less.

Pg. 120.
One tick of common type on rear left leg; no others could be found. Painted #153.
This entire area to NE and N of El Chato is very interesting. It was rather lush on my last visit here but has become incredibly more wet, moist, and lush in the past 2 months. The dominant herbs before were Passiflora, Commelina, and the common cucurbid. These are still very prevalent and growing all over the place at heights of 1.5 – 3 or occasionally even 4 dm high now. But many other herbs have now grown up and in some places are both higher and more prevalent than the common 3 herbs. These are plants like Tournefortia and the common Solanum. Of course many, many other herbs are all over the place. Too. These latter large herbs are mostly 8-10 dm high at minimum everywhere and are even reaching 1.5 m in many places. The lower growing herbs and mora-herb mixtures are still the dominants in terms of . . .

Pg. 121.
. . .total area covered.
There are still many of same animals scattered all over these areas and it appears that the density has even increased in the area as a whole.
In the areas where I painted #'s 21-36 in my last visit (essentially the whole sample area) I have seen very, very few of these animals. But since they do not appear to be at El Chato or any lower areas I suspect all of these, or nearly all of them, are still at these higher altitudes; some probably have moved to W and E beyond my sample areas.

#21 painted is apparently up at about 1100 feet altitude, because 2 Moreno boys said they saw him this morning grazing there near the trail – I did not see him but is some recent grazing there so probably some of it is due to him.
Another sign that population has generally moved upwards with new animals filling in over areas below (and some even going up to highest areas where animals all located also) is that area between 1000 and 1100 feet along trail has lots of recent turds, burrows, and grazing (past 2-3 weeks to present). So looks as if plenty of tortoises all over.

Pg. 122.
. . . these open fields up to 1100 –1150 feet altitude.
Collected a number of things from tortoises' shells today – all labeled and preserved. – From #205 ♂ - snails, ticks, seeds, etc. See pg 113 – 70% ethanol.
Cattle – ticks from 1 cow at 1300 feet altitude on Moreno's farm – 70% ethanol. Ticks from a cow at Bud Devine's also – 70% ethanol. Black-green type algae, on flaking white pieces of scutes material; from 2 animals; all in FAA; all material from rear portion of dorsal surface of the carapace. #545 ♂; #1297 ♂.
Tick distribution seems rather interesting based on observations today and on 9 September. Very few on only some animals in El Chato area; yet just above Chato along Reserve Border lots of ticks present; then on up toward Moreno's farm situation about same as at El Chato. Puzzling thing is we could not find any ticks on animals (tortoises) around Caseta at all nor along Reserve Border till we reached Camote patch; from Camote site to El Chato turn off ticks became more common. Ticks on cattle seem different from the 1 type seen on tortoises. Caseta Weather – 1900 hrs – cool, cloudy and rainy till 10000; then same but no rain till 1300; then sunny till sunset. Max 74.0; Min 63.0; Rain 2.45 mm; Evap 1.7, reading 9.3.

Pg. 123.
10 September 1970 – Up Bud Devine's central manga checking tortoises; will pick up Caseta upper pond area this afternoon or tomorrow.
#97 painted – just at small forest patch which enters into Caseta upper ponds area; grazing on pangola.
#98 painted – 75 m past Caseta upper Pond area – in pangola grazing; appears to be moving down toward ponds; repainted. W.g.i.'s nice and moderately thick. Paint OK but wearing a bit.
Just above where #98 painted was, there are several trails leading off to E into mora-herb mixture; rather extensive eaten out areas are present all along pangola-herb-mora interface and on out into herbs which are in and around and under mora. At least one animal headed of ENE toward Devine's eastern manga from here – can't follow – trail take off for over 100 m and mora gets too abundant to move easily through it. Anyway, point is that animals are working extensively along pangola-herb border, and eating herbs (Commelina, cucurbid, passion flower, others almost exclusively; very little eating of pangola grass.
#2 painted – 75 m further up manga. Examined for ticks; could not find any. Grazing on herbs; w.g.i.'s clear but rather very thin.
Bud Devine has now run an additional 6 little mangas, about 1 m wide each and 4 m apart down just to W of . . .

Pg. 124.
. . . central manga – looked like tortoises might move to these from central one so I went across them midway up to first fence is a place where I could look up and down them nearly their full lengths. In first one there only was a bit of tortoise sign, and at an altitude of about 820-840 feet found #91 painted. W.g.i.'s present but extremely thin; basking in sun. Back to central manga at same altitude – just above #2 painted (#91 painted is just above #2 painted a short distance).
#101 painted – another 75 m distance up manga; basking; w.g.i.'s present but extremely thin.
#482 ♂ - CL 116.4; CW 128.3. W.g.i.'s clear and thick; scutes smooth completely only in tiny central parts, but very worn nevertheless; notable lack of flaking disease for an animal of this size, this certainly being the major cause of the lack of greater scute smoothness; only a few tiny patches of flaking disease on last costals and last vertebral. No lichens or definitely identifiable algae. Some dry "scum" in a light covering on rear and front marginal area but doubt it is . . .

Pg. 125.
. . . black-green algae because if it were I would expect more greenish color and definite development because of extensive nightly garua for past 3-4 nights and mornings. Grazing and basking just 75 m below first fence on manga. Trail leading to this beast clear for past 100 m up manga.
Took some photos as example of lack of flaking disease and consequent slower "abrasive" smoothening of carapace. Roll 175, #'s 11-15. Examined for ticks; could not find any. Painted #154.
#84 painted – just on other side of first fence a few feet. Basking out in open grassy field. W.g.i.'s clear but very thin; no obvious algae or lichens; Examined for ticks; none could be found.
To this point on last visit, about 1 month ago, saw #'s (painted all): #2, 12, 14, 84, 97, 98, 99, 100, 101, 102, 103. Of these, as is obvious above, have found only #'s painted 2, 97, 98, 101, and 84. Location of #99 is known (see end of day's notes) and 103 was seen above this area later than day painted. But still do not know whereabouts of #'s 12, 14, 100, 102. Below here saw extensive signs of grazing for past month all along manga up to hill where #482 ♂ was encountered. Almost exclusively feeding along and away from to E and W) herb and mora – pangola interface – virtually all grazing done on herbs; pangola matted down a bit here and there from movements, but very . . .

Pg. 126.
. . . little; most movement also along interface in herbs. In 3 locations more (higher up but all over 100 m below first fence) found fresh sign where tortoises had been grazing off to E of manga out into mixture of mora and herbs (this is 3 more locations in addition to that mentioned on pg. 123). Tortoises grazed well out into mora for past 3 months all along manga up to nearly first fence; and then are extensive patches of introduced beans and other herbs (Passiflora, Commelina, cucurbid) all over what was mostly mora last year at this time. Then, in addition, found 3 paths (fresh) leading off to E from these areas of previous grazing. This would account for at least 3 additional animals at these

altitudes which are now out in herb-mora fields between central and eastern mangas of Devine. If so, then could be 3 of those seen 1 month ago. These 3 paths are only a few days old and widely separated, so definitely seem to be 33 different animals; none of the paths returns to the central manga.

Pg. 127.
Of course some of the animals seen last month could have moved further to N or NE on Devine's land or seven have returned to Caseta area (as has #99 painted).
Just spotted two more:
#14 painted – no lichens or algae; w.g.i.'s clear but very, very thin. Grazing on Commelina. Up from position 1 month ago.
Tortoise movement - #38 painted – (all way from Zone 3 Nesting Area) – same carapace conditions as previous animal; both without ticks; repainted #38. both basking just E 25 m from #84 painted.
Saw some animals down near fence corner at upper end of eastern manga so will search that area now-
#45 painted – no lichens or algae; w.g.i.'s very, very thin; moving W along fence line at altitude just below banana patch – more or less half way between 2 mangas. Up from Upper Ponds!
#100 painted – just E of where #110 painted was last month; out in extensive Commelina field just above first fence and 20 m E of Devine's fence on Paisan Herrera's land. Grazing. W.g.i.'s very thin.
Both #100 and #102 (animal recorded below) up from central manga altitudes of 1 month ago.
#102 painted – just 40-50 m further N of where #100 painted is: also on E side of Devine's fence line but only by a few feet; grazing on Commelina also. These 2 animals have cleared out extensive area of herbs and really mashed down a lot of mora in these areas in past 2-3 weeks; eaten areas and turds indicate they have been here for awhile. Repainted; a lot of mora scratchings on carapace and has chipped off paint W.g.i.'s rather thin.

Pg. 128.
Two photos of #102 painted in mora where she has destroyed some of it – Roll 175- #'s 16 and 17.
#123 ♀ - same area as last 2, but on Devine's land; this is same small ♀ which was at Caseta upper Ponds about 1.5-2 months ago. Also eating Commelina, and destroying mora by crushing it in the process. Most have moved up a manga (probably eastern one) to get here or via Guerrero's land because very few mora scratches on carapace. W.g.i.'s clear but rather thin. No lichens, but black-green algae on rear 1/5. Painted #155.
Went on up eastern manga extension to level of house (Devine's) but no more tortoises or any sign at all above the last group of animals, above. So swung back down to upper end of banana patch and came up central pathway of land, i.e. NNE of central manga to house. No sign at all till about 30-40 feet altitude above upper end of bananas, then:
#104 painted – grazing on herbs (mostly Commelina) – w.g.i.'s clear and thick; black-green algae on rear ¼ of shell . . .

Pg. 129.
. . . is prominent. No ticks at all that I could find. It was at Maternidad Pond 3 weeks plus or minus ago then has come down to SE about 100-125 feet in elevation and about ½ km distance. Bud said was in that area 3-4 weeks ago (see previous notes) No ticks found on it at all.
Saw a few fresh droppings about 50 m N of #104 painted – within his size range and toward Maternidad Pond so could be from him.
Rest of way up to house saw no more animals and no sign at all.
Bud Devine saw a number of painted animals in past week or so:
#104 and #103 – near where I saw #104 today.
#45 – in area to E of his old eastern line – now called Potrero J – (i.e. where 3100 and 3102 were today).
#38 – in central manga (more or less ½ way up) below first fence.
Two unmarked ones same day in same area as #38 (perhaps 1 #48l2 ♂ from today)
One unmarked one in area where #100 and #102 were (probably #123 from today).

Neither Bud Devine or Bulmar have seen any tortoises around house or above it at all recently. Apparently highest known tortoise on the land was #104 painted when it was at Maternidad Pond.
The most impressive thing on his land is that whereas 1 month ago herb forage was super-abundant for tortoises, it is now even more abundant. At that . . .

Pg. 130.
. . .time the herbs were about 1-4 dm high everywhere in the most open areas and even reached 4-10 dm in some shady more protected areas. Now they are about 3 or 4 – 10 dm everywhere in the open areas, occasionally even getting to 1.5-2 m in open places (certain plants especially, like a certain Solanum.) In other more protected areas, such as the banana patch, many herbs are up to 2 and 2.5 m height. Of course in these areas the dominant height of certain low growing species like Commelina and Passiflora is only 3-5 dm. Since the herbs are very mixed it is difficult to describe any one area – There are tall growing plants like Solanum, Tournefortia, Psychotria, and others, and the lowest growing forms like grasses, Passiflora, Commelina and the common cucurbid. Anyway, the main point is that the vegetation all over above the Reserve Border is lush and super-abundant; the tortoises are hardly making a noticeable dent in it, it is so abundant. They clearly prefer the herb Commelina to almost . . .

Pg. 131.
. . . any other plant although I saw them eating several grass species (including pangola), Commelina, Passiflora, Tournefortia, the cucurbid, the Solanum, and many additional species.
Of course as one goes upwards in altitude from the Reserve Border, there are noticeable changes in the amount of vegetation , it becoming generally more lush and dense as one gets higher up where it is and has been more moist for the past 3 months, But it is lush all over above the Reserve Border (as well as below the Reserve Border for some distance now).
Henning Grossmann saw several animals in an area a couple hundred meters due E of Caseta on 8 September 1970:

#11 painted; #99 painted; #2 ♀ small (wrong # - I saw this same animal at Caseta pond #4 recently).
** I collected and preserved some ticks from Devine's cattle.
11 September, 1970 –
Continuing on Devine's and Caseta Upper Ponds –
Upper Ponds first:
Field below ponds - #31 ♂ - basking.
#40 painted – eating herbs.
#1021 – eating herbs; w.g.i.'s clear and thick! CL 82.1 (for checking against 3) – tail intermediate in length; probably ♂. Painted #156.
#712 ♂ - CL 103.8; CW 112.6. Basking. No flaking disease! Scutes smooth only in central 1/20 or less, but worn somewhat. No lichens; black-green algae present in abundance in 2 usual areas.

Pg. 132.
Painted #157. No ticks at all that I could find.
At ponds area:
#86 painted – repainted; w.g.i.'s clear but extremely thin; grazing. Eastern Pond.
#117 painted – Pond #2 – Western edge; repainted; w.g.i.'s clear and moderately thick.
#40 ♂ - CL 125.7; CW 124.3; last saw him near Caseta Pond #1 in April! W.g.i.'s now clear and medium thick; extensive flaking disease on rear 1/5 of carapace, front marginals area, and spots along both sides and here and there on top. Scutes smooth only in central 1/15 or less. A good example of flaking disease just under way. No lichens; black-green algae in 2 normal areas; Grazing on grass in Pond #2's bed. Painted #158. Rear marginal scutes upturned noticeably. Took a number of photos, Roll 176, #'s 1-6 to show extent of flaking disease and marginal flaring.
Starting up Devine's eastern manga –
#96 painted – just at "beginning" of manga beside upper pond's eastern side; w.g.i.'s incomplete and extremely thin. Repainted. Grazing on herbs.

Pg. 133.
#123 painted. W.g.i.'s clear and moderately thick; no lichens. 100 m NE of ponds on manga. Looks as if got here from E via forest on Guerrero's land; trail comes in from there. Definitely did not come up manga. Sign indicates probably only here a maximum of a few days.
#867 ♂ - another 100 m NE distance; on manga. Has been here awhile as there are many trails around in 1-2 m high herbs. Eating herbs. CL 106.8; CW 114.7. Scutes smooth only in tiny central parts, but very worn carapace beyond these areas; but growth rings still visible. Only a few small fresh patches of flaking disease on rear area and one patch on 3rd right front marginal. No lichens; black-green algae in 2 usual areas; w.g.i.'s clear but very thin. Difficult now to guess how he got here but was not by manga itself.
Painted #159. Could not find any ticks on this animal.
Clear sign of at least 3 and perhaps 4 more animals:
One going off into forest to E onto Guerrero's (and a fresh trail (from yesterday probably).
Between animals #123 painted and #867 ♂.

Two going off into mora-herb mixture to W – also fresh trails – 1-2 days old at most. One only 50 m further up manga from #867; the other another 50 m beyond the first.
Then at level where I saw #919 ♀ on last trip here – 1 month ago more or less:
Some sign and turds of 1-2 weeks age. All over manga.
Just beyond this, near manga but a bit E of it –
#368 ♀ - am rather sure she was only 75 – 100 m N of here near Devine's eastern fence and corner (on manga) 1 . . .

Pg. 134.
Month ago. Has been where she is now for 1-2 weeks at least because several nice burrows, lots of turds, and hug eaten out areas of Commelina. Apparently has been grazing here for some time. W.g.i.'s well developed but not thick – rather thin in fact. Painted #160.
3919 ♀ (#108 painted) – in exact same place she was 1 month ago! Abundant trails around her where she has been eating herbs and moving. Repainted.
#570 ♀ - CL 97.5; CW 111.0. Same general area as previous 2 animals; about 25 m E of manga. Very domed; extremely short body. Scutes smooth only in very central 1/20 or less; no flaking disease, lichens; black-green algae light in 2 usual area; w.g.i.'s clear but incomplete here and there and very thin. No ticks could be found on her. Painted #161.
Went on over to E of Devine's eastern line at about 900 feet altitude (straight to E). This is lower end of Remegio Barrera's land but Bud Devine has recently purchased it. Saw tortoise turds of 1-2 weeks age several places along this route. Also some trails and eaten out patches. Then reached house of Sr. Marcos which lies at about 860 feet altitude more or less and is surrounded by . .

Pg. 135.
. . . fields of herbs and herb-mora mixture. To S is northward extension of Scalesia forest from Caseta upper ponds – about 250-300 m more or less from Devine's old eastern line and just 50 m from Marco's house, to S of it:
#336 ♂ - in that location – abundant trails, turds, burrow all around him where has been eating and living for at least past few weeks. CL 106.5; CW 117.3. Scattered flaking disease on front marginals and rear area of carapace. Black-green algae in usual area; scutes smooth only in central 1/15 or less – not surprising because flaking disease so light; no lichens. W.g.i.'s clear and very thick. Painted #162.
Near Marco's house (50 m SW) is an open area of very flat surface rocks of large size ~ 1 – several sq meters each in a low, shallow depression – must be a temporary pond after heavy rains; then found a much deeper and larger depression, about 250 m SW of house, just 40 m N of edge of Scalesia forest; obviously will be sizable pond (20 x 40 m more or less) after extensive heavy rains. Now full tall, lush herbs. All this area is still open, covered with lush, abundant herbs. [Marginal note: one trail (fresh) of a smallish (circa 70-80 cm CL) animal just 35-40 m E of #336 ♂.] There is tortoise sign scattered here and there all through it, not much beyond . . .

Pg. 136.
. . . house but fairly abundant reasonably fresh (1-2 weeks or less time ago) all over fields between house and forest to S. Also not much to E toward Guerrero's land and house.

Looks as if tortoises may be coming up into this pond area from and through Scalesia forest below. Wend down near Scalesia forest- jackpot - 250 m SSW of house. In forest about 50 m found #48 painted – repainted. Extensive trails, burrows, eaten area all around him. Has certainly been in this area for some days or even 1-2 weeks plus. Then in open field on forest's border found 3 more animals= 70 m NW of #48 painted and about 250 m SW of house; also about 250 m NE of where saw 3919 ♀ this a.m.: Altitude here about 850 feet plus or minus.
#44 painted; #89 painted – repainted both of them.
#136 ♂ - (short, fat, thick tail, but certainly a ♂); CL 105.2; CW 117.9. Have seen sometime during past few months in Caseta area, am sure.

Pg. 137.
W.g.i.'s clear, thick, and very well developed. Scutes smooth only in central 1/15 or less; flaking disease not extensive but good bit on last 2 costals of each side, 5th vertebral and front marginal area; no lichens; black-green algae in 2 usual areas. Painted #163.
These animals all grazing on lush herbs. Clear that some if not all of the 5 found in this area so far have been here for some days and probably weeks; are turds of up to several weeks age, lots of fresh trails, lots of eaten out areas – both in open fields and into Scalesia forest – field border zone for some dozens of meters; lots of fresh soil burrows also. None have many if any scratches so have not gotten here through mora!
All (except perhaps #336 ♂) are from Caseta area of recent sightings 1-1.5 months. It is probable that come to this area because it is an old grazing area and has the ponds mentioned above. Would be interesting to know route. From few trails I have seen running out into Scalesia forest from Caseta Upper Ponds and Devine's eastern manga I would guess they are moving to NE and NNE from those areas and altitudes. This however remains to be see; I will try to trace their routes back to Caseta area this afternoon. One thing is clear, these beasts, #919 ♀, and certainly others (i.e. 45 painted; 109 painted; 110 painted; 160 painted; 161 painted) did not get up here via Devine's . . .

Pg. 138.
. . . eastern manga and then walk directly E to present locations. There is simply not and has not been sign along it indicating animals move up it to any extent at all. The cross it and use it for short distances, but mainly they have been moving up in altitude via Scalesia forest E of Caseta Upper Ponds, Devine's central manga, and the mixed mora-herb area between Devine's central and eastern mangas.
There are probably a few scattered tortoises even above Marco's house and on up onto Remegio Barrera's land. Plenty of fields of herbs and scattered bits of Scalesia forest on up that way.
Went down a new manga Devine just put in which lies about 1/3 km e of what I have been and will continue to call his eastern manga. This has just been put in so tortoises mentioned above could not have used it. However, seemed worthwhile to see if I could find tortoise paths crossing it, since this would . . .

Pg. 139.
. . . then indicate a possible line of movement to the pond and large fields where #44 painted, #89 painted, #48 painted, etc. now are located.

#136 ♂ is only 10 m from manga to its east and #'s 44 painted and 89 painted just a bit further (25 m). But sign of tortoises was limited to within a stretch of about 30 m in vicinity of #136 ♂. Appears that these few turds of 1-2 weeks age could have been all left by one tortoise moving N in the area. Since this manga is but a few days old and freshly cut, it would suggest that one animal moved up from below along this line for at least a few hundred feet before the manga was there. This is logical as it (the sign) is on a line running roughly toward Caseta Upper Ponds area below, via the Scalesia forest. Went up to Juan Guerrero's house but no none home – saw no sign of tortoise along the way save for one old burrow site of several weeks' age. None around his house. Then cam back down, and continued on Juan's trail toward Caseta Upper Ponds on other side of new manga. In Scalesia forest almost all way to Caseta Upper Ponds from just below Juan's house; very dense and lush all through it. Herbs ½ to 1 m high almost everywhere, lianas, epiphytes, fungi- green, lush, moist, and . . .

Pg. 140.
. . . lovely.
#775 ♀ - first tortoise seen – to side of trail just beyond new manga about 20 m. has been here a short while – trails, turds, grazed areas. Is in forest proper of about 75-85% canopy closure; feasting on Commelina and other lush herbs. She is from Caseta Upper Pond Area. Painted #164.
Between #164 painted and Caseta Upper Ponds. Saw fresh trails of at least 3 more animals – could distinguish by size and from #475 ♀ by location, and some old trails as well – all but one going up through Scalesia forest to NE or ENE. Certainly good evidence that his is a pathway to area around Marco's house.
** Also! #158 painted (from Caseta Pond #2) about 450 –500 feet straight line distance from where marked this a.m. = in Scalesia forest moving along trail more or less. Sometimes on trail, sometimes off of it – to NE toward Marco's. Quite a move since about 1000 this a.m. (now 1545) considering real distance moved is more than straight line one by 50 –75% because of circuitous route; also is grazing along the way extensively!

Pg. 141.
This adds to the evidence that his forest is a pathway to higher altitudes. Probable that many of animals seen along Devine's eastern manga actually first go up through forest and then over to W to the manga through mixed herb-mora fields.
At Caseta today several animals passed by:
#246 ♀ was around all day and then left.
#31 ♂ - came down drainage and is now (1615) burrowing in by weather instruments.
#115 painted – Came up drainage and into tent area from small manzanillo ponds to W a short ways. All way up from well below Zone 3 NA.
#276 – was at small manzanillo pond just W of tent – came by tents, then turned S and is now heading down toward pond #1 along our trail.
#98 painted – passed by also – went off into fields and Scalesia forest E of the Caseta.
On 9 September Jan saw 2 other animals here –
#246 ♀ came into the area from Caseta Upper Ponds area via our trail.
#695 – passed by but Jan does not know in what direction left area.

#81 painted – passed by and headed off toward pond down trail later same day.
** Nesting – It is of interest that some ♀♀ of smaller size, such as #475 ♀ are well up in highlands and seem to be showing no signs of going down to nest. This is . . .

Pg. 142.
. . . true despite the fact that we have seen a number of ♀♀ of this size copulated with, or at least the ♂♂ try to mate with them. Yet only the oldest, largest, all smooth-shelled ♀♀ are down nesting or at least they are they only ones we have seen nest. Along these lines it is of interest that I have found no large ♀♀ of this latter size and type in highest area to which population extends since nesting season began. Highest up largest females seem to be is Caseta and El Chato altitudes and lower down.
Caseta Weather – 1900 hrs – Cool and cloudy till 1430, then a bit of sun of and on till 1600, then cool and cloudy again till dark. No garua last night or today, so rain below is from yesterday. Was sunny yesterday from 0900 on so highest temperature recorded below certainly from then and not today; not same for low – low certainly from last night because clear last night till early morning hours and cloudy right before. Max 77.5; Min 60.5; Rain 1.55 mm; Evap 4.8 ml, reading 14.1.

Pg. 143.
Dead Tortoise – Also, Bud Devine saw a slaughtered tortoise only 40 m SSW of Marco's house, very near where I saw #336 first today. He saw this fairly recently but will have to get exact date from him later. He said legs were missing completely and had been burned and covered with some brush. Had been cut into via plastron as is usually the case. He could not see any sign of white paint on it. I found site but someone had returned and removed the animal; did however find one partly burned marginal scutes as evidence. Looks like scutes from front border of a rear leg pocket. Anyway probably another murder by Remigio or Daniel Barrera. Must have been a large (130 cm CL plus or minus) ♂ - judged size from scute found.
12 September, 1970 –
Back to Devine's to finish looking over regular sample areas.
For in-forest went up his western most manga with is now lush herbs up to waist height all the way up. Saw only a few tortoises low down on it. If others are using it are doing so only at very upper ends beyond first fence – no recent (past 2-3 months) sign above those mentioned below till I got to banana patch.
#7 painted – on Reserve Border at entrance to manga, but grazing on grass of Reserve Border – does not look as if will use manga soon
#43 painted – 20 m up manga – eating herbs.
#608 ♂ - (duplicate number) – CL 103.1; CW 108.0 – 400 feet up manga from #43 painted. In between 2 abundant recent (2-3 weeks max.) sign – probably all from #608 as was working. . .

Pg. 144.
. . . up the manga because no sign at all above him.
Banana patch area –

#106 painted on its western border; 2/3 way up it; grazing on herbs – fresh trails show he has been in it recently (yesterday and before) grazing extensively. W.g.i.'s clear but rather thin.
#627 ♂ - Eureka! Have not seen since June just above to NE 150 m from where now is – on eastern side in center of whole patch – grazing in 1.5 m high herbs – eating banana leaves and common Solanum. Painted #165. W.g.i.'s clear and moderately thick. Slight black-green algae in 2 usual areas, especially concentrated on front and rear marginals' inner borders.
#782 – on central pathway just above middle level of banana patch – i.e. very near #627. have not seen this one for several months also. But like #627 was apparently here all along. Just came out of bananas as I can see trail easily. W.g.i.'s clear but very thin Painted #166.
#107 painted – in banana patch, precisely in same area where last saw on 2 day sample . . .

Pg. 145.
. . . about 1 month ago.
Plenty of tortoise trails, burrows, and turds of past 1-2 weeks all through banana patch, but hard to tell if many more than I saw there today because herbs are 1-2 m and more tall all through the area near. Probable that may be another 1-2 animals somewhere in it. Continued on up western side of Devine's land as usual to Maternidad area. But saw no sign of tortoises once I got much above altitude of upper end of bananas – i.e. above area where saw #'s 104 and #105, both painted, 1 month ago (#'s 305 ♂ and 1072 ♂)
So have accounted for all but #1 ♂ and painted #''s 105, 109, and 110, of all those seen on past 3 samples on Devine's land. Virtually all other animals which were on his land before (past 3 samples) are still there save for some which were on central manga near Caseta Upper Ponds, and some new ones are up on his land. Quite probable thus that the 4 "missing" ones are still up at these altitudes (950-1100 feet) and on Devine's land on one of adjacent farms on either side.
Then went directly to WNW over across land of old man Barrera to check on tortoises – at an . . .

Pg. 146.
Altitude of about 950 feet, i.e. center of Devine's banana patch. Went W till I hit N-S running manga of Barrera which I followed up a couple of months ago from just before Right turn area- Camote Patch on Reserve Border. Then went down it to Reserve Border and returned to Caseta. Did not sample this area- just a straight walk, so should not regard this as nearly as complete a count as I did through this area on previous trip. Saw a number of animals –
#58 ♂ - and #167 ♂ - both in an area about 250 feet W of Devine's western line. Former was abut 200 m due W of here grazing in Commelina on previous trip. Is doing same now in this new area. Lot of sign from past 2 weeks when he is so has been eating and moving abut in this immediate area for some time – lots of turds and hundreds of square feet of eaten out Commelina. All this area I've . . .

Pg. 147.

. . . crossed this afternoon is open fields of Commelina, Passiflora or other herbs with extensive amounts of mora scattered through it in patches.
#167 – coming at a barreling pace, due E, down a long 20º sloped hill, all the way crunching through fairly heavy mora with intermixed herbs. He already went up NE from just before right turn area and then is moving E. #58 ♂ appears to have done same basic thing over the past few months, but clearly has been spending weeks at a time in one area grazing, then moving some and repeating process. #167 ♂ is traveling a hell of a lot more than #58 ♂.
Then to W more – at about 1000 feet. Altitude (but same direction) – is up and on other side of a large rise from previous 2 animals- 200 m away more or less. Same general area where #58 ♂ was on past trip. #71 ♂ - also extensive moving and grazing on Commelina and Passiflora in his area.
Lots of tortoise grazing, turds, burrows, trials from recent few days and up to 2-4 weeks ago all over these areas at this altitude. Very extensive fields of herbs and sign is not concentrated – scattered all over; thus probably quite a few more animals scattered all over these fields between 1000 feet (and maybe higher up) and . . .

Pg. 148.
. . . down to the Camote patch, right turn area and even over toward the Caseta through the scattered fields of herbs which are mixed throughout the mora.
#1176 – CL 83.6; CW 90.3 – at 950 feet – on manga enroute to Reserve Border. Extensive severe flaking disease and a lot of thick black-green algae all over 2 usual areas; w.g.i.'s clear and moderately thick. Trail coming directly where this one is from E through herb fields. Painted #167.
Scattered tortoise sign continues through fields of herbs all way down to right turn area. Will have to more carefully sample this area in coming month.
Went to Caseta Pond #1 late this afternoon to look for goats. While there found several tortoises in this area: painted #'s 4, 111, 9 (up from Region 4!) 134, 49.
** Saw #134 painted (#125 ♂) just below zone 3 NA on 24 August, 1970!
Caseta Weather – 1900 hrs – Cool and cloudy all day; no sun but only a little garua in morning. Rain 1.0 mm; Evap. 0.9, reading 15.0; Max 74.5; Min 63.5.

Pg. 149.
13 September, 1970 – At Caseta working today-
Caseta Weather – 1900 hrs. – cool and cloudy all day; considerable garua off and on during morning and from 1630 on. Dry but cool and no sun all afternoon; Rain 2.85 mm; Evap 0.4 , reading 15.4; Max 73.0; Min 62.0.
14 September, 1970 – To part of area above El Chato, El Chato, Zone 5, Cerrito, nesting area etc. Enroute to El Chato turn-off – saw a lot of same animals seen on 6 and 9 September to this point. Only comments worth making - #7 painted is just where I saw him last on 12 September. Jan says he came through Caseta area via drainage on 9 September – thus has returned to this area rather promptly(via same route, because have not seen sign of an animal his size along trail and Reserve Border from Caseta to his location.
#50 painted – half way between first hill and little forest below Caseta Upper Ponds – thus moving E.

#1013 – at forest border with mora just above Caseta on Reserve Border.
#43 painted – at top first hill – did not go up Devine's eastern manga.
#97 painted – has moved back onto Devine's central manga from Reserve Border.
#15 painted and #450 – same area where last saw them.
Near El Chato turn off – will search around in area of small woods just south of pond, and in one area . . .

Pg. 150.
. . . just E of pond where I normally look for animals; then to area above small pond in direction of Mirador – i.e. where I did not look on 9th (September). This will complete the above El Chato sample.
First area S of pond in forest along Reserve Border –
#144 painted
#54 painted – grazing along Reserve Border – just out of burrow at 0830.
#13 ♀ - CL 93.8; CW 100.3; extensive flaking disease in 2 usual area; black-green algae scattered in same 2 areas, but concentrated only on front and rear marginals; w.g.i.'s clear but rather thin. Is this ♀ a duplicate to one seen here last year and later on Reserve Border near Caseta Upper Ponds? Burrowed in still at 0915 – took 2 photos, Roll 178, #'s 1-2. Cold and rainy all night ands still so – wind too. Painted #168.
In area to E –
#52 painted – clear, medium thickness, well developed w.g.i.'s; Repainted because chipping.
At small pond –
#57 painted; #142 painted – up in very extended posture as was #205 ♂ other day – letting finches clean forelegs- only finches around were G. fortis – I got three at end of this behavior. Finches near him in front, on ground; but I did not actually see any cleaning.

Pg. 151.
#600 ♂ - CL 116.5; CW 130.0. 200 m NW of pond; extensive grazing activity, and turds from past 1-2 weeks too, present all over field of herbs where he is now moving about. Almost no flaking disease anywhere – one spot on a rear marginal and one on a front marginal; scutes smooth in central ¼-1/3 plus or minus of their area, nevertheless; old sign of flaking disease in center of 2nd and 3rd vertebrals. W.g.i.'s extremely thin. No lichens; small amounts of black-green algae on rear marginals. Painted #169.
#177 ♂ - CL 105.0; CW 110.8. Just 3o m further N; same general area. Eating Commelina in open. This entire area shows lots of activity for weeks and even 2-3 months past. Extensive flaking disease and thick black-green algae on front and rear marginals. Extra flaking disease on rear ¼ of carapace in general and scattered along growth ring lines elsewhere. Painted #170. No lichens; scutes smooth in central 1/8-1/4 or less; w.g.i.'s clear but rather thin. Re-cut marks because becoming faint.
#617 ♀ - CL 85.7; CW 89.6. slightly higher up – 20 feet altitude; on Xanthoxylum forest, open herb field border; sitting beside burrow at 1045. On edge of large open field wherein I usually find 2-5 animals in garua season – i.e. near new corn patch (on last samples notes). No lichens; extensive flaking disease and black-green algae on rear 1/5 of

carapace and front marginals area. W.g.i.'s clear and moderately thick. Scutes smooth only in central 1/15-1/6 or less. Painted #171.

Pg. 152.
In this large open field:
#28 painted – repainted; w.g.i.'s clear but very thin; grazing on grass and Commelina.
#146 painted – already here – grazing.
#83 ♂ - CCL 117.0; CW 135.7. Extensive flaking disease all over rear 1/3 of carapace and front marginals. Black-green algae in same areas, but concentrated mostly on marginals only. W.g.i.'s clear but rather thin. Scutes smooth only in central 1/10-1/5 or less. No lichens. Painted #172. Not very active - at 1100 still basking beside last night's burrow.
#78 ♂ - CL 141.0; CW 151.5. Flaking disease and black-green algae scattered all over 2 usual areas; latter especially along scute junctures; no lichen; completely smooth scutes; w.g.i.'s extremely thin; Painted #173. Grazing on Commelina.
#671 ♂ (probably) – CL 89.1; CW 98.0. Sex hard to determine; probably ♂, but tail very short and stubby – but thick at base and stubby part at end – more so than on largest females. No flaking disease, no lichens; black0green algae scattered on rear marginals area; w.g.i.'s clear and well –developed but rather thin. Scutes vary in smoothness – most hardly at all, max about 1/10 (central vertebrals). Grazing on Commelina. Painted #174.
In open fields, 100 m and 25 feet altitude above last area –
#56 painted – w.g.i.'s clear and thick; repainted.
#16 painted – w.g.i.'s clear but thin; repainted. Both basking.
Both in areas of extensive eaten-out Commelina. This area is only 200 m more or less from base of Mirador; am now going to search all over these fields – many, many hectares –
#139 painted and #703 ♀ (from El Chato!) - together 40 m N of last 2 animals; both grazing on grass.
#139 painted – is about 700-800 m N of small pond where painted him on 9 September.
#703 ♀ - w.g.i.'s clear and moderately thick. Black-green algae thick on rear 1/6 of carapace. CL 86.8 – to check. Painted #175.
#149 painted – has moved about 75 m w from where last saw on trail.
#33 painted – at about 975 feet altitude – just W of 1000 feet mark on trail about 100 m. Has w.g.i.'s of good development but very thin. Sleeping in an open area in general Xanthoxylum forest.
To trail at 100 feet – searched this area more thoroughly today than on 9 September, - but no more seen – 2 trails lead way off to E into mora and can not follow them-
#150 painted – up here already1
#608 ♂ - here other day. Painted #176.
#1241 – moving up near trail just below 100 feet mark. Painted #177.

Pg. 154.
#206 ♂ - CL 88.9; CW 95.9. lower down a few hundred feet distance – in open field to E of trail where found #'s 149, 150, etc. (painted #'s 0 on 9 September. No flaking disease;

black-green algae in 2 usual areas; no lichens; scutes smooth only in very tiny central parts. W.g.i.'s present but extremely thin. Painted #178.
#141 painted – slightly further down – about 175 m NE of ponds along trail.
Went down new trail into El Chato to its juncture with old one to look for tortoises – saw only 2 fresh trails of different sizes (1 medium, 1 large, ♂ scale) from today and #444 and #140 painted out in this big open field of mora and herbs. But plenty of tortoise sign – burrows, turds, trails, grazed areas, from recent days to 2-3 months ago.
Came back out via old trail = this will serve as first half of Region 2 sample – saw no animals but 2 very fresh trails (1 medium-large, 1 large, ♂ scale) of tortoises along the trail in guayavillo forest. Could not follow animals because of extremely dense brush.

Pg. 155.
Everywhere I went today I was overwhelmed by the tremendous amount of tortoise sign – its everywhere. Throughout all the fields of herbs and herb-mora mixtures there are scattered tortoises and areas where they have been grazing moving and burrowing, extensively for past month to 2 months. Oldest sign is 2-3 months old but it is much less prevalent than fresh sign and that up to 1-1.5 months old. Clearly are a tremendous number of beasts along the Reserve Border and above it to N and NE of El Chato toward and to Mirador and Los Hermanos. This repeats what I saw on Devine's land and Barrera's land on 10-12 September. Tortoises have recently (past 2 months) and are now moving beyond Reserve by the dozens to graze on moist, wet, lush fields of herbs. Above Chato, as usual, they pass through both guayavillo and Xanthoxylum forest, but hardly ever see an animal or much grazing sign in any of these shaded areas – they definitely prefer and choose to live in the open fields where there is abundant moisture and some weak solar radiation every day. Must mainly be for the opportunities to bask and to get solar radiation that they prefer the fields because are abundant herbs even in forest floors also. Of course, their favorite herb, . . .

Pg. 156.
. . . Commelina is much more abundant and dense in the open areas versus the forests. One wonders how many tortoises (certainly hundreds) are now above the Reserve Border between the eastern extent of their range and the western coast? Also how far up do the extend as a population now in terms of elevation – most seem to be below 1100 feet more or less, but I wonder if this changes W of El Chato and E of Devine's, these being the limits of the areas I have carefully examined? (For example, do they now extend to Salasaca and beyond as a population or are there only a few individuals that high up?) Should note that nowhere now are they dense; they are scattered out all over open herb fields at a density of perhaps 1-2 per hectare or even 1-2 per 2 hectares (eyeball estimates) in some places.
Jan saw #'s 3 ♀, 31 ♂, 246 ♀, and 695 all around Caseta today. at 1505 #695 initiated an aggression by attacking #246 ♀ by ramming and biting at her front legs. #246 raised head up in typical position and bit at carapace of 3695. The latter fled.
Caseta Weather – 1900 hrs – cool and cloudy all day with extensive garua off and on all day. Rain 5.55 mm; Evap. 0.6 ml, reading 16.0 ml; Max 70.5; Min 62.0.

End of notes; Some lists of tortoise numbers are on final end papers of the notebook but they are undated and therefore of unknown or limited value. These were not copied. THF.

Isla Santa Cruz Volume #12.
Field Notebook of Craig MacFarland

Pg. 1.
15 September, 1970 – Continuing El Chato sample –
#'s and sexes only will be recorded for most because I do no have list of those encountered on last sampling here; also short of time.
Lower half of Region 1 – in Guayavillo forest –
#151 ♀ - in thick forest, moving downhill. About ½ way to ponds at base of Chato.
#302 ♂ - only 50 m before ponds – also in fairly dense forest. He has many interesting lichens; will photograph and collect them – Roll 178, photos 3-17. Has what appears to be 3 types of lichens, plus both types of algae and spots of flaking disease all over rear of carapace below middle of 4th vertebral – photos will nicely show that plants are limited to that area below which abrasion is not severe. Also has 1 lichen type (#1 below) and black-green algae and flaking disease on front marginals, (lichen only on first marginal on each side, tiny spots).
Lichen types – 3
#1 – medium green color – in small (0.5 cm or less diameter) roundish patches, "liverwort" growth form on lower half of 4th vertebral and scattered all over 5th vertebral and last costal of each side.
#2 – pale bluish –grey-green – same growth form and sized patches as #1; located on same scutes in roughly same areas; plus a bit on next to last costal (right) on border with last costal.
#3 – large oblong patches (e.g. 1 x 0.5 cm) of a "painted-on" growth form. Grey-green color – very pale as in #2, but less bluish color. Collected some of all 3 types.

Pg. 2.
This ♂ is large.
Around Pond #1 –
#281 ♂ - large; basking and sleeping.
#139 ♂ - huge; basking and sleeping.
#149 ♂ - large; grazing.
New #1298 ♀ - CL 74.8; CW 78.3. no flaking disease dorsally, heavy on underside of rear marginals; light on unde3rside of front marginals. No lichens, scutes smooth only in central 1/20-1/8 or less but worn noticeably. Black0green algae fairly dense on rear 1/6. W.g.i.'s non-existent. Basking.
One very fresh trail off into dense brush made by a large ♂ - can not follow.

Between Ponds #1 and #2 –
#59 painted – grazing on grasses.
New #1299 ♂ - CL 81.4; CW 86.0. Few minor spots of flaking disease on front and rear marginals; extensive on undersides of same. No lichens. Black-green algae thick in a few areas on rear marginals and adjacent last costals. W.g.i.'s non-existent. Scutes smooth in central (tiny? – word not clear) parts only but carapace worn somewhat. Grazing on grasses.
On #59 painted notes some lichens-

1 – One same as #2 from #302 ♂ (see previous page – scattered in small tiny, tiny splotches on same area as on 302 ♂.
2 – Another a single yellow patch with greenish color around borders on last left costal.
3 – Another type – in between colors of #1 and . . .

Pg. 3.
#2 types from #302 ♂ - same growth form as these 2 types. On lower half of 4th vertebral – all over. Collected some small bits of each of these last 2 kinds and photographed them – Roll 179, photos 1-6.
Pond #2 area –
#150 ♂ - large (maybe 154 but doubt it anyway very recognizable – has huge cuts in 2000 and 4000 scutes); grazing on grass.
#1124 ♂ - large – drinking in muddy pool.
#168 ♂ - very large – grazing on grass.
New #1300 ♀ - CL 72.9; CW 80.9; Flaking disease heavy on undersides of front and rear marginals and light on upper surface of each. No lichens; black-green algae thick on rear 1/5 of carapace and light on front marginals area. Scutes smooth only in tiny central parts. W.g.i.'s extremely thin.
#212 ♂ - huge – grazing on grass.
#147 painted – grazing on grass.
Pond #3 and #4 area –
#566 ♂ - very large – grazing on grass – some photos on Roll 179, #'s 7-10.
#326 ♂ - very large = huge; grazing on grass.
#204 ♂ - very large; grazing on grass.
#61 ♂ - huge; grazing
#156 ♀ - grazing on herbs – unlike all other animals in pond area she is on steep slope of Chato in forest, grazing.
#130 ♂ - hug, long, low and flat – very strange shape; eating grass.
#14 ♂ - (could be #84 but doubtful) – large; eating grass.

Pg. 4.
South side of El Chato – pampa area –
#299 ♂ - huge; moving along drainage bed into pampas.
#1015 ♀ - basking; small.
#1271 – basking.
#616 ♀ - large; sitting in woods a short distance from pampa.
El Chato Weather – 1515 hrs – Rain 0.65 inches, emptied; Evap. 11.8, refilled full.
Very striking differences in numbers of animals at El Chato now and on previous samples since garua began in mid June. Explanation is at least partly, I think, that since ponds there are dry the animals have simply re-dispersed somewhat, especially in that they are moving N and NE (and probably NW also) from Chato in large numbers to Reserve Border and well above it. The same phenomenon is occurring along Caseta La Fe trail and in areas above Caseta.
In addition there is the amazing lack of almost any animals and very little sign from past 1-2 months all over the pampa area on the S side of El Chato. Tortoises have clearly simply not . . .

Pg. 5.
. . .been using these areas to the extent they usually do even during parts of garua season when pond are dry (i.e. see last years Oct.- Nov. – Dec. samples from here). The main contributing factor to this I think is that goats have moved even higher and in larger numbers, than any time up till now since last garua season. They have severely been eating herbs and shrubs all over the S side of El Chato area, such that the area is in more dry and decimated condition than it has been anytime since late June just after garua had started. In July and August this area was recovering well and in good condition and tortoises were grazing here in large numbers. – usually saw 10-15 every time we passed through here. But goats have been here (and similarly near Caseta and Caseta Pond #1) in large numbers since 2-3 weeks ago. They are utilizing vegetation so heavily in these areas that the abundant garua now is not helping the vegetation recover much at all.
Note: goats left these high areas and moved down as a population about 150 feet in altitude in late June shortly after garua began heavily again. But they soon – early – mid July returned to higher area around Chato and Caseta in small bands and have bee there ever since. For . . .

Pg. 6.
. . . past 3 weeks they have just been increasing in numbers each week in these highest areas such that they are now beginning to severely decimate the vegetation again for the first time since late May and early June.
Caseta Weather – 1900 hrs – cool and cloudy and dry; garua of and on till 1400 and from 1630 on continuous. Max 71.0; Min 62.0; Rain 2.25 mm; Evap. 0.2 ml, reading 16.2 ml.
16 September, 1970 –
To Zone 3 NA to take temperatures –
Enroute will record those we see –
Around Caseta - #3 ♀; #264 ♀; #31 ♂;
Just below Caseta - #81 painted; coming up trail.
Pond #1 area - #4 painted; #88 painted; #785; #111 painted; #12 painted.
Note: #127 ♀; back in center of Pond #1. Gives good estimate of time to move here from nesting area.
Checked soil moisture readings at Region 4 – not registering at both depths (1615 hrs).
#77 painted – up from Region 4 - only 90 m S of Caseta Pond #1 on trail and then moving off it to SE.
#1135 – just above Region 2-3 border, moving up trail.
#127 painted – Region 2-3 border, moving S down trail.
#126 painted – in usual hunts – just . . .

Pg. 7.
. . . below very steep ascent part of Region 3 – in lower-middle Region 3.
Region 4 Weather – 1600 hrs – Max 74.5; Min 59.5; Evap. 32.5 ml, refilled full; Rain 11.9 mm, emptied.
#1151 – at same burrow site where have seen several times recently near big boulder area, Region 5-6 border.

#1300 ♀ (painted #17) – about 150 m up tail from Central Zone 3 NA; no mud on feet, tail, etc. to indicate recent nesting; looks as if could be scratching around some now (1700) – will check tomorrow morning to see if attempts any digging. Probably just burrowed now but hard to tell because is sitting on a small pile of churned up soil. Checked about in Zone 3 NA central part quickly for ♀♀. Found #787 ♀ (painted #19) in process of laying her 2nd nest for the year. Just as I approached at exactly 1740 she was dropping 3rd egg into cavity already. No time to get photographic gear so I watched her a bit to look for certain aspects of behavior. While she was dropping eggs I managed to make measurements of nest cavity – it is an oblong (front to back), narrow and relatively small one. Depth in center from soil surface is 26 cm. Cavity opening (actual hole) measures 15 cm front to back by 13 cm side to side. Since sides all around slant inward somewhat all way around . . .

Pg. 8.
. . . in upper portions near soil surface actual dimensions at soil surface are greater than these given for actual cavity from top view. Given these consideration measurements are 27 cm front to back; 20 cm left to right. Has a very deep undercut around 1/3 of circumference (i.e. front 1/3 – deepest depth of undercut in very center front is 11.5-12 cm.
She laid 6 more eggs after I walked up and sat down about 2 feet behind her (she did not see me) and laid a total of 9 eggs.
[Marginal note: Saw no extra lowering of carapace when laying eggs. Was up on fully extended fore-legs. Only lightly raised on rear ones so cloaca about 2l-3 cm below soil surface and centered over cavity. All eggs appeared of very normal size and shape and none was damaged in any way in laying, moving or covering activity. When laying cloaca certainly lower over center of nest cavity than at any time during digging or covering – but still slightly raised on rear legs.]
She then stopped and for about 2 minutes and continued her labored breathing and some slight tail wagging from side to side and occasional contractions of the tail which move it up and down slightly. Seemed as if she was trying to get another egg out. However, nothing more came, so she began the typical "egg-moving" movements which lasted for about 4-5 minutes. She then began to fill the hole in at exactly 1759. I watched this initial filling in and then left at 1805. Will return and check her later on. Will also describe additional . . .

Pg. 9.
. . . aspects of this nesting tomorrow. Noted other interesting things during brief time I was there. She had used plenty of cloacal fluid. Could not tell how much but had a nice mud pile at each foot rest. However had neither as much mud or even as much soil in total out, at either foot rest, as 2 nestings by #131 ♀ I have witnessed. But given small size of this cavity this is not unexpected. She had dropped one large moist turd (one on foot rest pile now) and mixed in somewhat with mud now; obviously will become part of the hard cap.
Could not really see clearly if there were rocks or other obstructions causing the hole to be small. Everything was so covered with red mud that not much was visible. The only rock I could clearly see was near the surface (about 4 cm down) in the upper rear center

wall. There did not seem to be any rocks at all in bottom of nest cavity or up under overhang in undercut's forward wall, so I suspect she had dug as deep and for forward as was physically possible. This looked to be true later when I saw her leg length, the depth of the hole, etc. when she had foot in hole during "egg-moving" behavior. Only area where rocks could have been that would have resulted in a small cavity would be sides because . . .

Pg. 10.
. . . rest of cavity shape and "normal" sized". But sides did not appear to have any obvious rocks so perhaps this ♀ simply digs such small cavities normally.
The 9 eggs really filled up the cavity- at the end of the laying these were 4 on the bottom layer , 4 above these and forming a second layer of eggs (of course these partially fit down into the spaces between the eggs and egg-wall of the first layer) and then one egg was perched up on top of the 2nd layer. The top of this upper egg was only about 8-10 cm below the soil surface at this time (of course a rounded, normal hard cap would mean it would actually be below more than 8010 cm of hard cap soil in the completed nest). Anyway the eggs really filled the cavity. Completely full in this final position after laying Two eggs were up under the overhang (f9irst layer eggs) and 3 others were partly under it (1 first layer and 2 second layer eggs. Actually . . .

Pg. 11.
. . . a few more eggs could have been placed in the cavity (at the 2nd layer level or below) but only by skillfully doing so with the hands by a person. Given the way a ♀ tortoise is built and the manner in which the eggs must be laid, I doubt any more could have been gotten in the nest except as 3rd layer eggs- this layer could have had another 4-5 eggs – but I do note expect many eggs in such a layer would survive the heat (this remains to be proven).
When she put her feet in to perform the egg moving movements, the behavioral sequence was essentially as I have described it for #131 ♀. She started with the left foot (rear). She put it in, made 3 sweeps with it, out, right foot in, 3 sweeps; then left again, 3 sweeps; then right 1 sweep; left, 2 sweeps. Then immediately she began the filling movements. The insertion of the foot was made very carefully such that the furthest part in, the downward pointing, extended nails are into the cavity only about 14-15 cm from the top. She then begins the sweep (from where the foot is inserted)-slightly to the opposite side of the center–rear of the cavity (from the foot being used it is opposite). The foot is turned sideways more or less relative to the front-rear axis of the nest.
The sweep is made gently forward and slightly rising upwards all the way to the front-side of the cavity. Then the foot is lifted, returned to the beginning spot and the next sweep made (or instead the foot is just lifted out of the cavity and returned to its rest spot. Several interesting occurrences during this behavior by the ♀: only 1 egg was high enough in the nest to be hit by her foot. That was, obviously the 1 highest one. On her first 3 sweeps with the first left foot insertion she did not hove this egg at all although she did slightly brush it with the inside edge of the foot with each sweep. The with the firs sweep of the firs insertion of the right foot she caught this egg solidly (L8t was sitting at the right center rear of the nest) with the nails of this foot and move it forward till it was resting on 2 eggs of the lower (2nd layer and flush up against the . . .

Pg. 13.
. . .center-right forward wall of the nest. Interestingly this resulted in this egg's final position being raised up slightly higher than before so that its top is now only 7-8 cm below the soil surface (hard cap will undoubtedly increase this depth by at least a few centimeters). No other eggs were touched or any of their positions changed by this or any other sweeping motions.
Interestingly, after this egg had been moved, she continued to perform the other sweeps and insertions as described above, apparently continuing with a few more insertions and sweeps by each foot until she was satisfied the eggs were dispersed properly because she was make no more contact with them. After this one egg was moved she made no other contact with any eggs or the next cavity sides, yet she continued to insert each foot only to such a depth as described before and to perform all seeps as the first ones. Apparently the level to which they insert the foot each time and after each sweep is a predetermined distance which they can judge by their foot rest position or some other set of positions and or tactile phenomena. After a few additional sweeps have . . .

Pg. 14.
. . . demonstrated to the ♀ that the eggs have been properly arranged she simply quits this activity abruptly and begins filling the cavity.
The filling activity began in this case largely as with #131 ♀, i.e. there was no breaking of stride or rest period after the egg arranging movements. She simply began after the last sweep of the left foot and its removal to the rest spot, to push in mud from the right foot rest into the cavity.
One other interesting aspect – there was a small herb stalk L(about 0.5 cm diameter, woody) of 4-5 cm length, rooted in the ground but freshly broken off by her and positioned directly between her right foot in its rest spot and the cavity. Each time she raised and begins to swing the right foot over to insert it into the cavity for the egg arranging she hit this stick dead center with her foot. Every time she simply lowered the foot a tiny bit again, moved it back toward . . .

Pg. 15.
. . . the foot rest a few cm, then raised it higher up and over the stick, thus avoiding it, but coming lower into the nest cavity with the right foot in exactly the right position. Thus she seemed fully capable of judging how to avoid certain obstructions when directly striking them, but she did not remember this one's location from one insertion of the next. Or, perhaps she did know its rough location but need to touch it each time to be exactly sure of how to avoid it.
Noted another important fact we were missing in watching night time nestings, probably because of type of lighting. As each egg came out, the gelatin around it was as viscous , that the egg did not simply fall on top of the others but was noticeably slowed in its descent by a large mass of very thick gelatin which enveloped it and was connected back to the cloaca. Thus the egg gets a slow cushioned drop down onto the other eggs and not a free fall drop and it also has the gelatin between it and the other eggs or cavity floor as a cushion. This was quite noticeably very effective when seen in daylight. Eventually and

usually, before the next egg comes the gelatin left hanging on the tail and cloaca and running to the previous egg, falls . . .

Pg. 16.
. . . away form the cloaca and on top of the egg (s) below it.
Checked her again at 2010 hrs – still covering but rather far along – all mud now in and on nest and has covered all of it with loose, dry, red soil. Has a nice rounded hard cap formed. She is pivoting enough so that is bringing in loose soil from 6-8" beyond former foot rests now. Also is doing plenty of tamping of hard cap with nails up under rear edge of carapace and is performing test movements in which rest son plastron momentarily and raise both feet and lowers them till bases touch hard cap. Looks well along toward completion.
Checked her again at 2100 – still covering but appears near completion. She has covered the loose dry soil on the nest hard cap now with a mixture of small sticks, other organic debris and small pebbles. She is now taking rests of 3l-5 minutes, down on plastron . . .

Pg. 17.
. . . in rear, but raised on front legs; she works for 5-10 minutes then stops and rests. She is now in the final stages of sweeping soil in from as far away as she can reach on each side while still maintaining her front feet in their permanent holding positions. However, unlike #131 ♀, instead of continuing to sweep further and further out to the rear-side beyond the original rear foot rest positions, she is now reaching them forward and sweeping all along side of carapace and way out to side, as far as the forelegs positions but laterally to them. The scratches in the soil show that she has been at this for some time and is now reaching her limit. In the rear area she never scratched beyond about 8-10" to sides of rear foot rests original positions. But forward, she has managed to scrape 8-10" out from carapace all along its sides (taken from where she is centered over nest cavity) and to abut 2 feet in front of original rear foot rests; i.e. she has swept the entire area to sides of nest for 10-12" outwards and 2 feet from foot rests forward. She has now, as mentioned above , just about reached limit she can reach forward by pivoting as far as possible to each side and reaching far forward with the foot to the side forward which she is pivoting.

Pg. 18.
She is still checking the hard cap height occasionally by raising both rear feet or one rear foot and putting it down slowly to measure cap cover. She is also still packing the cap down by using nails, base of foot, and fore-face of foot along sides of cap after each sweep to bring soil in.
At 2140 hrs she moved right fore-foot out of its fixed position and is now up on all 4 legs. Made 4 packing movements with right rear foot on fore-side of nest and then moved off of nest and slowly started walking away, crunching into herbs enroute. It is a fairly bright night (full moon, but cloudy) but she obviously can not see very well. Am leaving now and will check her early in the morning.
17 September, 1970.

At 0700 looked for #787 ♀ - can not locate her in main NA or around nesting site of last night so he has apparently already moved away. Will look for her more carefully later and comment on . . .

Pg. 19.
. . . her resting site. Jan heard a tortoise clunking around at 0600 so could have been her then moving away.
Weather Zone 3 NA – 0900 hrs – Max 79.0; Min 59.0; Rain 9.2 mm, emptied; Evap dry-thus 35.8 ml plus – was dry when arrived at 1700 yesterday, refilled full now.
At 0730 this morning #1144 was out in flat rock area drinking already (strong garua between 0300-0630). Saw this one last night in same burrow which he has been using for past 2-3 months. #1193, little fellow, was out on flat, rocky, lava pile near #1144's burrow and only about 24 m S of his 2 favorite burrow spots at 0730 also. He was drinking from small puddles in rocks here with great gusto. Took some photos of him, Roll #179, #'s 11-17.
Also at same time, #918 and #130 ♀ were up drinking at dry pond area, also on rocks, jus NW of north-central Zone 3 NA and camp. #130 ♀ clearly did not make any nesting attempts last night and she shows no signs of any mud or even loose soil. She is now (0900) moving back N along our trail toward where we saw her at about 1700 yesterday evening. Jan will take temperatures at Nest #1 today – these are recorded on following pages.

Pg. 20.
Temperatures in Nest #1, 17-18 September, 1970.

Position	0800	1000	1200	1400	1600	1800	2000	2200	0600
1	21.8	25.7	37.6	35.0	30.6	23.1	20.1		18.1
2	21.4	24.4	30.6	32.4	30.1	25.2	22.1		19.0
3	21.5	23.6	28.2	30.9	29.7	26.3	23.3		19.9
4	22.3	23.4	24.8	27.6	27.7	27.1	25.1		21.8
5	23.1	23.3	23.5	25.1	25.9	26.5	25.8		23.2
6	24.0	23.9	23.9	24.4	24.9	25.6	25.8	25.9	24.0
7	24.4	24.4	24.4	24.4	24.4	25.4	25.5	25.6	24.6
8	25.0	24.6	24.2	24.2	24.2	25.1	25.3	25.4	24.6

Pg. 21.
Temperatures in soil control column, 17-18 September, 1970.

Position	0800	1000	1200	1400	1600	1800	2000	2200	0600
1	22.6	26.3	44.0	36.9	31.6	22.8	20.1		18.5
2	22.0	24.6	31.7	32.0	29.7	25.4	22.5		19.9
3	22.1	24.2	28.7	30.5	29.4	26.5	23.9		20.6
4	22.8	23.5	25.6	27.5	27.5	27.5	25.7		22.2
5	23.5	23.6	24.5	25.9	26.2	27.4	26.3		23.4
6	24.4	24.1	24.2	24.9	25.1	26.4	26.3	26.2	24.5
7	24.8	24.6	24.5	24.6	24.7	25.9	26.1	26.2	25.1

8 25.2 24.7 24.6 24.6 24.6 25.9 25.9 26.0 25.4
Sun out strong just before and during temperature taking at 1200 hrs.
Checked soil moisture blocks several times today, at 0800, 1200, 1600, and 2000 hrs. All 4 , i.e. at 5 and 22 cm in nest and control column, gave no registered reading on instrument at all; i.e. so dry that instrument did not record % available soil moisture – below its range of sensitivity.

Pg. 22.
Weather description for period during which nest temperatures taken.
0600–0700 – Cool, cloudy and fairly strong garua.
0700-800 – cool, cloudy; no garua but windy and cool.
0800-1000 - cool, cloudy; few minutes of garua now and then; no full sun but some weak radiation that could be felt from 0830 on except during heavy clouds when raining.
1000-1200 – cool and cloudy most of time, with no garua from 1000-1115. From 1115 till after 1200 sun out and very warm; almost hot for about 30 minutes. Sun came out strong and stayed out just as we took temperatures at 1200.
1200-1400 – Sunny till about 1220, then clouded over again and very cool. No garua.
1400-1600 – Cloudy and cool whole time, some weak radiation most of time; no garua and not much wind.
1500-1800 – Cloudy and cool; no sun, no garua; weak radiation whole time.
1800-2200 – cloudy; no garua. Garua light most of night off and on.
0600 – next morning – light garua; cloudy and very cool.

Pg. 23.
Went up tortoise pathway to N of Central Zone3 NA, which just lies a bit E of our trail and parallels it. Saw no digging sign or any nest since what was there on last trip. #133 ♀ was her on trip down here on 4 September, but she apparently did not do any digging here because she left no signs of every scratching about any.
#1020 was along this route, moving down pathway toward NA, about 150 m N of camping area.
Searched all over yellow-brown soil areas around Nest #13 from 1969-70 (above mentioned pathway passes through part of this area so does out trail). But no nests and no new digging sign at all. No tortoises and no very recent sign of them either.
Then returned by way of our trail to small dry pond just NW of campsite and found that fresh trail of #130 from where we saw here to dry pond area was very clear. She very clearly used out trail till she was just passing beside the dry pond area and then made a sharp right turn off of the trail and went directly to the pond which was then only 40 m away from the trail – she clearly knew exactly where she was going and was oriented well – took most direct and easy route from her last night's resting spot.
#1144 – is now (from 0930 till present – 1335) grazing around campsite area. #918 has crossed to area of nest #5 and 10 1970-71 and is clunking around on there rocks there, foraging.

Pg. 24.
Then searched along 3 pathways to main highway hub- one from western part of NA, one via nest #12, 1969-70 location, one via large cactus (Opuntia) just S of nest #12 1969-70.

Found trail of a large ♀ sized animal along the first of these and found #787 ♀ (#19 painted) at hub center drinking H20 and grazing on tiny, tiny herb seedlings (this at 1115 hrs). So she had moved here early this a.m. from last night's nest. Searched all along highway but found no other animals or sign of recent activity. Checked over all of central main Zone 3 NA but saw no more digging attempts or nest save for those discussed below:
In western part of Central NA, just over rock pile from our campsite and weather instruments, found some fresh digging and 2 nests. Both in bright red soil of Central NA. One of these nests was that #787 ♀ laid last night. This one will be labeled #16 nest, 1970-71. This means this same females is responsible for nest #2 and #16 for this year, laid about 1.5 months apart. More on this nest #16 later.
About 25-30 m ESE of Nest #16 in another area with open red soil found Nest #15, 1969-70 **[Note: clearly CGM means 1970-71 i.e. a new nest as suggested by notes on Pg. 31 in this volume.]** and 2 clear digging attempts. Both attempts and . . .

Pg. 25.
. . . the nest were all made in fairly open red soil spots of typical soil for the Central NA. All 3 sites had a light covering of scattered dead, prone malvaceous herb branches, so they were no completely bare sites. One digging attempt was very shallow, only going about 5 cm below the soil surface. It has rocks all over at this level so the ♀ stopped without using any cloacal fluid. She must have dug here for only a few minutes at most – certainly < 30 minutes. Can not judge age of this but looks very fresh – 1-3 days. The other attempt was nearly successful, the ♀ achieving a very deep hole with a respectable front flask undercut and she obviously released a copious quantity of cloacal fluid, as the foot rest have a large quantity of fresh mud on each one. Given the extreme freshness of this mud I doubt the nesting attempt could be any older than the evening of 15 September. It is certainly a bit more fresh than nest #15 itself. It is logical therefore that #787 ♀ probably accounted for this hole and then the next night (last night) was successful. The ♀ was stopped at this attempt by: 1. a large rock in the central floor of the cavity; 2. a smaller rock in the left rear corner wall of the cavity near its floor; 3. some caving in of large muddy rocks (1/2 to 1.5 x fist size) and soil. She clearly however reached the point of committing her cloacal fluid and I can see why because the cavity is deep and otherwise a fine site for digging. She probably could have even laid up to 5-7 eggs as it is now (assuming 1 layer only) but was clearly dissatisfied with its maximum dimensions when the rocks got in her way. Its deepest depth (in the center where the rocks is in the floor) is 22.5 cm from the surface. The undercut in the center – front is 7.5 cm deep. See notes later in day for a few comments on Nest #15.

Pg. 26.
At very southern end of Central NA found 4 more new digging attempts, all halted rather early without any cloacal fluid being dropped because of excessive numbers of stones in each. [Marginal note: All in open soil spots with little or no organic debris on top of typical red soil. Some scattered pebbles and small rocks on most of soil surface here.] All had stones in the walls and on the floors of the cavities. Their depths were 8, 8.5, 10, and 13 cm from the soil surface when the ♀♀ or ♀ stopped. Interesting that no cloacal

fluid committed in any of these – all very poor sties. Can not judge age of these, but none of the 4 were here on 4 September.
In new tiny NA to SE of Central Zone 3 NA, found two more digging attempts. [Marginal note: Both in typical open, bright red soil sties; very little or no organic debris or dead or living vegetation on either soil spot on the surface; ♀ was clearly choosing most open spots here; interesting because unlike parts of Central Zone 3 NA, not many open spots here – most have some slight organic debris or dead vegetation on them.] In neither case was cloacal fluid used. Did check here on 4 September and neither hole was here then. First digging in this area this year. Could well have been made by #787 ♀ on recent evenings because she knows this area well. One hole had rocks in forward-side wall and on front floor of cavity. Stopped when at 18.5 cm below soil surfaces. Other one likewise has a large rock in forward floor of cavity. Stopped when 15 cm deep. Otherwise these 2 holes in rather good sites and fee of rocks in . . .

Pg. 27.
. . . rest of cavity walls and floor. But apparently these rocks were enough to prevent release of cloacal fluid and to stop the digging attempts. There was no caving in of rocks or soil into cavities so problem must have been rocks in floor. No clear sign as to what direction ♀ or ♀♀ responsible for these holes came from or exited by way of. Again, additional data on what causes and when cloacal fluid is released. I took down old Nest #8 (1969-70 wall to clear additional space out here; also did not fill in 2 holes, to see if another ♀ might use them.
#1269, little guy, also in this area, only 5 m from where I first found and notched him. Was grazing on herb seedling when I first saw him at 1430 hrs. At 1445 he moved into a burrow site of typical red soil but wedged into some rocks. He is remarkably well camouflaged in this position; however, may have burrowed in response to me because he is well aware of my presence and is sniffing the air just as adults do when a human has been sighted by them. Unlike adults he keeps head ¼'s of way withdrawn when sniffing after first retracting it when seeing me; adults usually raise head way up and out and look and sniff simultaneously with head thusly elevated.
Two other tortoises I noted movements of –
#787 ♀ - at 1410 found her sitting in an open soil patch near the eastern . . .

Pg. 28.
. . . most of her 2 favorite Opuntia trees; apparently just resting and basking; may be that she will spend night here. This means she moved about 100-125 m more or less, from Central Highway hub due W along this commonly used pathway to her present location, sometime between 1145 (she was then foraging and grazing at herbs) and 1410.
#1193, little one – has now "moved" due S of where saw this a.m. (of course could have gotten here by a circuitous pathway) – is about 35 m from where was drinking from 0730-0900. Is foraging and grazing on what few tiny herb seedlings are available here. Have never yet seen this little fellow, or #'s 1266, 1269, both of similar size, feeding on fallen Opuntia pads or fruit! Do not know if they will, or do, eat either of these foods or not. Anyway, they certainly do not seem cued in on Opuntia trees because are some near normal activity areas of all 3 of these small fellows.
Nests #15 and #16 – More on nests #15 and 16 –

#15 nest 1970-71 is only about 1 m away from the nearly successful attempt which I think ♀ #787 . . .

Pg. 29.
. . . made on evening of 15 September. However, it is clearly 1-3 night older in that even though covered by a slight protective layer of loose dry soil and organic debris and pebbles (unlike open, muddy, exposed foot rests of nesting attempt), its hard cap is slightly drier than the nest attempt foot rests and notable so. Therefore I am reasonably sure that this nest was laid recently, but before night of 15 September to 16 September. Almost certainly was laid between evenings of 12-14 September. I doubt it could be any older than this because hard cap is still quite moist to within a few mm of its surface and drying out takes place rapidly here – would be much direr if were older than I have suggested. Could not find any ♀ in Central Zone 3 NA or along first portions of any obvious trails out of here to N, E, or W. So, in absence of any obvious ♀, and given that are no other nests, but only some feeble digging attempts in other parts of Zone3 Central area, I would guess that ♀ #133 laid this nest. She was heading right for this nesting area along pathway just E of our trail on 4 September in afternoon and looked to be poking about for a nesting site then. It is easy to imagine that she could have entered Zone 3 near our campsite, proceeded to its southern end, dug 4 attempts there and then come up the few hundred feet distance to the SE to this . . .

Pg. 30.
. . . area and laid. If she really was intending to nest when we saw here on 4 September, (her previous movements might reasonably be interpreted to indicate she was), then the other circumstantial evidence available would fit with these notions. In addition to the facts noted on the previous page and others signs I have seen today in searching the nesting area and surrounding pathways, is fact that no digging sign at all was found along northern pathway she was on into Zone 3 NA; i.e. she could have been heading directly for red soil areas to dig; and in fact only new digging since 4 September I have found was in red soil areas of typical bright type red soil. Anyway, all this is speculation so I will not push it further. Anyway, Nest #15 appears OK, has a good solid hard cap and is nearly round in surface outline. [Marginal note: Most of hard cap is covered by about ½-1 cm of loose dry red soil scraped up from beside nest.] The ♀ who laid must have had an especially tough time because right in front of it, in fact the hard cap is flush against it, is a large 15 x 18 cm rock, sticking about 3 cm out . . .

Pg. 31.
. . . of the soil. The ♀ thus was standing above this rock as best as I can judge from the impressions of her forefeet and the areas scraped in covering the nest. It was directly under the center of her plastron and occupied the front half of this surface it looks like. She probably only rarely touched the rock in fact since the ♀'s seem to remain almost completely elevated during virtually the entire nesting process at their front ends.
Nest #16 is also in an open area, with no shade trees around it, but it was made in an area with a solid caver of dead dry prone sticks, leaves, and other vegetation and general organic debris. In digging the ♀ simply swept this material aside with the first few strokes (easily done). She then used similar material from beside the nest to top off the

covering over the nest. The nest has about 0.5 – 1.5 cm of loose dry soil and organic debris over the moist hard cap, the thickness of this cover depending on location.
It is impossible to guess how long #787 ♀ worked at digging her nest cavity but since it was small I would guess about 2 hours at most. Also it was an easy site in which to dig and she did not have to move any rocks out of the cavity. Therefore I suspect she spent about 6 hours total on the nesting. More or less 2 hours digging; more or less 15 minutes laying the eggs and for transitions; 3 hours, 45 minutes in covering the nest.

Pg. 32.
Given her speed in covering the nest her excavation time could have been even quicker.
Checked some animals again at 1615 hrs –
#787 ♀ - same exact location; sleeping; apparently was in for night at 1410; in open completely; just sitting on a small flat patch of exposed soil.
#1144 – returning from campsite area down La Fe trail; proceeded directly to favorite recent burrow site, and burrowed in at 1622 hrs.
#1193 – still foraging! Walking about 10 m N of last location, poking about and eating small grass and other herb seedlings; so little to eat that he is doing a lot of looking and walking about for each few mouthfuls of food.
Jan checked #130 ♀ at about 1510 and she was already "burrowed"; lying still in a flat open patch of soil at dry pond. I checked same animal again at 1730 and was in exact same position.
Interesting activity periods – animals of all sizes from small ones to the largest ♀♀ seem to become active as early as 0530 and most are active by 0700; then they retire mostly between . . .

Pg. 33.
. . . 1500 and 1600, but some remain active as late as 1630-1700.
Grazing activity in this area – I watched a number of animals foraging and feeding today; I purposely watched animals of quite different sizes to see if any notable differences could be indicated. Watched #787, very large adult ♀, #1144, 60 cm CL plus or minus animal, and #1193, about 23 –25 cm CL each for about 30 minutes. All 3 were feeding and foraging on same plants, i.e. essentially only those available, the small tiny very scattered herb seedlings which have been growing up here since about the 1st – 2nd week of July. All these animals used the same searching technique of moving slowly along and looking down at the ground for the small green seedlings, most of which are about 2-5 cm tall. When located they then bite them off as close down to the ground as possible; i.e. usually right at the ground surface; they get quite a lot of mud in their mouths in this foraging.
It seems rather incredible that a large animal like #787 ♀ can exist for long periods on the small amount of total herbage she could take in, even if she was foraging and eating these little herbs for 10 hours a day constantly. Obviously an animal of the size of 1144 or 918 can exist rather permanently at these altitudes since these 2 have been here ever since I first . . .

Pg. 34.

. . . sampled this area last November, and perhaps were here since hatching. Perhaps they can survive here only because the occasionally occurring very wet years like 1969 result in abundant forage for a few to many months and they store up on fat at those times. Of course Opuntia pods and fruits which fall to the ground are used as extra food supplements or even the main food over certain time periods. Certainly it is the Opuntia which is the main food from this altitude on to the coast over long time periods.
It seems reasonable that animals of the size of #1193 can survive and grow on only these small herbs. For the entire period of late March- mid July there was virtually no food except Opuntia pads in this area at all and I suspect the newest hatchling suffered greatly and in fact the starving evidence I have seen could well be due to this past extreme dry season. All the herbs dried up by the end of March and none re-grew here till mid July after about 1 month . . .

Pg. 35.
. . . of light garua had fallen. The hatchlings can probably find enough to eat more easily, even though the area is still extremely devoid of most vegetation, but at least the small herbs are scattered about, especially in the rockiest areas. Their density per acres is very low but they are succulent and becoming more dense and prevalent all the time as the garua season progresses.
18 September, 1970 –
Checked #'s 130 ♀ and 787 ♀ - same areas; no further sign that either will nest again soon – no digging activity by either last night.
Zone 3 NA – Weather – 0815 hrs – Rain 1.7 mm, emptied; Evap 2.4 ml, refilled full; Max 77.5; Min 60.5.
Region 4 – Weather – 0930 hrs – Rain 5.7 mm, emptied; Evap 2.4 ml, refilled full; Max 73.5; Min 60.5.
#70 ♀ painted – in Region 4 at flat rock water collection site; only one we saw anywhere in Region despite extensive garua last night. Puddles all over H20 site, but not a large group of tortoises – Why? Seems they must have been leaving this area recently. It is extremely dry here – almost nothing at all to eat except for very few, very scattered small herbs such as in Zone 3 NA – even less than in that latter area over much of Region 4.

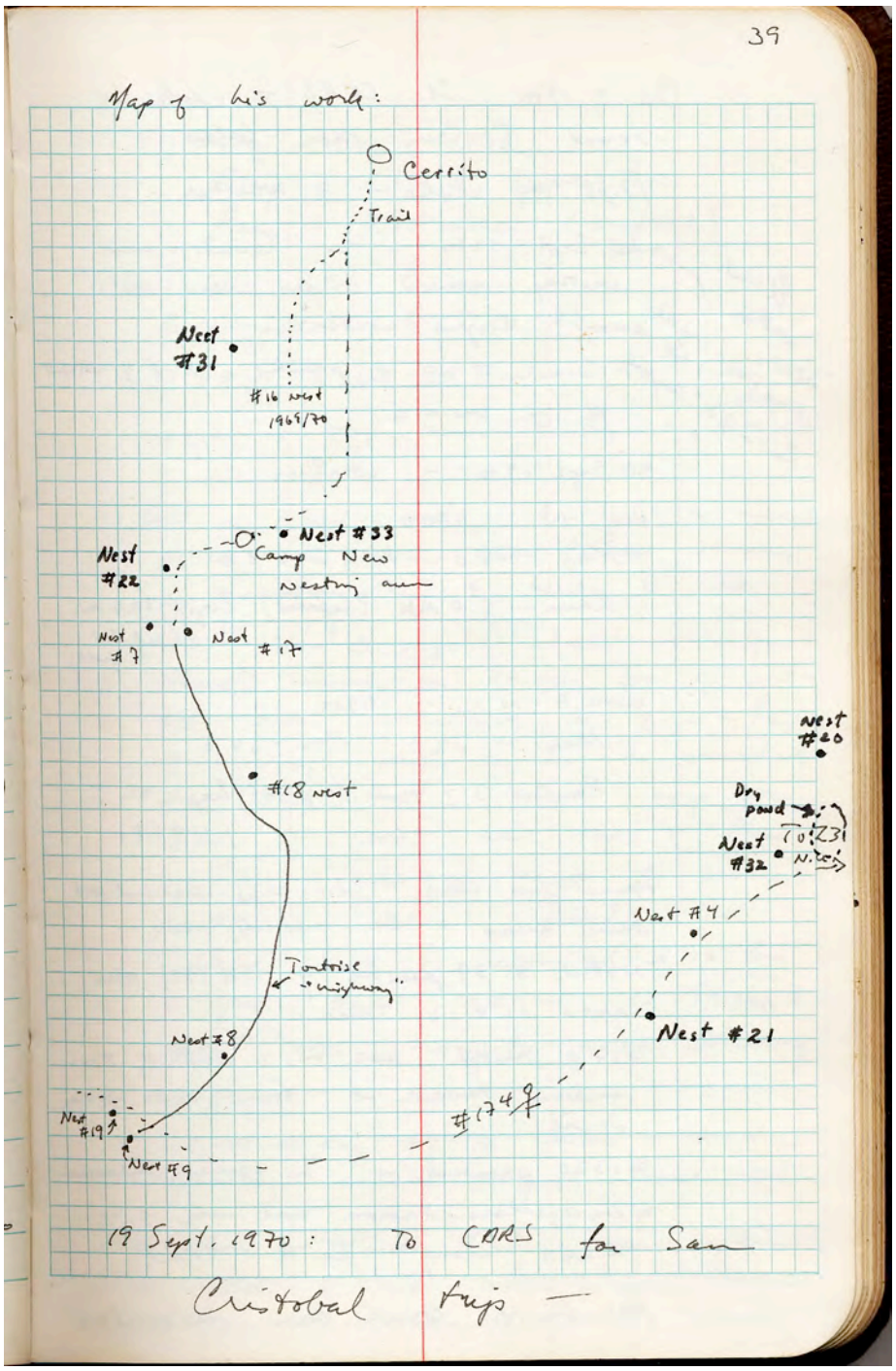
Pg. 36.
#126 painted – in upper Region 3.
#1275 – upper Region 3 just 35 m distance from Region 2-3 border.
#127 painted – Region 2-3 border – same area where saw 2 days ago.
At Caseta Pond #1 area –
#88 painted; #127 ♀; #110 painted (down from Devine's).
Around Caseta area - #31 ♂; #3 ♀; #246 ♀.
More new nests - #'s 12-14; #'s 17-19. – Two recent rips by Julio san Miguel to nesting area yielded flowing new nests and information:
8-10 September, 1970 to La Torta –
Found 3 new nests - #'s 12, 13, 14 for the year; #12 was dry mostly on top and therefore 1-2 weeks old, in brownish soil.. #'s 13 and 14 were very recent and fresh; still wet soil on top layers of hard cap even; both in typical red soil of "pampas coloradas". He saw 4 adult large ♀♀'s – 3 without marks and #591. Lots of goats – killed 16 ♀♀; 4 ♂♂ fairly

abundant burros; no sign at all of pigs anywhere in the entire nesting area. He found 1 nest from 1969-70 season, but with no holes to exterior, i.e. no young had left . . .

Pg. 37.
. . . it. Upon opening he found no eggs but 4 hatched out young all trapped in the nest by rocks and dry compact soil. Three were dead, 1 very recently and still without maggots, the other 2 largely decomposed. Incredible as it seems, 1 was still alive – but weak, starved, and thirsty looking. When offered H20 in a lava basin it immediately drank itself full. He took this animal to CDRS on 14 September 1970 when Juan Black placed it into the tortoise house.
Two things of note – 1. Small clutch size, 4 for this nest; 2. trapping of young; 3. 1 live one must have been inside for a minimum of 5-5.5 months since hatching!!!
Estimated limit of Reserve population – On this trip he also saw a tortoise 35 ♂, in the "Pampa Schiess" just up trail toward Aldaz beyond encanada and northeastern corner of reserve. Was a tortoise a bit further up trail on Aldaz's land in January also – perhaps also this one?
18 September, 1970 – to new nesting area below Cerrito and around this area. Found 3 new nests.
#17 and #19 – both very fresh and wet.
#18 – older; surface dried out. All 3 in red soil (pampa Colorada type). All 3 appear to be well made, normal nest; were 2 eggs on surface, clean, clean white – no mud on them. Only 2-3 feet away from center of Nest #19. Both appear normal and OK. Perhaps laid by . . .

Pg. 38.
. . . same ♀ that placed the nest. Not much sure as to which ♀♀ may have laid nest. One without a number but with a clear hole bored in her #10 scutes was about 100 m N up trail (moving N) from nest #19; she had fresh red mud on feet, legs, and tail so perhaps she made Nest #19 and also left there the 2 eggs. Will take eggs to CDRS tomorrow and incubate them.
♀♀ seen- besides 1 mentioned above:
#64 ♀ - near old corral from 1969-70 Nest #16; some new attempted nest there; none completed yet.
#60 ♀ painted – near camp in new nesting zone; red soil on feet and tail and legs; some newly dug holes in area; one with mud indicating a recent local fluid drops.
♀ without number – near #8 Nest; no sign of recent nesting by her.
#174 ♀ - near old corrals on trail to Zone 3 NA – no sign of recent nesting activity.
On return he saw a very tiny one 1969-70 or 1968-69 hatchling on side of Cerrito where trail passes it.

Pg. 39.
Map of his work: [Sketch of nests, trail and females encountered relative to Cerrito]



19 September, 1970 – To CDRS for San Cristobal trip.

Pg. 40.
3 October, 1970 – At CDRS – notes of recent Santa Cruz data follow.
Trips by Julio – and Weather –
25 September, 1970 – El Chato Weather – 0800 – Evap 10.0, refilled full, Rain 0.71 inches, emptied. To Cerrito and new nesting area; no new nests seen; digging continues – Saw #60 ♀ painted, and one ♀ without number in New Nesting Area.
30 September, 1970 – Weather – Region 4 – 0800 – Max 76.0; Min 64.0; Rain 3.2 mm, emptied; Evap. dry thus35.8 plus.
Zone 3 NA – Weather – 0900 – Max 78.0; Min 64.0; rain 3.2 mm, emptied; Evap. dry thus 35.8 plus.
Found no new nests – he searched all same areas I usually do.
Noted #39 painted ♀ (#131) near Nests #15 and #16 area.
#17 ♀ painted 200 m N of Zone 3 NA moving toward it form N along trail.
#132 ♀ painted – in small depression in a yellow-=brown soil area S of Zone 3 NA along La Fe Trail.
He built corrals for Nests #15 and #16.

Pg. 41.
1 October, 1970 – El Chato Weather – 0830 – Evap. 11.5 ml, refilled full; Rain 0.30 inches, emptied.
New Nesting Area below Cerrito –
Three new nests - #'s 20-22.
Nest #20 – a bit dry all over top - 1 week or more old.
Nest #21 – very fresh and only a day or so old.
Nest #22 – very fresh and only a day or so old.
All in red soil; he thinks he missed #20 on previous trip because is way up above others and hard to see.
Nest #21 had 3 eggs almost on surface- barely covered by 1- few cm of soil – all broken – probably by ♀ in laying and covering nest. So re-opened it and found that below 3 eggs was plenty of soil (hard cap) and then a large clutch of eggs in normal location – so he filled in and covered nest and repaired it to form a good hard cap – he threw 3 broken ones away to avoid attracting pigs.
Did not see any ♀♀ to which he could definitely ascribe any of these nests. On return to Caseta – this same afternoon he noted #97 ♂ was near Reserve Border near Camote patch, dead.

Pg. 42.
Died same day he thinks because animal was there in a.m. but he did not notice flies – now hundreds of flies all over it. Just dead because no decomposition or maggots visible yet and no odor yet. Cause of death a great mystery – he noted throat was swollen – perhaps a stuck Camote??
Finally, small tortoise that was trapped for 5 + months in nest at La Torta died at CDRS on 21 September 1970. T. DeVries preserved in 10% formalin. He noted a small yolk

sac was still present. Weight at death was 53 g. I examined it myself – has a small yolk sac containing an estimated 2-3 cc of yolk still inside. Not extremely emaciated or desiccated at death but clearly not fat at all and not healthy. Meat on legs sparse and no fat reserves present at all anywhere on body. No signs of every having grown since hatching and no white growth increments. Must have starved down to a certain point of bad health and then not been able to recover at CDRS so . . .

Pg. 43.
. . . died shortly after being put in tortoise house with heat, light, and abundant water and food.
10 October, 1970. – Jan, Baby Bennett, and I returning to Caseta!
Enroute: Began seeing scattered very recent tortoise sign 1 km E of Zone 6 turn-off on trail – i.e. fresh trails, grazed areas and droppings. This increased generally till just before Zone 6 turn-off where was a lot of same type of sign and trails running N-S and S-N all along Reserve Border – saw #707 here.
Same scattered sign continued till Zone 1 turn-off; then again heavy activity all along Reserve Border from Zone 1 turn –off to Poza de Manzanillo area and beyond it. Saw #335 ♂ and #1023 ♀ along Reserve Border, both grazing at Poza de Manzanillos.
Beyond here sign was only very, very scattered till reached area just 150 m before Caseta Pond #4. Then a great amount of trails, grazed areas, burrows, turds of recent days.
At Pond #4, #11 painted grazing; half way from Pond #4 to Caseta, #94 painted grazing.
11 October, 1970 – Around Caseta this morning - #'s 31 ♂, 246 ♀; no sign of #3 ♀.
Went over to look at skeleton of #97 ♂ to see condition of it. Enroute saw . . .

Pg. 44.
. . . a number of animals, largely same ones in this area along Reserve Border in mora as where there over 3 weeks ago:
#1013 – at forest-mora border just above Caseta.
#43 painted – ¾ way to top of first hill.
#450 – top of hill.
#81 painted – just other side of hill.
#50 painted and #15 painted – low area between first hill top and Camote patch – Right turn area.
Just beyond here found skeleton of #97. In tall (1.5m) high herbs right beside Reserve Border. Had decayed nearly all the way. Found only bones, scutes, and a lot of oil soaked into ground.
Hard to tell much about the cause of death; no clear sign of anything. Animal had been moving along Reserve Border steadily at least for a few dozen meters; then turned slightly, dropped one normal green-filled dropping; move 4 m into taller herbs beside Reserve Border and expired it appears. Given its location, only a meter off of Reserve Border, am sure it was just dead or still alive when Julio passed it . . .

Pg. 45.
. . . on morning of 1 October because he did not notice any flies then (passed it about 0745-0800). But same day in late afternoon it was dead. He says it was in Reserve

Border in a.m., off Reserve Border to side in afternoon, so that clinches argument that it was alive till some time during day of 1 October.
Collected all bones but carapace-plastron and attached vertebrae; also left scutes; will go back and get these soon.
To Caseta Pond #1 for enlarged sample.
#246 ♀ at Caseta.
#31 ♂ - just below Caseta 25 m on trail. At eastern side of pond, out in herbs - both basking.
#12 painted; repainted, numbers worn.
#129 ♀ (number a bit hard to believe because of size, but clearly marked as such). CL 71.1; CW 76.7. No lichens, algae, or flaking disease; w.g.i.'s clear but extremely thin; scutes worn but smooth only in very tiny central portions.
In pond – inside circuit –
#9 painted; basking.
#3 painted; basking; repainted; back to pond! CL 85.6; CW 92.7; w.g.i.'s extremely thin; no lichens; flaking disease and black-green algae heavy in 2 usual areas.
North side of pond – none and almost no sign at all of recent activity; tall hers, moist vegetation abundant.
W and SW sides of pond –
#2 ♀ (mis-marked) – CL 85.0; CW 92.9. saw before at Caseta Pond #4; do no know what number should be; heavy flaking disease on usual areas; no lichens; black-green algae light in usual areas; scutes smooth only in . . .

Pg. 46.
. . . central 1/10 or less; w.g.i.'s very, very thin; grazing , 45 m SW of pond.
Two more – Fresh sign of 2 more on W side – one very large ♂, one medium-small sized one (♂scale) – both fresh trails near small manzanillo pond with mud and pockets of H20 on W side, but could not find them.
#4 painted – E of Pond #1 along hunters' trail.
Then up drainage to level of tents- only one found – scattered recent sign all through this area but not nearly as much use as in June and July and even August –
#3 ♀ - no sign of any recent nesting or travel to lower zones – i.e. no red soil, etc.
As with last sample very noticeable that tortoises are now widely dispersed in the Caseta and Caseta Pond #1 general area. They have apparently either fanned out widely over this area or moved elsewhere or both. Anyway, the obvious objective fact is that the density here has dropped from what it was in the July and early August period of the present . . .

Pg. 47.
. . . garua season. Density seems to be less now even than it was in September, i.e. about 1 month ago when I sampled.
I think the cause of this is that after re-concentrating to Pond #1 area after hot, dry season, tortoises hung about in garua season for about 1-2 months; then, when no water actually collected in the dry pond beds, they:

1. dispersed more widely.

2. Many individuals moved to N and NE above Reserve up to altitudes of 900-1000 to 1300 feet (see samples of Devine's and Moreno's land for September, 1970). Of course, even though standing H20 is not present in ponds to enable wallowing and drinking; they have abundant moisture at altitudes from 450 feet and above almost daily now in and on fresh lush vegetation. Vegetation and garua are so abundant that dispersal is not at all disadvantageous; especially when there is no advantage to concentrating about the dry pond beds at El Chato, Zone 6, Zone 1 , Caseta Pond #1, etc. Of course in general the higher they move from 450 feet or so upwards the more lush it becomes and the more garua there is providing moisture more frequently. Note: is a bit of mud and standing H20 (a few centimeterrs only) in Manzanillo grove ponds to W of Caseta Pond #1.

Pg. 48.
12 October, 1970. – (Columbus Day! Hoopla! Huzzah! Etc!
To Zone 3 NA to sample – straight line sample.
Enroute –
Region 1 - #3 ♀ at Caseta near trail and tents. Grazing.
#31 ♂ - just down trail 30 m from Caseta. Grazing.
#12 painted – beside Pond #1 to E a short way beside trail.
#2 ♀ - (from yesterday) same place as #12; #12 painted aggressing #2 ♀ a bit – ramming in rear with gular projection. All four in open fields of herbs.
Region 2 –
#124 painted – 50 m below Pond – grazing; in woods.
#82 painted - another 25 m down trail in drainage; moving up it. In semi-woods.
#1212 – between trail and drainage; grazing in woods. No flaking disease or lichens; w.g.i.'s extremely thin. Black-green algae a light coating in usual areas; (Painted #179); CL 87.7; CW 92.0.
#1301 ♀ - not in sample – CL 77.5; CW 85.8. No lichens or algae; scattered flaking disease on rear and front marginals areas; w.g.i.'s extremely thin; scutes well worn but smooth only in tiny central parts. Painted #180. Grazing in an area beyond (to W of trail) last animal; but not in sample; beyond it.

Pg. 49.
Seems unbelievable but eating leaves and stems of stinging nettle (Certica? = ortigo in Spanish, common name) with great gusto.
Neither of these ♀♀ show any sign of recent copulations, nesting attempts or any red soil indicating have been below in nesting areas.
3109 – CL 90.2; CW 96.5. Duplicate number? – Am sure there is another one or two #10 ♀♀. At Region 2-3 border area; grazing in woods on nettle also; Eating a lot of it incredible. Scutes smooth in central 1/10-3/5; no lichens or algae; flaking disease only in a few tiny spots on front marginals; w.g.i.'s extremely thin. No sign of recent nesting or copulations. Some red soil on lower rear of carapace but very old and worn into shell (Painted #181).
Region 3 – no tortoises and virtually no recent (past 2 weeks) sign at all – certainly hardly any tortoise activity along here for past 2-3 weeks.
Region 4 – none till main central area.

Then #1185 ♀ - CL 75.6; CW 79.2. No flaking disease, lichens, or algae. W.g.i.'s clear and moderately thick. Moving toward pond through weather instrument area – from trail. No sign of nesting or copulation. (Painted #182).
#1050 ♀ - CL 75.5; CW 82.6. central area along trail; grazing; no lichens, algae, . . .

Pg. 50.
. . . flaking disease; w.g.i.'s clear and moderately thick; deformed – only 3 left costals, first very, very large and elongated; first vertebral extra long on left side; it and first costal take place of missing (1st) one. There is a tiny "tear-drop" shaped scutes at lower front corner of 1st costal and between it and 1st vertebral on left side. See Roll 193, photos #'s 30-31. No sign of recent nesting or copulation. (Painted #183).
#415 ♀ - CL 72.9; CW 77.4. Same area; sitting in dirt wallow, inactive. No sign of recent nesting or copulation. W.g.i.'s clear and well-developed. No lichens, algae or flaking disease. Scutes worn, but smooth only in tiny central parts. (Painted #184).
#1194 – crossing weather instrument area.
Region 4 – Weather – 1445 hrs – max 77.0; Min 60.0; Evap. 33.0 ml, refilled full; Rain 16.0 mm, emptied.
Region 5 – none; no fresh sign.
Region 6 - #521 – burrowed into a soil patch at root base of a fallen tree; beside 1969-70 Nest #13.

Pg. 51.
No others seen in this region; but scattered, abundant sign (turds and trails) from where #521 was to Zone 3 NA central northern part at campsite.
Zone 3 NA – Weather – 1830 hrs – Max 81.0; Min 60.0; Rain 11.5 mm, emptied; Evap. dry, refilled full.
Searched briefly around main nesting area for nesting ♀♀ - saw only #131 ♀ already burrowed in. A great amount of new digging activity was apparent but saw no new nests. Will examine more carefully tomorrow while doing enlarged sample of this area.
13 October, 1970. –
Zone 3 NA – will take nest and control temperatures beginning at 0800 today.
Data sheets are on following 3 pages.
Soil moisture readings:

	0800	1200	1600	2000	0600	1200	1800	0600
	13 Oct.				14 Oct.			15 Oct.
Nest								
5 cm	NR	NR	NR	NR	NR	NR	NR	NR
22 cm	NR	NR	NR	NR	NR	NR	NR	NR
Soil								
5 cm	NR	NR	NR	NR	NR	NR	NR	NR
22 cm	NR	NR	NR	NR	NR	NR	NR	NR

NR = no register; i.e. below machine's sensitivity in % available soil moisture.

Pg. 52.
Nest #1, probe in nest; 13-15 October, 1970

Position	13 Oct.							14 Oct.									15 Oct.	
	0800	1000	1200	1400	1600	1800	2000	0600	0800	1000	1200	1400	1600	1800	2000	2200	0600	0800
1	23.4	43.2	54.2	41.6	34.4	26.6	23.2	20.7	24.4	32.3	44.9	40.4	38.3	26.9	23.9	22.7	20.1	24.6
2	24.8	31.9	43.4	37.6	34.2	29.9	25.8	21.9	23.4	29.4	36.1	27.4	25.6	29.5	26.1	24.4	21.4	23.4
3	24.9	28.2	37.5	36.3	33.7	20.7	27.0	22.5	23.3	27.7	32.2	24.7	24.2	20.2	27.1	25.5	22.1	23.2
4	24.2	24.7	29.9	31.9	31.7	30.9	28.7	24.1	23.9	25.8	27.8	30.0	31.4	30.3	28.8	27.1	24.2	23.9
5	23.8	24.4	26.2	28.1	29.6	29.9	29.2	25.6	24.8	25.5	25.9	27.2	28.7	29.2	28.9	28.1	25.5	24.9
6	23.1	24.6	25.7	26.3	28.0	28.9	28.6	26.3	25.4	25.7	25.9	26.1	27.2	28.3	28.4	28.1	26.1	25.7
7	22.6	25.1	25.3	25.7	26.7	27.4	28.1	27.1	25.8	26.2	26.2	26.2	26.3	26.7	27.3	27.1	26.9	26.4
8	22.4	25.6	25.4	25.2	26.1	26.7	27.3	27.2	26.2	26.2	26.2	26.2	26.3	26.7	27.3	27.1	26.9	26.4

Pg. 53.
Control; in soil beside nest; 13-15 October, 1970

Position	13 Oct.							14 Oct.									15 Oct.	
	0800	1000	1200	1400	1600	1800	2000	0600	0800	1000	1200	1400	1600	1800	2000	2200	0600	0800
1	23.3	46.7	56.4	43.1	33.4	26.0	22.6	20.7	25.6	33.1	48.7	41.9	36.4	25.2	23.1	22.2	20.1	27.2
2	25.2	32.8	41.3	37.0	33.2	29.2	25.6	22.6	23.9	29.2	36.4	36.3	35.1	28.6	26.1	24.5	22.1	24.8
3	25.3	29.2	36.4	35.2	33.2	30.1	27.1	23.3	23.8	27.7	32.5	34.2	33.7	29.9	27.4	25.5	22.6	23.9
4	24.6	25.9	29.6	31.2	31.5	31.0	28.9	25.1	24.6	26.2	28.4	30.2	30.9	30.3	29.1	27.3	24.9	24.5
5	24.2	25.2	27.1	28.6	30.2	30.4	29.4	26.0	25.2	26.1	27.4	28.4	29.4	29.9	29.3	28.1	25.9	25.2
6	23.4	25.2	25.6	26.4	28.3	29.1	28.9	26.6	26.1	26.2	27.1	27.6	27.9	28.6	28.5	28.2	26.9	26.1
7	23.0	25.8	25.6	26.1	27.5	28.1	28.3	27.1	26.2	26.5	26.6	26.7	26.5	27.9	28.1	28.0	27.2	26.4
8	22.7	25.8	25.5	25.7	26.6	27.2	27.7	27.7	26.4	26.6	26.6	26.6	26.7	27.4	27.8	27.6	27.4	26.9

Pg. 54.
13 October, 1970.
General comments on weather while taking temperatures.
0600-0800 – Garua till 0630; then cool and cloudy; no sensible weak radiation.
0800-1000 – Sun out strong about ½ time; cloudy with strong sensible weak radiation other ½.
1000-1200 – Sun out – strong and hot.
1200-1400 – Till 1245 sun out; then out intermittently till 1315-1320; then cloudy and much cooler till 1400.
1400-1600 – Cooling steadily; cloudy whole period.
1600-1800 – Cooling steadily; cloudy whole period till cleared about 1750.
1800-2000 – clear and moonlit night.
14 October, 1970.
0600-0800 – Cool and cloudy.
0800-1000 – Cool and cloudy till about 0915; then sun out ½ time till 1000.
1000-1200 – Sun out about ¾ of time; rest of time cloudy; even occasional garua.
1200-1600 – Sun out intermittently – about 1/3-2/5's of time in total – very much an off and on thing for entire 4 hours.
1600-1800 – Cool and cloudy almost entire time till just before sunset; then sun out briefly.
1800-2000 – Sky cleared just after sunset in part; moon out and bright.
2000-2200 – same as 1800-2000.
15 October, 1970.
0600-0800 – Overcast and cool breeze; considerable garua off and on; some weak radiation between 0730 – 0800.

Pg. 55.
Beginning expanded sample of Zone 3 NA.
Northern area of NE and around small dry pond.
#918 – normal area l- around 1970-71 Nests #5 and #10.
#1020 – on up to N of central NA along tortoise pathway which parallels our sample line – actually beyond sample are, but could count because Jan heard him near camp this a.m.
New # 1302 – tiny fellow – just NW of campsite up on rocky area. CL 32.9;CW 34.2. Scutes not smooth anywhere; can still plainly see those of first year after hatching. Normal shape and scutes normal save for an abnormally wide nuchal notch. Solidly build small fellow; but thin – not fat as can see around legs and leg pockets. W.g.i.'s almost non-existent and where present extremely thin. No lichens or algae; flaking disease present rather heavily on underside of rear marginals; on supracaudal and 1st right rear marginal. No noticeable plastral concavity yet; very different looking than young of similar size from Pinzon (G. e. ephippium). Weighted with Chatillon spring balance (40lb. One) – weighs just slightly over 7.5 lbs. – very heavy for size compared to Pinzon ones. See Roll 194, photos 11-15.
Central Main Zone 3 NA –
#131 ♀ - S side near La Fe trail – in shade.

#1193 – usual burrow site down toward 1969-70 Nest #4; in shade; inactive. CL 31.6; CW 22.8. Checked his size and weighted him also weight slightly over . . .

Pg. 56.
. . . 7.25 lbs. On Chatillon 40 lb spring scale. Fatter, but still thin in absolute sense, then #1302.
Eastern Loop – No tortoises seen.
No other tortoises seen on entire search; as in expanded sample at Caseta and entire sample down to here yesterday, certainly seems that tortoises are well dispersed now.
Checked over all nesting areas of central Zone and near it:
In tiny zone to SE has been no further activity since we were last here. Saw #1269 tiny one there near usual stomping grounds, resting in shade.
However in rest of main NA, in red soil areas that is, has been much digging since we were last here, but no successful nest; in fact none of attempts went so far that any cloacal fluid was dropped. Most are in fact very shallow and only a few cm deep. All were apparently stopped because of rocks in floor and or front wall of the hole. Some are only surface scratchings and nothing more.

Pg. 57.
The areas and numbers of attempts are:
1- New Camp – just W around Nest #17 from 1969-70. Four attempts - one right on top of Nest #17 from 1969-70; and very shallow – i.e. < 6-8 cm. Appears had trouble at #17 Nest site because of crumbly dirt clods.
One attempt just to side of 1970-71 Nest #1 – All 5 of these in open red soil areas.
2- Fourteen attempts in eastern part of NA near Nests #'s 15 and 16, 1970-71.
[Marginal note: Five only surface scratchings; 9 of greater depth – 5-15 cm.]
Five in areas with heavy cover of surface organic debris; 9 in open red soil. Two in old nest sites – one exactly on old nest site where a ♀ tried earlier this year (near Nest #15, 1970-71). Stopped in both by rocks.
3 – One attempt right on top of Nest #12, 1969-70 – very shallow, hit rocks and soil very crumbly and in large clods, only 5 cm deep.
#131 ♀ could o course be responsible for many of these since all are in areas she has frequented or dug in before. She has certainly not successfully laid or gotten to cloacal fluid dropping stage of nest at any time in past few weeks because she lacks red mud in tell-tale areas.
Went over to highway and up it to top – very little sign at all. Found only one animal-#1144 – all way over from . . .

Pg. 58.
. . . central Zone 3 NA near rocks where H20 collects. Now moving N through low area of brown soils just beside highway about 1/3's of way up it. Thus adds one more tortoise from Zone 3 NA who know and utilizes highway to E of central nesting area.
Went back to weigh#1269 – weight – 10 1/8 lbs. CL 35.9; CW 38.2. W.g.i.'s clear but rather thin – but clearly healthy and doing well. Just leaving resting spot at 1520, about 2 hours after clouded over and strong radiation ended. This is of interest because saw

#1193 about 30 m S of burrow he had been in during hot sunny period earlier today; at 1505 on way to weigh #1269.
Went down La Fe trail as far as last low depression with yellowish-brown soil in it, checking for tortoises and nest. No fresh sign till first depression, then in it lots of tortoise tracks and scratchings about by an animal about size of a large adult ♀. No digging here but in red soil area on small rise just to W of this depression a few meters, saw that a ♀ had made 3 nesting attempts, . . .

Pg. 59.
. . . all 3 ended because of rocks, of depths of 6, 8, and 13 cm when stopped; no cloacal fluid dropped in any of these. Two shallower ones made right in small tiny soil patches wedged in amongst flat surface rocks – incredible that ♀ can even dig in these spots.
In next major depression just before large red soil nesting areas of Region 7, saw some more surface scratching where ♀ had been prospecting for nests, but no nest or substantial attempts.
Found 1 tortoise on this excursion - #1054, very tiny fellow; CL 28.8; CW 30.9; weight 4.75 lbs on Chatillon 40 lb spring balance. No lichens, algae, flaking disease or smooth scutes; w.g.i.'s clear but very thin – however, clearly growing. No plastral concavity. Remarked because notches almost invisible now.
Examined fresh turds dropped by #1054 and #1302; neither contained any Opuntia or Jasminocereus material; both were full, mostly of stems and leaves, all rather well digested, of common small green herbs from this area. Turds were very moist and with abundant paste-like interstitial material in them. Each tortoise became excited and urinated profusely also; this was also true of 2 other small ones, #1193 and #1269. thus they do not seem lacking for either food or H20 now – not surprising given garua and flat rocky . . .

Pg. 60.
. . . H20 collection sites in combination with more abundant scattered tiny herb seedlings now available.
Zone 3 NA – Weather – 1900 hrs – Max 80.5; Min 62.0; Rain 0.5, not emptied; Evap. 4.1, not refilled.
14 October, 1970. On toward La Fe.
Region 7 straight line sample –
#918 – near flat rocks.
3131 – S side main Zone 3 NA.
#1054 – same area as yesterday late.
#1198 – big open red-soil area along trail in Region 7; moving about at 0800, just left burrow site. CL 55.8; CW 57.0. No lichens, algae, or flaking disease. W.g.i.'s clear but very thin.
Stop sample for awhile – am searching this general are for nests.
In main red soil area surrounding trail there is abundant recent digging sign; but not any of it resulted in nest or even deep holes with cloacal fluid dropping. All very shallow diggings of only a few to up to 10 cm; but all quickly hit rocks at or near surface.

Pg. 61.

Reinforces impression that his is not a good nesting area, perhaps largely because of goats scratching away and exposing surface soil to severe occasional erosion. Counted about 15 attempted nests throughout this area. Then in a low depression filled with yellow-brown soil to E a short distance from area usually searched – Nest #30 for this year (in fact has a huge oval hard cap; maybe 2 nests?, doubt it, probably just an excessively large hard cap for 1 nest). [Marginal note: See later on in this volume for Nests #23-29; from JCSM; La Torta.] Three other clear nesting attempts immediately around this one. All unsuccessful, being about 10-15 cm deep each but with rocks in bottom and or sides of each. Easy digging here but fine soil and does not form a good solid long lasting hard cap. A very open depression not shaded much by barranco walls around or trees. On a sunny day should get direct sunlight from 0700 to 1700 at least; i.e. during all but coolest portions of daylight time.
Nest is only a few days old at most as its hard cap is still moist right to its surface; has a layer of 0.5-2 cm of loose dry soil over hard cap, depth varying with location. Female responsible is on rocks only 20 m away eating fallen Opuntia pads and small herb seedlings - #1056 (= #136 painted) – remarked her notches as they are getting weak; also . . .

Pg. 62.
. . . repainted her. She has fresh soil and dry mud of type where nest is all over her rear legs, feet, tail, leg pockets area , and skin and lower and upper lip of rear of carapace.
1969-70 Nest - Also there is a 1969-70 nest in this same small depression, destroyed by pigs.
Continued lower Region 7 part of trail a short ways and then searched off for some areas on either side of it. Found 6 more attempted nestings, all less than 8-10 cm deep and all in red soil areas where plate lava rocks are right near or on surface.
Then left sample line again – and searched to E through series of 3 areas, including one where nests #6 and #11 1970-71 are located. Found only one new attempt here – a deep hole, 15 cm with cloacal fluid having been used; stopped by rocks in side walls. Apparently, had gotten several first-sized rocks out, but no further. At least 1-2 weeks old. No new nests. Two tortoises there – both old friends - #1132, small–medium . . .

Pg. 63.
. . . one (♀ scale), and #1113 ♀ (painted #113).
#113 ♀ - while I was here, after about 30 minutes of cool breeze and garua moved out and began searching movement pattern; looks very much as if she is going to try and nest here now, i.e. second attempt in this area; do no yet know if she laid a nest here or near here – perhaps #11 nest is hers. repainted her. She has certainly nested once this year already because her rear area has old red mud and dirt in tell-tale sites – however not very fresh at all – certainly 1-2 months or more ago. She has not nested or gotten to cloacal fluid stage recently for certain. She is definitely searching now; looking, sniffing ground, etc. in typical fashion. Now 1130 hrs; cool and cloudy but sensible weak radiation coming through – enough to create weak shadows.
Back to sample line and on southwards.
Region 8 – no tortoises or fresh sign.

Region 9 – no tortoises or fresh sign except some recent burrowing and a few turds in area where I usually see 2-5 animals. Still, incredible absence of tortoise activity or sign in Region 9 where I almost always . . .

Pg. 64.
. . .see at least several animals and abundant sign. All sign in these areas is at least 3-4 weeks old and most is much older.
Then instead of going to La Fe itself went to S directly to coast along new trail I cut in August for W. G. Reeder's group. This will serve adequately as a substitute for La Fe trip usually done because at about same altitude as La Fe "pampa colorada" is a pampa of red soil which is reasonably similar to La Fe.
For entire remainder of the trip on through rest of Region 9 equivalent and Region 10 equivalent to coast saw no more tortoises and almost no sign, new or old – i.e. from right turn area of La Fe trail, through pampa colorada and to coast. From beginning of Region 9 all way to coast I was impressed by tremendous quantity of fallen Opuntia pads all throughout tree cactus forest which begins at Region 8-9 border. There, of course have been fallen pads around virtually every juvenile to adult Opuntia all year round, . . .

Pg. 65.
. . . but much more now than ever before – much more especially than this same time last year (why?) and more also than in hot season (January – May) when there were a lot of downed pads. Also noted more fallen fruits now than have noted at any previous time. Opuntia are just beginning to flower now.
Should note that this pattern of fallen pads holds true wherever there are Opuntia , i.e. all way up through Zone 3, to Region 4 and even above Region 4 where there is a scattered occasional Opuntia to altitude of even 300 feet. I mentioned it above in relation to cactus forest per se because it was so notable there.
Also note that pads are more desiccated when fall now than they were in hot season – why I do not know but it is true. But freshly fallen pads are still quite moist and offer goats and tortoises fresh food and moisture. Tortoises are certainly using this source; saw #'s 131 ♀, #136 painted (#1056), and others all eating cactus this trip. Down through all of Region y found fresh to 1-2 month old turds all full of Opuntia pad remains. Found same in . . .

Pg. 66.
. . . scattered 1.5-2 to 3 month old turds in Regions 8, 9, 10 of trail to coast.
Goats are also eating Opuntia – saw some eating fallen pads in Region 9 and also have seen many, many fed-upon and destroyed or partly destroyed "seedling" and "sapling" Opuntia; apparently cause by goats – always are abundant signs of goats near these (small plants) and chewed places on remaining pads. Goats still chew into trunks of large, adult ones with red bark, but not often in these areas of the cactus forest because other fallen material is so abundant, as are seedling and sampling –sized ones with pads. Right now in fact, vast majority of quantity of fallen pads and fruits below 150-120 feet altitude, i.e. Region 8 and below of trail, is simply rotting because goats and tortoises not plentiful enough to eat it all up. In Region 7 and above, Opuntia are much less common and tortoises more dense and they clean up instantly . . .

Pg. 67.
. . . completely, all pads and fruits around bases of Opuntia trees.
Have seen no clear evidence of tortoises eating young Opuntia seedlings or saplings at this time (as I saw #422 ♂ doing earlier this year); instead seem to be utilizing less spiny pads and fruits fallen to ground from large trees. Goats on other hand are now eating all of these size classes of Opuntia.
Food situation in general has much improved all along sample line from Caseta to coast. Of course is rather lush now from Caseta (and above it of course) all way down to about 400-450 feet altitude. Below this zone with a superabundance of vegetation (superabundance for tortoises that is, it appears so anyway), vegetation is much more scant and still very sparse and of course decreases in quantity and is more and more scattered as one goes downward in altitude to coast. However, comparatively, quantity of leafy shrubs, and herb seedlings is continuing to increase each month as it has been doing since herbs first began to grow again in about mid July. This is now enough of a cover in Zone 3 NA and other nesting areas . . .

Pg. 68.
. . . of Region 7 of Caseta-La Fe trail such that smallest tortoises and hatchlings could survive and grow I'm sure. Herbs are not abundant by any means and are small, but they are scattered everywhere, especially on lava rock piles and are green and moist. This situation holds true down through Region 8 and even on to coast in most places – i.e. vegetation quantity, i.e. herbs and leafy shrubs at tortoise feeding levels, is enough for young tortoises to probably survive on small scattered herbs. Of course, the lower one goes in altitude below zone 3 NA the less and less abundant are herb seedlings.
In sum, one could simply say that now there is something to eat from about 300 feet (i.e. Region 4 more or less) on to coast, for small hatchlings and littlest tortoises. There is more vegetation now than at any time since late January 1970 – i.e. just before the big die-off caused by the . . .

Pg. 69.
. . . extremely long, hot drought of February – mid June, 1970. There is not nearly as much or as lush a growth as grew and persisted after the heavy March, 1969 rain on into and through the 1969 garua season (or at least most of it – till November – December was still rather green in Zone 3 NA) in these lower zone but it is something; in contrast by mid to late March and from then till mid July there was nothing small and green for the young hatchlings and juveniles to eat in areas such as Zone 3 NA. The could eat Opuntia droppings but do not seem to be able to do so or at least do not do so. I examined turds of #'s 1193 and 1269 in late hot season and on into mid to late July before garua had accumulated enough for herbs to begin growth – no Opuntia or Jasminocereus material; just dry leaves and twigs' remains. Today and on this trip I looked at turds from #'s 1054, 1193, and 1302 – all little fellows; all were very moist and full of green leaves and twigs' remains – no cactus material; i.e. dedicative of abundant garua in H20 collection pockets and small green herbs available to them now in rocky areas.
So with combined effect of green herbs and collected garua H20 now available to small as well as older . . .

Pg. 70.
Tortoises, Zone 3 NA and similar areas has enabled them to begin growing again since about mid to late July. Progressively since first seedlings were seen in July, more and more have popped up and quantity and size have both increased steadily till now with the accumulating effects of the garua.
In smaller (but similar to La Fe) pampa colorada on new trail found are reasonably fresh sign of an attempted nest (more or less 1 month old I would guess); saw no tortoise and only a few scattered turds of 203 months age at minimum. Also some few older turds, bleached white.
Also here located 2 skeletons of slaughtered tortoises. Both about 90 cm CL (measured; but exact values impossible because alls scutes off of bony carapaces). And both definitely large adult, laying-sized ♀♀; scutes smooth and old like largest ♀♀. In both cases men had cut plastron away to enter body for . . .

Pg. 71.
. . . liver and fat. Both in northern area, i.e. pampa colorada, and both only a few meters apart. One is about 3-5 years old I would guess; breaking in at top and more weathered. The other is only 1-1.5 or 2 years old, being much less weathered and just beginning to open up along one scutes juncture on top. I, in fact, would guess this one (see Roll 195) is closer to 1-1.5 years old a kill at most. Interesting because this area is about a 15-20 minute walk inland from coast only and there are landing markers here and lagoons below along this stretch of coast (markers are ladders and long sticks set up in lava pile supports).
Two other kills (also both large adult ♀♀) are inland only about 40 minutes walk from coast; these I have noted before, and are both in area with small soil filled depressions and large lava rises and Opuntia forest in Region 9 of my trail – i.e. area where I usually see 2-5 or more tortoises on each sampling. All 4 of these are more or less directly N inland from this area of the Santa Cruz coastline.
This pampa colorada probably used to be a small and perhaps significant nesting area, but it has a lot of lava blocks and rocks all over surface now and . . .

Pg. 72.
. . . burros and goats keep it well cleaned up and dusty and subject to erosion when rains are occasionally heavy. This fact plus fishermen and old-timers taking ♀♀ and other adults and young has certainly led to the end of this small area as a productive nesting zone. I would guess that a successfully laid nest would be a rarity here now on a maximum for most years.[Rewrite phraseology?] Certainly very limited tortoise activity here now.
From this pampa on to coast is only about ¾ - 1 km – all lava, but gently rolling and cactus forest. But saw no tortoises and no more sign of them; even old dry turds not in evidence. Probably use to occur here but very rarely now because of human predation on population in past.
On return to Zone 3 NA found that #1295 (Jan watched) had moved in over rock pile from E, down past camp and to rocks where H20 collects. Clearly headed specifically to rock area and is . . .

Pg. 73.
. . . now (1600) poking about there grazing on herbs; probably has definitely come here for H20 in mornings provided by garua.
#131 ♀ - no nesting activity yesterday; none today also. Saw here at 1530, already burrowed into a soil depression in western part of nesting area; only 25 m from where spent all of yesterday, mostly resting, occasionally grazing.
15 October, 1970 –Zone 3 NA - Weather – 1900 hrs – last night – Max 78.5; Min 63.5; Rain 0.0, still reading 0.5 mm; Evap. 3.9 ml, reading 7.9 ml.
Zone 3 NA – Weather – 0915 hrs – today – Min 62.0 ºF, reset this and max; Rain 1.0 mm, reading 1.5 mm; emptied; Evap. 0.5 ml, reading 8.4 ml; refilled full.
On to Region 4 to take temperatures of soil probe.
Enroute –
#128 painted ♀ (#133♀) – only 200 m below big boulder area (region 5-6 border) on trail; moving S on trail; no sign of recent copulating or nesting; looks as if nest once earlier this year definitely as has red and yellow-red soil and mud ground into rear legs, feet, tail, and carapace lip area.
#112 painted (#121 ♀) – repainted. In mid-lower Region 5. Sitting in . . .

Pg. 74.
. . . shrubs near last night's burrow. No sign of any recent nesting or copulating activity. Not even any old red or yellow-brown soil detectable anywhere, just dark brown mud. If has laid this season did so in a site like those where Nests #5 and 10 are just above campsite in Zone 3 NA.
Region 4 – near rocks – 4 small-medium fellows - #1194, 962, 1104, and 182 painted.
To instruments and camp – Began at 1100 taking data.
Soil moisture availability:

Hour	1200	1600	2000	0600
5 cm	JBR	JBR	JBR	JBR
22 cm	NR	NR	NR	NR

NR – no register; JBR – just at first line of scale.

Weather information for day:
0600-0800 – cloudy and cool; occasional rain (garua) off and on.
0800-1200 – sun out about 1/3 – ½ of time.
1200-sunset – sun out off and on ; cloudy about 60-70% of time; cloudy almost continuously from 1500 on.

Pg. 75.
Soil control column - Region 4 - 15-16 October, 1970.
Position

	1100	1200	1400	1600	1800	2000	0600	0800	1000
1	32.2	35.7	33.4	29.3	28.6	23.1	19.0	23.0	26.0
2	30.0	32.2	31.0	29.1	24.6	23.1	19.8	22.1	25.0
3	27.8	29.6	29.6	28.9	25.4	23.6	20.5	21.9	24.2
4	24.4	25.0	26.2	27.2	26.1	25.1	22.4	22.3	23.2

5	23.9	24.4	25.2	26.3	25.9	25.4	23.1	22.8	23.1
6	24.2	24.1	24.0	24.8	25.0	24.9	23.9	23.6	23.8
7	24.2	23.9	24.0	25.0	25.2	25.2	24.0	23.6	23.6
8	24.2	24.0	24.0	24.5	24.9	24.9	24.3	23.7	23.6

Pg. 76.
Going over to new area of yellow-brown pond – pampas to W of camp; area where first saw #51 ♂. No in sample; just poking around.
#1078 or 1071; probably former but hard to tell – CL 59.9; CW 58.5. No lichens, algae, flaking disease or smooth scutes; w.g.i.'s incomplete and extremely thin where present. ♂ probably; strange anomalies in shell – 10 left marginals; to make up for this, extra wide gaps between 2nd and 3rd, left front marginals and 3rd and 4th rear left marginals; also some of scutes, notably 3rd left costal has very protruding prominence in center of scutes – very raised. All the costals on both sides show some of this tendency; certainly same in bony carapace below. All this due to developmental pressures? See Roll 196, '3's 14-17.
At entrance to pond – pampa area on its N edge; grazing on small herb seedlings beside goat trail.
No others seen and no other sign; see Roll #196 for other photos of dry pond areas, bones of slaughtered tortoises, etc.

Pg. 77.
Region 4 – Weather – 1620 hrs – Max 77.5; Min 63.0, both reset; Rain 1.9 mm, not emptied; Evap. 9.6 ml, no refilled.
16 October, 1970.
Region 4 enlarged sample –
Western loop –
New #1303 ♀; CL 69.3; CW 77.0. No lichens, algae flaking disease or smooth scutes; w.g.i.'s clear but rather thin. Near camp; inactive (0700); in forest. No definite sign of recent copulating or nesting detectable. (Painted #186.)
No others seen – only very infrequent and scattered recent sign.
Central area and around water collection sites.
#184 painted – in burrow still near flat rocks.
#1194 – up on flat rocks drinking.
#183 painted – just E of dry pond – in burrow.
New #1304 ♂ (probably) – CL 65.9; CW 72.4; no lichens, algae, flaking disease, or smooth scutes. W.g.i.'s clear but very thin. Drinking H20 from pockets in rocks, E of water collection area up on some other flattish rocks. (Panted #185.)
In pond area:
#1104 – basking.
#182 painted – basking.
Very, very few and very dispersed tortoises in Region 4 now; a strong proof of this in addition to above 2 hrs search and sample . . .

Pg. 78.

. . . results is that for past two mornings have had substantial garua and H20 collected at watering site on flat rocks – but very few animals there to use this – very unlike other times when 10-15 would be there after an early morning of garua.
Apparently here as in Caseta area above – large ♂♂ and ♀♀ have gone up to higher altitudes, some smaller ones have done the same, and only remaining ones are smallish 60-70 cm fellows; in addition those remaining are very dispersed. There is enough food here now, i.e. small herbs and leaves on shrubs, but it is very, very scattered and barren in comparison to wet lush areas at 450-500 feet and above. This plus lack of standing H20 have certainly added to tendencies to disperse and to move higher up. Of course some large ♀♀ may be below nesting. As illustration of these movements see previous notes on #'s 75, 77, 80 all painted ones, and some others. Also, where have #'s 71, 73, 79 all painted numbers gone – were here for 3 months and have suddenly left it appears. Everywhere to Caseta level tortoises seem to have dispersed and many have . . .

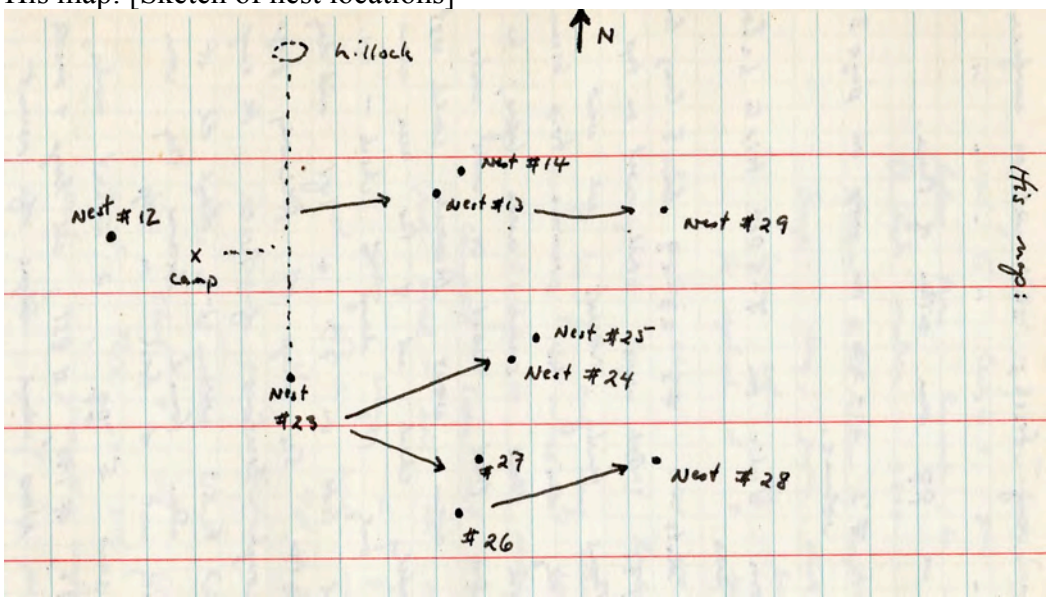
Pg. 79.
. . . gone well up in altitude, many way above Reserve Border.
Region 4 – Weather – 0900 – Leaving at 1015 so will finish check now. Max can't read, too early; Min 62.0; Evap. reading 10.1 mm, refilled full; Rain reading 3.2 mm, emptied.
On return to Caseta:
#127 painted – Region 2-3 border.
#181 painted – Region 2-3 border.
#1215 – mid Region 2 – moving S along trail.
#1255 – 100 m below Caseta Pond #1 – grazing in main drainage bed.
#124 – painted - same area exactly where saw on 12 October.
#47 painted – 50 m below Caseta in drainage just below small pond; grazing on grass.
#31 - just below Caseta; grazing on grass.
This afternoon went over to retrieve carapace and plastron of #97 ♂ from Reserve border in Mora. Enroute saw a number of animals:
#695 and #156 painted – at Caseta trail – Reserve Border junction.
#1013 – same area where last saw on 11 October.
#608 – ½ way to top of first hill.
#50 painted – 2/3 way to top of first hill.
#15 painted – just over top of first hill.
#99 painted – just over top of first hill – 50 m further on.
#450 - same place saw on 11 October.
All were grazing between 1330 and 1430 when passed by each one twice.

Pg. 80.
Today (15 October) Julio San Miguel went to Cerrito and new nesting area below there. Enroute he checked El Chato Weather – 0900 – Rain 0.32 inches, emptied; Evap. dry; paper disk gone – had been eaten by birds or goats. He replaced it and refilled tube full.
In nesting areas: Saw no large ♂♂; only 2 large adult laying –sized ♀♀.
#463 ♀ half way between Nests #7 and 8. No sign that had laid a nest yet.
#1064 ♀ - in new nesting area near campsite (near Nest #7). She had red mud and soil all over rear parts and was near a freshly dug hole which had mud all around and in it. Not a completed nest and had one broken egg in it on floor – I wonder what caused her to stop

short and not complete this nest. This is 3rd anomalous nest in general nesting areas here this year (see previous notes, this volume on Nests #19 and 21).
3 new nests –
Nest #31 – dry on top; at least 1 week or probably even older – missed before certainly. No ♀♀ near this one.

Pg. 81.
Nest #32 – very fresh; still wet on surface.
Nest #33 – very fresh; still wet on surface. Saw no ♀♀ near either of these.
These nests and #'s 20-22 on map on page 39 of this volume.
Notes from Julio for 7-9 October trip to La Torta Nesting Area:
7 new nests – Nest #'s 23-29 for Santa Cruz for 1970-71. All were still wet on top and thus fairly recent; all new definitely since his previous trip because checked these same areas before; he protested that must be more nest there even now because could not adequately check all of the area alone with only 1.5 days to check – i.e. arrived late on 7th and left mid day on 9th. See map on following page for rough locations of these. He say Nest #'s 23 and 29 were 1-2 days old at most when found because they were extremely wet and fresh on top.
He saw 5 ♀♀, 2 without marks, #593, #190, #831; all large and smooth shelled. None had signs of recent nesting or cloacal fluid drop stage of nesting at least. Says lots of new holes from attempted nestings all over nesting areas.
Near small hill above nesting area he found a slaughtered tortoise, #453 will all scutes still on and all bones compete; only plastron open and fat removed. Not there on his previous trip.

Pg. 82.
His map: [Sketch of nest locations]



Caseta Weather – 1900 hrs – Cool and cloudy all day; but almost no garua; but not any sun. Max 70.5; Min 63.5; Rain 1.55 mm; Evap. 0.0, reading 16.3.

Pg. 83.
17 October, 1970 – Sampling Caseta Upper Ponds area –
Fields below ponds –
#695 – grazing just below Reserve Border (Painted #187.) W.g.i.'s thin but OK.
#505 ♂ - moving just S of Reserve Border and E of Caseta trail to W steadily through 4 foot high herbs – coming from forests to E. CL 111.2, only to check identity. W.g.i.'s present but very, very thin. (Painted #188.)
#2 painted and #156 painted – just below Reserve Border; grazing ; w.g.i.'s of both well-developed and of medium thickness.
#117 painted – above Reserve Border 25 m in field; grazing ; w.g.i.'s as in previous 2 animals. Repainted.
#157 painted – grazing ; w.g.i.'s mostly non existent, when present thin.
Ponds - #96 painted – near Pond #2; grazing.
One large adult male, 128 cm CL almost; unmarked Could not paint because of rain and could not mark because do not have saw. Am sure I did not see this one before today during entire study.
Worked most of day at Caseta – was miserable and wet and grubby all day long virtually; garua most of time, cool, breezy; no sun.
Caseta – Weather – 1900 hrs – Max 72.0; Min 63.5; Rain 3.35 mm; Evap. 0.1, reading 16.4.

Pg. 84.
18 October, 1970.

Ill today so not able to do much. Packed up some things for playa and wrote notes. Cool, cloudy morning but nice hot warm sunny afternoon.
Caseta - Weather – 1900 hrs. – Max 77.5; Min 61.0; Rain 1.55; Evap. 1.4, reading 7.8.
19 October, 1970. To La Torta nesting area for 3 days;
Enroute noted following animals –
#2 ♀ (duplicate number; small one) – near Caseta Pond #4.
#268 – at Poza de Manzanillos along Reserve Border, just before Zone #1 turnoff.
#813 ♂ - 100 m before Zone 6 turnoff.
#189 ♂ (perhaps #389 ♂ - hard to tell) at Zone 6 turnoff.
Starting down "pica de vaca" for La Torta.-
#911 ♂ - CL 124.89; CW 138.3. Only 500 m down trail = still in nice forest of Scalesia, Xanthoxylum, with nice undergrowth of herbs of 2-4 dm high (Blechum, etc.) – very green and wet; grazing all over here – lots of his trails and turds; moving down a bit for past day or so. W.g.i.'s extremely thin and most non-existent. (Painted #189.) Has no lichens; scattered flaking disease, and black-green algae on two normal area of front and rear marginals.

Pg. 85.
Below in first real pampa-pond area we found first slaughtered tortoise Julio had encountered before on first trip to La Torta this year. Took photos, Roll 200, #'s 16-20. Only a few months old at most – was fresh with (word no legible) when the found it; scutes just now falling off. Number was under 100 because none on rear; but killer cut all of front marginal scutes and base off so can't tell number. Probably a small ♂; CL about 92 cm; not exact. CW 102.5 (exact). Scutes worn and smooth only in very central 1/10 or less. The took only fat and perhaps liver because all leg bones, head, etc. are present. Cut into from below as usual with machete – see photos. I collected head (skull) and lower jaws.
New #1305 ♀ (probably) – CL 77.9; CW 80.5. Same general pond area; at edge of a dry pond full of Rodillo de Caballo; in sun-shade mixture under a large dead manzanillo eating small herbs – a Verbenaceae species – seems to be same species or at least genus as collected from ponds on NE San Cristobal near our camp in late September, 1970. W.g.i.'s clear and well-developed but thin. Scutes smooth only in very tiny central parts. No lichens or algae or flaking disease. (Painted #190.)
One other slaughtered one – same pond – pampa area – will check on return or another trip.

Pg. 86.
#1094 – too small to determine sex; CL 54.3; CW 56.5; no lichens, algae, smooth scutes or flaking disease. W.g.i.'s thin but very well-developed. Grazing; same pampa-pond area. Remarked; notches becoming faint.
Continued on down through this pampa – pond mixture for at least ½ km and perhaps more – very huge area obviously, extending "vertically" and laterally over a great area. Very little tortoise sign but no time to really look over area – will describe more adequately later.

Came to "hill" or "Lomita" as so is call by Julio. Is actually a very long high barranco. From here can see highlands very well. Compass directions from high point on this barranco:
To center of Cerro Camote – 38 º
To highest point on Cerro Bandera – 354 º
To center of Cerro Lechoso – 319 º
Altitude – Lufft – 1300 hrs – 29.5 ºC inside case; top of barranco reads 108 m. Therefore approximately 80-85 m on pampa to N we have just crossed because barranco is about 25-30 m high at least.

Pg. 87.
Immediately due S , SW and SE of barranco is La Torta pampa colorada and nesting areas.
New #1306 – small fellow – too small to determine sex. On flat top of barranco in shade of a palo santo, inactive. Lots of small boulders and spots of red soil all over here; small herb seedling sonly to eat. Like Zone 3 NA conditions more or less. CL 43.0; CW 45.9. No lichens, algae, flaking disease above (one tiny spot of it on underside of rear marginal) and no smooth scutes. W.g.i.'s clear and well-developed but thin.
Weighted with 40 lbs Chatillon spring balance – reads 15.5 lbs. Not fat but growing and healthy; plenty of food and garua H20 available here.
Just to S of barranco top in plandada of rocky red soil type which stretches out to S form its top found #453 (slaughtered one Julio recently found) and another slaughtered one on 20 m away from it – appears both killed in same period or same day. Area is an open pampa with lots of Opuntia of all ages, scattered Bursera and an H20 collection site of flat rocks. Tortoises clearly use H20 site and feed and water here – some scattered dry turds. Small one above (#1306) essentially in this same pampa.
Slaughtered ones –
#295 ♂ - CL 125.0 plus or minus; CW 135.0 plus or minus. Scutes smooth in central 1/15 – 1/10 or less.

Pg. 88.
#453 ♂ - CL 120.0 more or less; CW 130 more or less; Both losing almost all scutes now; all bones left; so people only took fat and perhaps livers. Same stage of decomposition exactly so certainly killed at same time. Both open below in standard fashion. No attempts made to cut off marked scutes – bones.
Collected skulls and lower jaws of both. Took some photos – Roll 201, KII - #'s 1-3 of #295 ♂; #'s 4-9 of #453 ♂; some with Julio.
Went on down S toward main pampa colorada and nesting zones. Enroute passed mostly over rock, but every 100 m or so (no regular; what I mean to say is frequently and in scattered fashion) passed through small depressions filled with reddish brown soil and often through small plate lava areas with lots of scattered patches of bright red soil. We began in the very first of the latter type area to note some recent digging activity – all shallow holes stopped within 10 cm of surface (most much more shallow . . .

Pg. 89.

. . . even – by rocks. Julio says this digging (but no ♀) was here on 9 October when he passed by here. Then began a series of 2 similar spots and other 3 depressions with red-brown soil. Trail passes over small areas of rock and Cactus forest between them. In each we noted a few to many attempted nestings, all relatively fresh. Julio says all this digging is new and was not here on morning of 9 October when he passed by. All these attempts stopped early because of rocks in walls and or floor of holes and or because of dry loose crumbly soil – mostly because of rock it appears Depressions make for better digging and deeper holes are in them; goats and burros have churned all this soil up and especially on plate lave areas, soil has washed away badly leaving rocks at or very near surface which ruin nesting success chances.
Finally in last or 3rd depression found several more holes, one about 15 cm deep stopped by rocks in walls of nest. Female had used much cloacal fluid here – all dry now, so probably 7-10 days old. Then in a similar site only 3 m away found Nest #34 for 1970-71. Also dry completely at surface and only slightly moist inside at egg level. No hard cap at all. She was apparently rather . . .

Pg. 90.
. . . desperate when finally laid this nest (apparently after digging many, many holes, if same ♀ can be said to be responsible for all those in this 5 or 6 small areas; probably so because is a ♀' trail going from nest attempt to nest attempt and small zone to small zone, downhill all the way from first of the 5 areas), because obviously used almost no cloacal fluid, and some of egg at least are right near soil surface. First 4 eggs we could see all only 3.5 cm below "hard" soil surface and with cap of 2.5 cm of loose soil which she had placed over nest, they are only 6 cm bellow soil surface. Will be interesting to see:
1 – how many eggs in this nest and how large hole or nest cavity is,
2 – if eggs fill cavity completely,
3 – if cavity is abnormally shaped or of abnormal size, and
4 – if eggs, especially those very near surface develop successfully and hatch. Area is slightly shaded by some surrounding but leafless, Bursera trees, but nest will get full sun on really . . .

Pg. 91.
. . . sunny days from 0730-1700 more or less with not much nut very slight partial shading. We re-covered nest without excavating it further or removing any of eggs – only could see tops of them; should note that because did not seem to be a nest Julio accidentally broke one with his boot in looking at site when we first approached it. We removed this and threw it away – seemed well formed but could not tell if fertile because too fresh – looked OK; normal size, shape, shell thickness, yolk-albumin proportions, etc. There is no air space around eggs because of lack of ♀'s use of cloacal fluid (perhaps she used most of it before finally successfully laying ?) and lack of hard cap; instead they are packed in with loose slightly moist soil all around them. Marked tree nearby as Nest #34; no corral yet. No ♀ in immediate area.
Lufft read 69 m here at 1530 hrs; 30.5 ºC inside case. (this is probably too much).

New # 1307 ♀ (probably) – CL 50.5; CW 53.5; In same area; inactive in shade very near nest. No lichens, algae, smooth scutes or flaking disease. W.g.i.'s clear and well-developed but very thin. Took weight - 26.25 lbs.

Pg. 92.
Went down trail only another 50 m and we were in beginning of huge nesting area. Decided to camp here as a central spot and work S, E and W through many nesting zones. Is at same altitude as Nest #34.
As it was late we poked around a bit only – found 3 ♀♀ digging; 1 that perhaps will dig (nest) (near campsite); 3 more new nests. Will write all this up tomorrow in my notes.
20 October, 1970. – Will examine as much of nesting area today as possible. Will take temporary notes with idea of eventually drawing a rough map to locate all nest. Therefore will not try to describe our movements or specific locations of nest or animals in following notes; Will do this later with map and a general summing up.
The following notes will simply record animals (tortoises) and information about them, nest and information about them, and other such data. After map is complete will roughly locate all these tortoises and nest on it. Will also wait . . .

Pg. 93.
. . . till summary for general comments on nesting area, its substrate and structure, etc. Area all around campsite – more or less a depression with red soil.
New #1308 ♀ - CL 93.7; CW 105.5; no lichens, algae, or flaking disease. Scutes smooth in central ¾ plus – only small border of ¼-1" of worn old growth rings visible on scutes. Notably flared rear and front marginals. May have nested recently – old dry red mud and red soil all over rear legs and tail – impossible to say if really nested or just wallowed in red soil here after some garua. (Painted #191). Sleeping in dust wallow; did not try laying last night.
New #1309 – Too small to sex accurately; CL 45.7; CW 47.4. Same area; moving about foraging; no lichens, algae, flaking disease, or smooth scutes; w.g.i.'s extremely thin. Weight (Chatillon 40 lb spring balance) – 16 1/8 lbs.
Just E of campsite beyond Nests #13 and #14 –
One small one – CL 22.3; CW 23.2; sleeping in a very dusty red soil burrow just above depressions where ♀♀ are laying; under a very neat overhang of a large rock. Weight – 2 3/8 lbs (Chatillon 40 lb spring balance). Painted with a #1 on rear of carapace; too small to mark permanently yet. Sleeping still 0830 hrs. See Roll 201, #'s 10-11 – photos of him in little dusty hidden burrow; very good information behavior.

Pg. 94.
A bit further to ENE checked for one small one we saw sleeping in a red soil dusty burrow in a crack in rocks; was up on a rock pile just N of main large open pampa. Had moved this a.m.. Could not locate so will return here to check for him later; he has a nest well worn path, avoiding roughest rocks, down through tiny soil patches and out onto main pampa; it is just his width and well worn and used frequently; probably almost daily; fresh tracks on it look as if he used it this a.m. Looked for him on pampa below but could not find. In case I do not see him again should note is about 30-35 cm CL and has

a small hole in 1st right rear marginal (put here by Galo Torres; in this same area on Julio and Galo's first trip here.
More to ENE wet up onto another large open planada –pampa. Will search over it and in many small depressions all around it.
#4 ♀ - CL 99.6; CW 115.0. Found her last night digging in . . .

Pg. 95.
. . . one depression on W side of this upper planada; depression full of powdery, fine reddish-brown soil. She made one hole and quit on it when still shallow- only a few cm deep – full of rocks; many holes all over this small depression – fresh and certainly hers – at least some of them. Then she started a new one and got it going well – used much – several cups I would guess of cloacal fluid but finally quite – nor rocks in bottom but a large one occupying entire front wall of cavity prevented her from making any of normal flash undercuts. Apparently, therefore quit. Hole was 15 cm deep in center when she quit; could have put a single layer of 5-6 eggs in nest as it was but she was clearly unsatisfied because of lack of flask shape. See Roll 201, photos #12-14. She has no lichens or algae; flaking disease scattered in 2 usual areas along scutes border and elsewhere also along border; scutes mostly smooth save for outer ¼-2" of very worn remnants of growth rings on some of them. No evidence of recent copulation. Clearly trying for nest now. Has been her awhile because is covered with red dust. W.g.i.'s clear but thin. Julio thinks she was in Zone 1 pampas in January 1970; perhaps he says when he and J. Black were there; her #4 cut has been recently re-marked. (Painted #192)

Pg. 96.
Two old nests, 1 year or more old – large pieces of hard caps thrown to side. Julio is rather sure has not been here before so must be 2 destroyed by pigs – almost certain – has tiny egg shell fragments and other pig signs. Almost certainly 1969-70 or 1968-69 nests.
A short ways to N in another large depression with more bright reddish soil then last area - on NW side of upper pampa planada –
Nest #38 – well dried out at surface – probably couple months old at least and very hard to detect. Julio says he and Galo passed here on first trip but he has not since bee by here. At that time were no nests here (will check dates) but a ♀ was digging here; was one hole in which she had used a lot of cloacal fluid and was fresh and muddy then – still present now but of course, all dried out. Other sign of recent digging here also. But all only shallow holes.

Pg. 97.
Continuing to swing around entire northern limit of this upper open pampa – at N edge is a sharp rise of rocks, almost a barranco – perhaps are more nest and or sites to N but we can not cover everything and does not look as promising there – probably mostly rocks above and only small patches of soil.
On very N side of pampa in a rather rocky area but with lots of red soil and Bursera trees – one more old nest from 1969-70; typical exit hole made by young tortoises – inside 1 infertile egg and egg shell remains of another 9-11 – all OK and apparently left nest. Not one sign of a dead tortoise hatchling inside – a large well-made nest. Closest eggs to top only 10 cm down from soil surface.

In same area found a dead tortoise – small one, about 15 cm CL or less and of 1.5 – 2.5 years age I would guess. Killed am rather sure by cat – no head, legs, or insides left; crushed some – entire top of carapace eaten out; looks as if a large tom cat killed and ate it; doubt pig because a pig would eat all or nearly all of it; took photos – Roll 201, #'s 15-19 Collected for CDRS museum or myself – not sure which yet.

Pg. 98.
On NE side of upper planada – in a large depression at foot of a large barranco which runs around planada at this point. Depression is full of mostly yellowish-brown, fine powdery soil; some patches of red-brown soil, but not much.
Found remains of another one of just about same size as previous one – again surely a cat - remains are only scattered plastral bones, rear legs, all scutes; some skin; appears to have eaten head, forelegs and all inside flesh and parts – dry and a bit older than previous one – both in past 2 months however. Below a large Opuntia with lots of pad on ground; some of its small droppings full of herb stems and grass in same area. Surely another cat kill.
Nest #39 – Still wet right to top of hard cap and covered with about 1 cm loose dry soil. Julio has not been by here since first trip with Galo Torres. Abundant digging and sign of tortoise of almost all sizes but largest ♂♂ all over here.
Nest #40 – Same area – drier than others here; moisture only about to 8 cm below surface, right above eggs; had to open a small hole to see eggs to detect for sure that was a nest l- could only see 4 eggs but . . .

Pg. 99.
. . . certainly more; closed up well and covered top again with loose soil.
Nests # 41 and #42 – same area; both exactly in same condition as #39.
Found 1 more 1969-70 nest here; Galo had already opened 3 here; all hatchlings had left all of them – no rotten eggs or remains of young. This makes a total now of 52 nests from last or at least recent years; and in 50 of these all young had left ; only 2 contained infertile eggs (1) or trapped young (1). Impossible in the 4 here to count how many eggs/nest – shells too broken up now.
One small hatchling found here beneath a large Opuntia tree; 1969-70 for certain; has added on some growth rings and although not fat, is healthy and growing slowly. Has very thin fine, w.g.i.'s. No lichens, algae, or flaking disease. Food not abundant now but are scattered herb seedling all over nesting area which can eat. When Julio found was eating Opuntia fallen pad – green, moist type. Placed him near some green herb seedlings and he immediately began to eat them with great abandon. Painted with a #2 in white on rear of carapace. SL 9.80; SW 8.809; H 4.78; CL 11.60; CW 13.40. Weight – 190 grams (Chatillon 24 gram spring scale).
Back up on planada pampa – moving along its eastern border along line with rocky uplifts:

Pg. 100.
New #1310 ♀ - CL 97.5; CW 107.0; no lichens, algae, or flaking disease; w.g.i.'s present but extremely thin. Scutes very worn but smooth only in central 1/15 or less. Impossible to say if recently laid - has red dusty soil all over and red dry worn, ground –in mud all

over legs and tail; certainly has not laid in past week or so. Lots of digging near here – all shallow holes in rocky areas. (Painted #193.)
New #1311 ♀ - CL 89.9; CW 97.0. Carapace condition all same as previous animal, except w.g.i.'s a bit thicker. Also can not tell if has nested yet – with read soil all over and old dry mud all over leg, tail, etc. Both of these ♀♀ have certainly been digging and at least gotten to stage of releasing cloacal fluid. But are abundant holes everywhere and many attempts in these areas which reached stage of releasing fluid. She released several cupfuls of thick, deep amber-colored urine while being marked. (Painted #194.) She is only a few dozen meters from Nest #37.
To S side of upper pampa, past Nest #37. Nest #37 (found and marked last evening) is in . . .

Pg. 101.
. . . bright red soil of upper pampa-planada on its southern border. Is dry now and thus over 7-10 days old, perhaps older because was very hard to see and Julio did not search here carefully on 7-9 October, trip. First nest actually in open pampa zone. Just SE of this pampa, between it and lower, even larger one, in a depression with pale, powdery red-yellow-brown soil found Nest #43 – older and dry – also not sure of its age because hard to see and Julio did not pass this tiny depression on last trip. Therefore could be 1 month old or more.
Was a ♀ digging in this same area yesterday at 1600 hrs. No nest or deep hole from her however – just a shallow one which hit rocks; not certain who or where she is because we did not want to disturb her last night and did not thus check her for notches.
Just above this depression on rocks and beneath an Opuntia eating pads (just below upper pampa) - #851 ♀ CL 95.2; CW 103.1. No lichens or algae; flaking disease scattered especially along areas of old worn growth rings in 2 usual areas. Scutes smooth in central ¼-1/3 or les but very worn. Covered with red soil. Has certainly nested or at least gotten to stage of dropping cloacal fluid because has red mud all over rear feet, legs, and lower lip of rear of carapace;

Pg. 102.
. . . covered with red dusty soil; mud on her is dry so nested awhile ago, but not too long (1 week more or less) because mud still "caked" and has not fallen off completely. She may be one who was digging in depression noted above last night - simply do not know (Painted #195).
Nest # 29 – in red soil of a small, slightly lower sub-portion of large lower pampa directly E of main camp. Second nest have noted in pampa-planada proper – very much in open; area has more soil than much of open pampa because is in a bit more of a depression.
Near here in shade between depression and pampa grande – on rocks –
#1092 ♂ (possibly) – Too small to sex accurately – CL 46.1; CW 47.5; no lichens, algae, flaking disease, or smooth scutes; w.g.i.'s clear and well developed, but thin; fresh turds full of Opuntia pad remains. Weight 20.5 lbs. Tracks of his all over depression below.
Nest #44 – Same area Nest #44 – dry now; same general area and description as #29 Nest. Julio says was no here on 7-9 October trip; thus laid and dried out since then (questionable because obscure).

Pg. 103.
To E end of large pampa – down in a small depression full of yellow-red-brown soil – Nest #28 – normal – covered with loose fine dry soil.
Nest #45 – same place only 10 m away and immediately beside a 1969-70 nest - Well made – with hard dry exposed hard cap – no loose dry soil on top. This certainly was not here on Julio's 7-9 trip or he would have easily seen it. Same soil type, etc. as #28.
New #1312 ♀ - CL 87.5; CW 97.4. Nearby nests, in same depression resting in shade. No lichens, algae, flaking disease; scutes smooth only in tiny central parts but worn. W.g.i.'s clear and relatively thick – medium thickness. Good example of a female with no flaking disease and only slightly smooth scutes but already of relatively large size. Fresh shallow holes (without cloacal fluid having been used) present all over the depression – probably hers. Has fresh reddish soil all over underside and some dry mostly worn away mud all over rear legs, tail, lip of carapace etc. Could well have already laid – perhaps even Nest #45 – difficult to say. (Painted #196).
Short way S of this area and on SE corner of large pampa found Nests #26 and #27 again – in very similar sites, type of soil, same type of depression etc. as #'s 28 and #45 Nests.

Pg. 104.
From here another large open pampa extends out – to E – about as large as upper pampa which we examined this morning. Poked around it only briefly because we are very short on time. Tortoises:
New #1313 ♀ (probably) – CL 46.5; CW 48.1. No lichens, algae, flaking disease, smooth scutes; w.g.i.'s clear, well-developed but rather thin. Now resting in shade (1400), but tracks of his all out over open pampa near-by. Good condition and growing. Weight 19.75 lbs. – Chatillon 40 lb spring balance.
A very small fellow – a bit larger or about same size as 2 eaten by cats of which we found remains. Painted on rear of carapace with a white #3. CL 20.6; CW 20.5; weight 1 7/8 lbs. Growing well – lots of small growth rings; w.g.i.'s clear and well –developed but thin. No lichens, algae, flaking disease, or smooth scutes. Note: although very small now is moving in open of flat pampa colorada- his tracks from this a.m. all over this area! When released him headed off to W really rapidly – i.e. about 100 feet in only a few minutes. Off to rocks. Noted many more little tracks of tortoises. . .

Pg. 105.
. . . the size of this one; in 2 cases regular well worn pathways from nearby rock piles out onto pampa colorada- very well used.
Poking about this eastern pampa some more – it has a "lobe" running to S. Here to one side of it in a depression #46 Nest – same dryness, soil type, etc. as Nests #'s 26, 27, and 28; not very recent.
Just below here (to S) is another pampa with depressions all around it to sides – more digging activity of recent days all through this.
Another tiny fellow near one of these depressions but in rocks; moving around in small soil patches in a lava channel. Well protected areas. CL 17.2; CW 18.5. Weight 520 grams (Chatillon). No lichens, algae, flaking disease, or smooth scutes; healthy but not fat; nice growth rings, but w.g.i.'s mostly non-existent. Painted with a #4 in white on

rear of carapace. He has a very well –hidden nice little burrow here in soft dusty soil up under some overhanging rocks in sides of the lava channel.
Now back along S edge of large pampa to check Nests #24, 25, ♀♀ and for new ones.
New #1314 ♀ - CL 87.7; CW 95.4. No lichens, algae, flaking disease. Scutes smooth in central small parts only but well worn; another good example of scutes condition at this size and age without flaking disease activity. W.g.i.'s clear but very thin; Has either nested or at least made an attempt using . . .

Pg. 106.
. . . much cloacal fluid because has bright red mud all over rear area; and fresh – dry but still caked on. She is now resting in small bright red-soil filled depression on S side of large pampa. Area where Nest #24 is located.
Nest #24 – has good hard cap and is in a depression with deep soil and many recently attempted nests – a lot of holes. If she has laid we are not sure where; looks as if she could have been poking about in this area looking for a nesting site – a lot of trails of a ♀ her size. (Painted #197.)
New #1315 ♀ (probably) – CL 51.5; CW 54.6 – Sleeping in dry soil under a log in another depression just 20 m W of last one; no lichens, algae, flaking disease; scutes smooth only in very centers; w.g.i.'s clear and rather thick – growing well obviously. Weight – 26.5 lbs (Chatillon). Very near Nest #25 – same depression.
Nest #25 – same soil type etc. as #24 – very near it and near pampa-planada which is only 1 m, more or less, higher and immediately to N.

Pg. 107.
#738 ♀ - CL 93.6; CW 101.5. No lichens, algae, flaking disease. Scutes smooth in central 1/10-1/8 or less; w.g.i.'s clear and well developed and medium thickness. Has 12 marginals on each side; i.e. a tiny one on either side of supracaudal scutes. Covered with red soil and some red mud (old and cake worn off) on rear areas. Probably has laid once and is now looking again for a site. Is now (almost 1600) sitting in same depression, slightly to W of Nest #25 and #1315 tortoise. (Painted #198.)
21 October, 1970.
Checked some of our ♀♀ this a.m. –
#'s 191 painted, #197 painted, and #198 painted did not attempt any digging last night.
#192 painted which almost successfully laid night before has now moved directly across on central pampa to area of Nest #25 and is poking around there at 0645 this a.m. She definitely did not lay last night but may have tried – we do not know for sure.
#195 painted – who we think was one digging night of 19 October, has moved from site where we checked her yesterday about midday – not sure where.
#'s 193, 194, and 196 painted – unsure what they are doing – perhaps trying to nest, perhaps not.
#198 painted – moving out to N on open pampa at 0630; #197 painted same . . .

Pg. 108.
. . . but to ENE toward eastern pampa at same time.
Checked Nests #35 and 36 – found and marked 19 October late but did not see yesterday.
#35 Nest is dry at top of hard cap.

#36 nest is moist at top of hard cap.
Both since 7-9 October because Julio searched here and did not find. Both (only 2 m apart) in an area of red-brown soil, just in a small depression or lava channel on eastern side of main central pampa.
Headed down goat trail directly S of camp, over a short stretch of rocks and into more, but smaller pampas below – here in first pampa:
#190 ♀ (duplicate number) - CL 87.5; CW 92.3. No lichens, algae, flaking disease; scutes smooth only in central 1/10 or less but well worn elsewhere; w.g.i.'s well-developed but rather thin. Sleeping in a soil depression up under a log at 0730. Certainly did no t dig last night as saw here in same spot here at 1730 hrs then; also has not either . . .

Pg. 109.
. . . nested or reached cloacal fluid stage of digging recently (i.e. 7010 days past). Note that she was here on 8 October when Julio passed by. Has lots of red soil and some worn caked mud on rear areas so could have nested once this year already or even more often – impossible to say. (Painted #199.)
** Also- found #593 ♀ at 0720 digging a nest! Has gotten to stage in which she has a large hole – about 20 cm x 15 cm above and 15-20 cm deep and is just now working on flask in front. Has dropped several cupfuls of cloacal fluid and has a great mass of mud. Certainly has been working here only 2-3 hrs at most because mud is very fresh and soil is soft, powdery and easy to dig in. She is just beside goat trail and slightly above #190 ♀; she was in this same spot last night but 1.5 m away from where she is digging – saw here there at 1645 and 1730 sleeping up against a log. I suspect she turned westward and 180º from sleeping site this a.m. in early light (0500-0600) and began digging. Has been cool and cloudy till now (0730) and occasionally garua fell – still same weather. First nesting in field I have ever seen which was starting in morning hours after daybreak. Julio saw here in this same general area on 8 October and at that time she did not appear to have nested yet.

Pg. 110.
Dog disturbed her a bit so we passed by quietly and I will return to check her progress again in a little while.
Continued due S on this trail till we hit barrancos and ran out of soil – found digging scattered all over, but not as much as in areas above and good soil not as abundant here for potentially (valued? – word not clear) nesting sites. Found one more nest.
#47 Nest – just beside goat trail in an area of red-yellowish-brown soil – up against a small barranco where soil collects. Nest all dry and hard to detect. We thought it was a 1969-70 nest and thus opened it. But fresh eggs inside. Filled it in and covered well – only made a small hole so it will probably be OK. Hard cap on this nest huge- will check in February – March to ascertain possibility that are really 2 nests here. Anyway this nest or nest certainly 1-2 months old at minimum. Almost impossible to detect on surface that it is even a nest. [Marginal note: Found one more 1969-70 nest here in same site – 2 infertile eggs and an undetermined number (probably 6-8) young which had hatched and left nest.]
Then to SW through some dirt filled canals to old campsite and pampa . . .

Pg. 111.
. . . below (see map). Canal full of digging attempts all the way. Just on edge of main lower pampa and in yellow-red soil of canal found another nest:
Nest #48 – dry hard cap on surface now – well made and with almost no loose dry soil on cap. Julio says he passed here on 8 October and was not here – probably true because easy to spot it given that hard cap is exposed. Slightly shaded area due to leafless Bursera trees around it but gets full sun almost all day. Just on N side of lower pampa.
Passed old camp and Nest #12 –
Nest #12 is in a slightly lower depression on E side of lower pampa –bright red soil like on pampa however very open area; has a wall around it. Here is located 1969-70 nest which had 4 trapped young in it – 3 dead, 1 alive when Julio found in late September (see previous notes) – I collected 1 dead one which was just dead when we found nest – for skeleton and later examination.
This doomed nest had no exit so clutch was only 4 eggs, all hatched; very tiny nest cavity – just about big enough for 4 eggs in one layer with their tops at 10 cm below surface. Can not see immediately why trapped – perhaps so crammed in that could not dig well – no rocks – but solid very hard-baked hard cap of bright red pampa colorada soil.

Pg. 112.
On around a bit – to side of lower pampa – on its SW edge:
Nest #49 – exposed hard cap right on surface; well made large cap; in bright red soil; not in a depression, but with a few trees in area for some slight shading; in edge of pampa, not its most open part, just before rocks begin descent to surrounding depressions. One of few nests not in more "deep-soil" filled depressions. Recent, because Julio did not see on 8 October and still moist almost at surface of hard cap. Drying fast however.
We did not have time to go by Nest #23 – all others I have seen; Julio indicated where it is on my map.
New #1316 ♂ (perhaps) – too small to sex accurately; no lichens, algae, flaking disease, or smooth scutes; growing well-w.g.i.'s clear and thick or medium to maximum thick. Walking around on open pampa just above Nest # 48. CL 37.6; CW 37.4; weight 8 5/8 lbs.

Pg. 113.
New # 1317 ♀ (perhaps) – CL 41.2; CW 44.0; weight 15.25 lbs. W.g.i.'s clear and well-developed but thin; growing and healthy; no lichens, algae, flaking disease or smooth scutes. Moving over rocks between lowest pampa and pampa where ♀♀ #593 and #190 are.
Returned to #593 ♀; did not lay – rocks in floor, one side and front wall of cavity – so she quit. Still an interesting attempt and time of day.
#593 ♀ - CL 96.8; CW 100.7. No lichens, algae, or flaking disease. Scutes smooth in central 1/3 – ¾ and very worn on remaining growth rings. W.g.i.'s present and rather thin however. Julio notes was only a few dozen meters from here on 8 October, 1970. Soil where she tried to lay is pale red-yellowish-brown typical of many depressions here and where lots of nests are located. Took photos- Roll 202 (KK) - #'s 3-8 – of hole and attempt and general area.

Roll 202 – photos 9-14 – camp, dogs (Denuncio and Duguesa), Julio; shows pampa grande where tortoises lay nest only rarely. Altitude here at camp reads 45 m at 0730; temperature in case 22 ºC.
On return:
#1089 ♀ CL 94.4; CW 103.3. No lichens, algae, or flaking disease. Scutes well worn but smooth only in tiny central parts. W.g.i.'s clear and well-developed but rather thin. Has not laid yet – no mud on her – but has apparently been digging a lot because has duty red soil on feet and are lots of holes here. In area, uppermost one enroute to barranco, with lots of rocks, Opuntia, but some soil patches.

Pg. 114.
(Painted #201.) Altitude here reads 37 m at 1100; temperature in Luftt case is 28 ºC. At camp as we left at 1030 hrs read 32 m, temperature 25 ºC in case – thus about 4 m altitude higher here – these main nest areas below.
Continued up to S slope of large barranco – there, there is a huge pond-bed, dry now, but full of large black lava blocks, Clerodendron, and Maytenus, shrubs and tree respectively. Certainly an important site for remaining tortoises after heavy rains. – also must have been some area to visit before human depredation. Just below pond saw 2 old ♀♀ tortoise skeletons, all broken up and years old – plastrons off both showed had been slaughtered. Altitude here at 1115 hrs reads 41 m; 28.5 ºC in case of Lufft – thus 4 m above first nesting area below here.
Two recently slaughtered tortoise are here only 50 m to WNW near H20 collection spot (see notes of 19 October).
#572 ♀ - CL 70.2; CW 74.4; moving around in this pond bed.

Pg. 115.
No lichens, algae, flaking disease or smooth scutes. W.g.i.'s clear and very thick. Re-marked because faint notches; interesting that she shows no signs of any nesting attempts and is here above nesting areas. (Painted #202.)
Ten saw one more young one (about same size as #1306, i.e. 40-45 cm CL), unmarked, as we were passing over barranco or hill on way N. Scattered dry turds all over this area so am certain are quite a few tortoises in total in the area of the pampas, the big dry pond, etc. all around this hill. As we were in a bit of a hurry did not mark this fellow.
This general area is much like portions of Zone 3 NA, but also like parts of Region 4 of Caseta – Zone 3 La Fe trail.
Continued on up through enormous pampas which extend all way from barranco-hill to N, gradually rising all the way, to beginning of very green and densely forested and lush Scalesia – Psidium forests above.
At last major dry ponds just below very green forest (this area like Zones 1 and 6 very much – big pampas of Plant #1 (Blechum); pond surrounded by manzanillo, and full of lots of Clerodendron bushes) checked other slaughtered tortoise we passed on 19 October on way to La Torta. Clearly a . . .

Pg. 116.
. . . medium-large sized male; either #910 or #912; in doubt because #2 scute clearly cut (notched) but then sawed – off almost level so that only a very tiny inverted pip of a

notch is left – i.e. perhaps Castro or Chappy mis-marked and then tried to obliterate #2 – have found other tortoises on which they had done this. This was clearly not done by slaughterers because other marks clear and this one still clear too – they would not have done such a sloppy job had the really intended to remove the notches.
Anyway, this one probably 4-6 months old – skull decomposing and broken, scutes all fallen to ground. ;Certainly not as fresh as other 3 dead ones found on this trip. ?Right beside trail; made no attempt to hide it as perhaps did with smaller and fresher one from this area. Did not collect skull because too fragmented.
I have decided not to describe this transect from Reserve Border to coast till a later trip when I can . . .

Pg. 117.
. . . take more altitudinal readings, more careful observations of vegetation and substrate, and more compass bearing for certain sites.
For now suffice it to say that from these higher ponds (i.e. area like Zones 6 and 1) to barranco beyond is one monstrously large area of wide open pampas dotted with small sections of trees, small dry ponds, large flat rocks with H20 collection sites. Clearly a beautiful area for tortoises for a major portion of the year – yet saw on a few scattered dried up, mostly bleached white turds, and only very scattered dry mud wallows in pampas. In these pampas saw several more old, very broken –up tortoise skeletons-probably slaughtered but too old to tell. Whole picture, through lush forest for first 2.5-3 km, then through another 2 km more or less of pampa-ponds to barranco areas and around it is now rather bleak. Not many tortoises, only very scattered sign; 4 slaughtered recently; some old bones. My impression is . . .

Pg. 118.
. . . that people have probably over – exploited the population here to the point that tortoise density is very low – this would be expected given its openness, ease of access (smooth soil-bared trails; almost no lava), and proximity to oldest settled highland areas – i.e. Bella Vista and surroundings.
It is a certainty that population must have been enormous here – very dense – a brief comparison to Chato, Zone1, Region 4 of Caseta – La Fe trail suffices to show what must have been like here before man began exploiting tortoises heavily.
Another aspect arguing for this point is that people did not and do not now apparently go much below barranco or hill area at lower end of pampas – is very rocky below there and clearly no old trails of men and almost no tortoise bones. In La Torta nesting area no bones anywhere (we saw none in 1.5 days of extensive work and walking) and plenty of tortoises, large ♀♀ and . . .

Pg. 119.
. . . many, many small ones of assorted sizes. Luckily, unlike Cerro Gallina, La Fe, and some small nesting areas below Zone 3 NA near coast, appears that man has not entered much or at all into La Torta NA – probably because:
1. not many people know of it – Gilberto Moncayo is one of few who does know of it apparently;

2. protected by about ½ hr of nasty, tough, walking on lava both from above and from coastal side – lava is very rolling and broken and cactus – Croton forest is thick all around nesting area.
Anyway, point is that are many large ♀♀ in La Torta area now and tortoise droppings and sign all over – but almost no sign of large ♂♂ - only a few large dry droppings. And, it appears that these ♀♀ thus must either: 1. live year round at La Torta or; 2. come here mostly from more to NW (i.e. Zones 6 and 1 and similar areas to E and W of these areas). Probably both things are true. Note that vast majority of them seen in nesting area on this trip did not have flaking disease, and carapace condition of these showed this fact (see notes above) – this is one sign that probably must live in this area (dry and hot) most of the time. Another . . .

Pg. 120.
. . . indication of this is that many were unmarked till this trip despite frequent trips by M. Castro to Zones 1 and 6 and across Reserve at an altitude of about 200 feet from Bellavista – Puerto Ayora trail to Zone 3 NA.
Given the previous and present human exploitation and slaughtering in areas above (to N) of La Torta I am sure most of these ♀♀ either live here or came down from pond-pampa areas more toward Zones 1 and 6. It must have at one time been an awesome sight to see the vast numbers of ♀♀ and nest at La Torta. The area is so well –used by ♀♀ even now after many years of slaughtering that it must have been a riot of activity during nesting a few decades ago. Luckily, in this area of the Reserve, it is the nesting area which has largely escaped human exploitation at the expense of the higher altitudes, i.e. pampas and pond; very much the reverse of the transects from the Caseta to La Fe and El Chato to Cerro Gallina. I will describe and map the La Torta nesting areas in this notebook . . .

Pg. 121.
. . . later.
On return hike to Caseta I noted much the same thing as on 19 October and on hike down in late September and up to Caseta on 10 October, i.e. much tortoise sign and activity all along reserve Border from about 1 km E of Zone 6 turn-off to about 200 m other side of Poza de Manzanillos (i.e. pond near Reserve Border just W of Zone 1 turn-off). Also some more scattered sign from latter area to Caseta, increasing generally to "dense" sign around Caseta Pond #4 and just SE of it along trail for about 300 m. Many, many fresh tortoise trails crossing Reserve Border in both N and S directions, others working along border for dozens of meters; large eaten-out patches of lush herbs now growing here, also many droppings and fresh burrows. Virtually all this activity is in semi0open to closed canopied forest of Psidium or Psidium-Scalesia. Herbs are extremely dense, lush and tall (mostly 3 dm – 1.5 m) everywhere, occasionally even taller), and tortoises are feasting on them.
Tortoises noted today on return:
1. #813 ♂ - same area as 19 October sighting.
2. One unmarked, medium-sized ♂ - just W of Zone 1 turn-off.
3. #1023 ♀ - Poza de Manzanillos area.
4. #233 ♂ - 300 m SE of Caseta Pond #4 on trail – grazing along in forest.

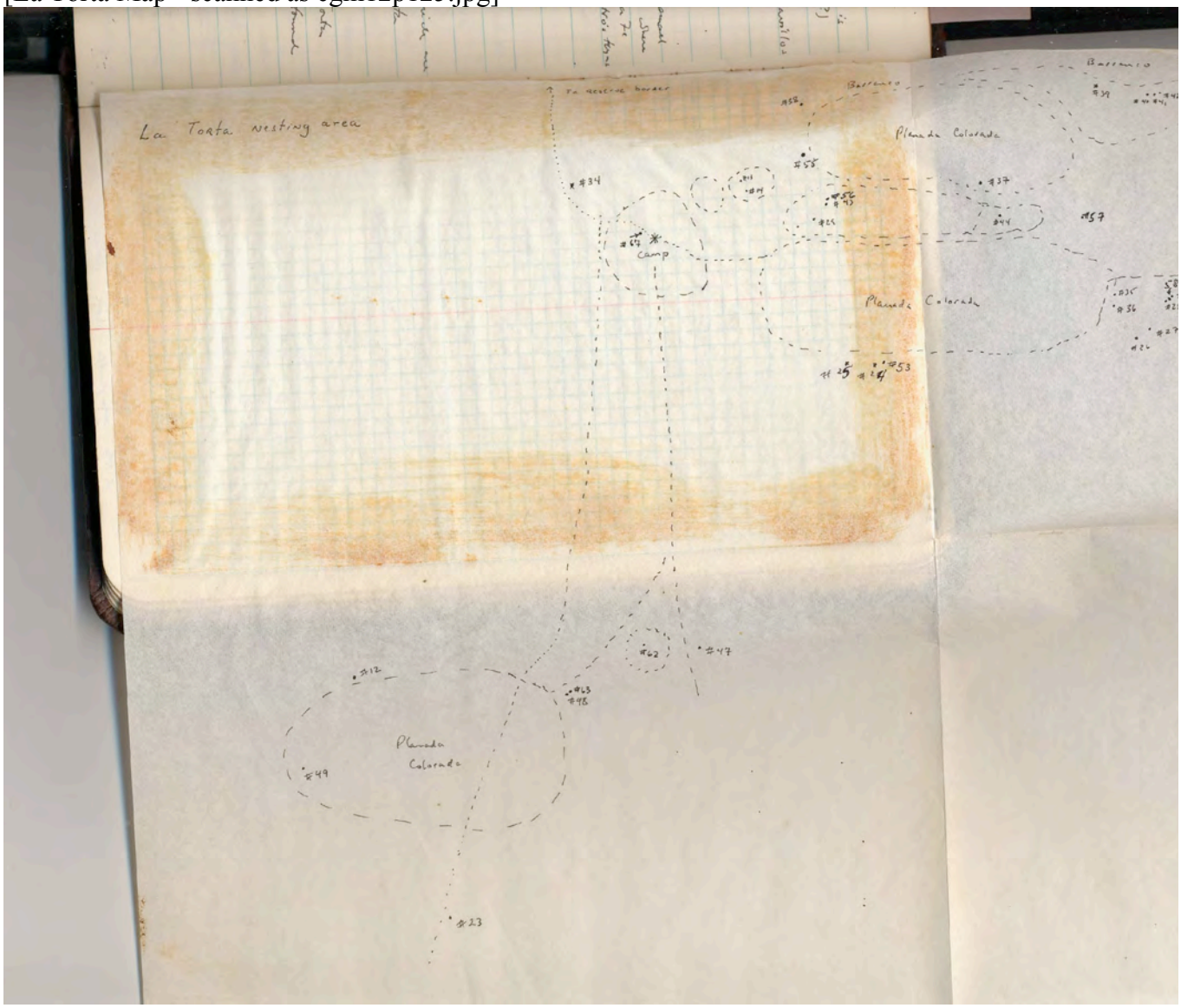
Pg. 122.
Caseta – Weather – 1900 hrs – cool and cloudy all day; some light garua in morning and stating again at 1800 and continuing – Max 75.0 ºF; Min 63.0 ºF; Evap 2.4 ml, reading 20.2; Rain 3.7 mm.
22 October, 1970.
At Caseta all day working and getting things loaded onto burros for playa. In afternoon to Caseta Pond #1 briefly to shoot a few goats – they are all over here now! Tortoises seen in pond and around it:
#'s 3, 88, 10, 124, 47 – all painted numbers.
#785
#352 ♀, large CL 101.5; CW 111.0. A ♀ without flaking disease and with only 1/8-1/3 of cutes smooth in centers – an example of smoothing process in absence of flaking disease. Very well worn growth rings on scutes but mostly still visible and clear; no sign she has nested or even been in nesting area (with red soil at least) recently; also no sign of any recent copulations.
Caseta – Weather – 1900 cool and cloudy all day – garua off and on; Rain 2.6 mm; Evap. 0.8 ml, reading 21.0; Max 73.5 ºF; Min 63.

Pg. 123.
23 October, 1970.
To CDRS; enroute noted some animals along Reserve Border –
#97 painted just below Caseta, grazing.
#90 painted – at Caseta Pond #4.
#810 ♂ - CL 110.0; CW 112.5; grazing just N of Reserve Border, ½ way between Poza de Manzanillos and Zone 1 turn-off – had come up from S – clear trail.
#751 ♂ - CL 121.4; CW 131.5. -- #888 ♂ - CL 125.8; CW 131.2. Both just W a short ways from Zone 6 turn-off – trails show both had just come to Reserve Border from S from Zone 6 direction.
24 October, 1970.
Checked file at CDRS for many of the animals seen on recent La Torta trip to find out where Miguel Castro and or wardens marked or last saw some of these animals – will have to again check these more carefully against old records, but it is worth noting here previous locations (and when seen):
#572 ♀ - 1964, La Torta.
#831 ♀ - 1964, Zona 1.
#1089 ♀ - 1968, La Fe.
#738 ♀ - 1964, La Torta.

Pg. 124.
#851 ♀ - 1964, Zona 1.
#4 ♀ - 1967 – "Manzanillas" (Where is this?) Also listed from Caseta and Pampas de Guayavillos.
#593 ♀ - ?
#190 ♀ - ?
#1092 – 1968, La Fe; #1094 – 1968, La Fe; were small then – where is La Fe in Castro's terms?

#910 ♂ - 1965, Zona 6.
#453 ♂ - 1963, “Manzanillas”
#295 ♂ - 1964, Zona 1.
#911 ♂ - 1965, Zona 6.
Most come from regions which are more or less reasonably close to La Torta nesting area.
On next page is a map of La Torta nesting area showing all nest found there to date.

Pg. 125.
[La Torta Map - scanned as cgm12p125.jpg]



Pg. 126.
28 November, 1970.
To Caseta; enroute saw no animals till nearly at Caseta, but much sign and huge smashed areas all way from 1 km E of Zone 6 to well past Zone 1. Then again same near Caseta Pond #4.
In afternoon went down trail toward Zone 3 to about 0.5 km below Caseta Pond #1 and noted following animals:
Around Caseta:
#3 ♀, #31 ♂; #246 ♀; the one from Horneman's (number escapes me now); #91 painted; #11 painted; so many of these still hanging about in same areas after months.
To Pond #1 – Three others – didn't check numbers but all were marked and of medium size (♀ scale).
Around Pond #1 - #127 ♀ - no sign of recent nesting or copulation!
Painted numbers 10, 12, 82, 88. Five others (4 marked, 1 un-marked) – all medium sized (♀ scale) but didn't get numbers.
Very green all over here now; no H20 in big ponds, but water (a bit, i.e. a few cm) and or mud in many of little manzanillo-grove ponds in the area.

Pg. 127.
29 November, 1970 – To El Chato, Cerrito, etc. to sample.
Enroute noted a number on manga through mora –
#40 painted – in low dip circa first hill.
#47 painted; #81 painted; #13 ♀ - all about 100 m E of Camote patch.
To Segundo Herrera's manga saw lots of tortoise sign – from there to near El Chato turn-off very closed and no tortoises or sign.
At pond near El Chato turn-off –
#54 painted; #140 painted; and #172 ♂ - all near pond areas. Water is now present in it! Tortoises have already obviously been using it heavily as there are tracks in mud and a few wallows all over it.
To Chato (will do Region 1 later – took short cut trail today). Very little fresh sign along short cut route – obviously only a few animals in Passiflora – mora fields here now.
Scattered fresh sign in woods on way down but saw none.
In El Chato ponds area –
Pond #1 and environs: also about 10 cm H20 in rocky part of pond – only about 2 square meters surface area, but tortoises have been using it somewhat.
Tortoises scattered all over here grazing about:
#59 painted; #1299; #387 ♀ - CL 100.2; CW 105.4; Large and ¾ smooth

Pg. 128.
. . . scutes mostly; abundant flaking disease and black-green algae all over rear ¼ and front marginals area; no lichens; no sign of recent mating or nesting (no reddish mud or dirt at all). W.g.i.'s clear, thick, well-developed. Re-marked because notches getting very hard to detect.

#705 ♀ - CL 82.9; CW 86.8. Smooth only in central 1/10-1/15 or less of scutes; no flaking disease or lichens; black-green algae in 2 usual areas and rather heavy; w.g.i.'s present but very thin. No sign of recent nesting or mating.
#68 ♂ - CL 120.6; CW 129.6. Flaking disease heavy in 2 usual areas and scattered elsewhere, especially along non-smooth growth rings; w.g.i.'s clear but rather thin. Black-green algae in 2 usual areas and heavy; scutes smooth in central 1/3-1/2 mostly; no lichens.
#862 ♀ - CL 9.65; CW 105.1. No sign of recent nesting or mating. W.g.i.'s clear but rather thin; no lichens; flaking disease light in rear and scattered elsewhere; black-green algae on rear ¼ mostly and moderately heavy. Scutes smooth in central 1/10-1/4. (#5 painted – can not read 4 any more but faint signs of paint are still there repainted now). All way over here from Caseta area.

Pg. 129.
One unmarked ♀ - CL 86.0. CW 88.0 – covered with red mud from wallowing; thick nice growth ring increments; no flaking disease, lichens, algae or (smooth) scutes. No clear sign of nesting or copulation recently.
#151 ♀ - CL 86.8; CW 85.5. W.g.i.'s clear, thick and well-developed. No clear sign of nesting or copulation recently; no lichens or flaking disease; black-green algae all over rear ¼ of carapace. Scutes smooth in central 1/15 or less only.
Pond #2 area:
#1298; 3149 ♂, huge; #566 ♂ - CL 124.2; CW 134.6. All smooth scutes; w.g.i.'s clear but very thin; no flaking disease or lichens; black-green algae in a few spots on front marginals and rear marginals and supracaudal.
#212 ♂ - large; #537 ♂ - CL 98.2; CW 105.6. W.g.i.'s clear and moderately thick; no lichens; flaking disease confined to spots on front marginals and lightly scattered on rear 1/5 of carapace. Scutes worn, but smooth only in central 1/20-1/15 or less. Scattered black-green algae in same general areas as flaking disease.
#339 ♂ -huge.
#170 painted –
#438 ♂ - CL 96.0; CW 102.1. No lichens, flaking disease; very, very thin coating of black-green algae in 2 usual areas; w.g.i.'s clear but thin. Scutes smooth only in central 1/15 or less.
#321 ♂ - huge – really covered with deep, scarred flaking disease-covered areas.
Weather – El Chato – 1200 hrs – Evap. 9.7 ml, refilled full; Rain 1.77 inches, emptied.

Pg. 130.
#281 ♂ - huge.
#711 ♀ - CL 83.1; CW 90.0. Scutes smooth in central 1/15-1/8 or less. No lichens; only a few spots of scattered flaking disease; black-green algae in 2 usual areas, thick; w.g.i.'s extremely thin and incomplete.
#296 ♂ - huge.
#14 ♂ - very large.
#1300 –
One in brush – large ♂ which I cannot reach.
Ponds #3 and 4 and environs:

#130 ♂ - huge
#61 ♂ - huge.
#168 ♂ - huge.
New #1318 ♀ - CL 93.3; CW 102.6. Perhaps up from nesting areas as has some old red soil on feet and rear underside of carapace – but hard to tell because covered with fresh red and brown mud from El Chato area; no signs of recent copulation. Scutes very worn but smooth only in small central parts (1/20 or less). No lichens or flaking disease. Black-green algae light in 2 usual areas. W.g.i.'s present but very intermittent and thin.
#208 ♂ - huge.
#150 ♂ - (perhaps #550 but doubtful) – huge – have seen frequently before – has huge . . .

Pg. 131.
. . . cuts in 2,000 and 4,000 scutes.
Some other small ponds in Pond #1 area had H20 (few to 10 mm deep); all well-used by tortoises; many of red mud pits very muddy (sticky mud) and lots of tortoise tracks all over these; saw about 10 tortoises so far with abundant red mud on them –
Pond #3 with about as much H20 in it as Pond #1 – very muddy and tortoises have been wallowing all over in it. Ponds #2 and 4 still dry.
Continuing on around to SE side of El Chato to big area of pampas there – following tortoises in these pampas:
#10 ♂ - huge.
#57 ♀ - large and smooth shelled – no sign at all that she has been down in red soil nesting area; but sign of recent copulation attempt is clear – and from ♂'s feet allover top and sides of carapace in streaks.
#1271; #53 painted; #1225 – CL 90.6; CW 97..6. Only a few tiny spots of flaking disease in 2 usual areas; w.g.i.'s clear, moderately thick and well-developed. No lichens; faint black-green algae in 2 usual areas.
#299 ♂ - huge.
One more large ♀ in shrubs so dense that I can not reach her ; marked but can't see all of the number.
Starting down toward Zone 5:

Pg. 132.
In first open pampa just below Chato pampas – same area really –
#198 ♂ - huge – noted some of same "painted-on" type of lichens as have seen on San Cristobal and Duncan races. Took photos 10-12, Roll 227 of this. Tried collecting a bit but discovered it is very flaky and hard to remove. Have a few tiny pieces anyway.
In next pampita along trail – 50 m more:
#507 ♂ - huge and badly diseased with flaking disease – old friend – up from Zone 5.
#548 ♀ - CL 80.1: CW 90.6. No nesting or recent copulation sign. W.g.i.'s clear, bright, moderately thick. Flaking disease very bad all over rear ¼ and front marginals. Black-green algae in same areas; no lichens. Scutes smooth in central 1/8 or less but very worn.
#764 ♀ (probably) – CL 70.9; CW 76.8. – could be #760 or #764 ♀ - hard to tell if 4 is notched or broken. Bad flaking disease on rear marginals and some scattered on front ones; black-green algae thick on rear areas where flaking disease is, but also, scattered in

non flaking disease areas in 2 usual areas. W.g.i.'s clear and thick. No lichens; scutes as in#548 ♀; no sign of recent nesting or copulation. Recent 700 notch.

Pg. 133.
New #1319 ♂ - CL 108.0; CW 108.2. Beautiful, round, dome-shaped animal. Covered with flaking disease in 2 usual areas and scattered elsewhere along growth ring grooves. Black-green algae large in same two areas and dense. Some chartreuse or yellow-green algae on soil collected in pitted supracaudal. No lichens. Scutes smooth in central 1/8-1/2 and very worn. W.g.i.'s clear and thick.
In next and last open pampita:
#139 painted.
#148 ♂ - huge – CL 142.6; CW 158.0. Has some pits on 1st and 2nd right costals which have yellow-green algae growing in them. Otherwise, all smooth shell, and with extensive flaking disease on front and rear marginals area with lots of black-green algae in same places; w.g.i.'s clear and moderately thick. Only a few minute spots of fructicae pale grey-olive-green type of lichen on rear area.
#1122 ♀ - CL 99.2; CW 114.3. Very oval, oblong shaped ♀, getting wider and wider anterior to posterior. Very old, smooth shell, extremely pitted and worn and large chunks of scutes have and are still flaking off. In some of these flaked off areas, yellow-green algae is growing (extremely bad flaking disease before).. Black-green algae also all over shell, along scute junctures. W.g.i.'s extremely thin and intermittent. See Roll 227, photos 14-20 of her for shape, flaking disease and algae. No sign of recent nesting but male footprints fresh all over carapace.

Pg. 134.
#65 painted – large ♀ - from nesting area way down below Cerrito! Almost to El Chato area. Extensive black-green algae along scute junctures; a lot of yellow-green algae in s cute grooves of rear marginals and supracaudal. No clear sign of recent nesting, but has definitely been recently copulated (or attempt anyway), with – foot prints all over top and upper sides of carapace.
From here to Zone 5 saw no more tortoises and very little sign save for some dryish droppings and an occasional track in the mud; really appears that most animals are probably at altitudes of Chato and above (unless, or in off chance, they have moved down-wards to nesting zone elevations, which I doubt). This is interesting because with months of accumulated garua and especially strong garua of past month or so everything is quite green and lush. Zone 5 is not by any description lush as it was when I was first here in October – November, 1969, but it has a nice . . .

Pg. 135.
. . . solid carpet of small green herb seedlings and there is plenty of tortoise forage. Appears as if they probably have been moving more and more to the highland areas to obtain really dense lush herb growth and heavy dew or rain that is on herbs each day. Also, standing H20 and wallows in Chato area and above can not be found in Zone 5 and below (wallows not at all now, H20 in rock pockets only rarely).
Straight line sample through Zone 5 – only 3 animals, all unmarked; am very tired so only noted them- will try to mark them on 1st when I sample this area more thoroughly;

one was circa 65 cm CL and on trail near eastern area of expanded sample; two others were about 44 and 60 cm CL, respectively, and near dry pond-campsite area.
Very little tortoise sign all through this whole Zone 5 area – just old dry turds of larger animals; only recent turds are from these smaller-sized individuals.

Pg. 136.
30 November, 1970. On to Cerrito and below –
Region 5: Very little sign along trail toward Cerrito; in areas where usually see at least a few animals, i.e. tow dry pond beds, only dry turds and old tracks.
Near lower dry bed there is one fresh burrow from a large ♀ or medium-sized animal.
This entire region is very dry and severely exploited now by goats.
On trail just below last dry bed –
New #1320 – CL 56.1; CW56.6 - ♀ probably but too small to sex accurately. No lichens, algae, flaking disease or smooth scutes. W.g.i.'s present but extremely thin and intermittent. Has 4 black "9's" on its carapace (one on each of 4 "sides" of carapace) made with a magic marker- must be from Julio San Miguel – will ask him when he last saw this one – because is nearly in Zone 5 now.
Becoming drier and more severely destroyed by goats as get closer to Cerrito. Just before Cerrito found tracks (fresh) of a large sized ♀ or medium-sized ♂ but could not locate the tortoise.
Region 6 – Cerrito's side and down to beginning of lava. Saw only a small burrow (recent) of a small to medium-sized animal (50-70 cm CL); virtually only . . .

Pg. 137.
. . . other sign was a few old dry droppings. This area has clearly been largely deserted by tortoises because it is dry and severely lacking in its normal greenness. Goats plentiful all through here – saw approximately 30, whereas I usually see only a few or often none here. Even most of the shrubs have been chewed up and herbs are very scattered and few in number. There are trails and wallows and bare areas all over. It is not surprising that tortoises have moved to other sites, as this areas is in abut as bad condition as it was in April-May 1970 after long and severe drought.
Region 7 – also dry, but no goats seen and not as heavy utilization of more scanty vegetative cover here by them. Most shrubs with leaves and a fairly nice covering of small herbs (even including Commelina) scattered about over the lava blocks.
About 4/5's of way down to upper end of Cerrito nesting area (where 1969-70 Nest #16 was located) :
#1065 ♂ probably – CL 60.0; CW 65.1. NO lichens, algae, flaking disease; scutes smooth only in tiny central parts; w.g.i.'s almost non-existent – a few extremely thin intermittent lines. Sitting in a dry, loose soil burrow in trail.
31233 – just down trail to "new" nesting area – in same area where I saw one this size (probably this same animal) in late June . . .

Pg. 138.
If this is same animal, worth noting that it is only about 40 ft from where I saw it last trip.
In nesting area and surrounding parts – will be looking for nests, tortoises, etc. so will simply indicate below which ones are in "straight-line" sample.

One tiny fellow – CL 26.7; CW 28.6, sitting in shade at campsite; can see his tracks crossing through this area. Took anal temperature about 2.5 – 3 cm inside when first found him (1145 hrs) – 31.4 ºC. Painted him #1 because is a bit small to mark. Weight – 40.0 lbs. Chatillon balance. No lichens, algae, flaking disease or smooth scutes. W.g.i.'s extremely thin and incomplete. In straight line sample. Took 2 photos - #''s 21-22 of Roll 227 of this fellow in defensive posture.
New # 1321 – CL 50.3; CW 53.4. Temperature recorded when found, 2 cm in rectum 32ºC. (1210 hrs). No lichens, algae, flaking disease or smooth scutes; w.g.i.'s clear but extremely thin and occasionally intermittent. Was marked with black #7 by magic marker (Julio surely). Weight 25.0 lbs – Chatillon. Resting in dirt wallow under a tree when found. In straight line sample.

Pg. 139.
Nest #33 found – near trail just before campsite – no young have left it yet – no corral.
New nest #64 – beside trail just near #1320 tortoise; reasonably fresh (4-10 days more or less) because hard cap still moist about 1-2 cm down inside it. Marked but no corral built. No ♀ immediately near by.
(For nests 40 –63 see Julio San Miguel will add these notes from him in end of this or next volume.)
In nesting area depression close to campsite where I saw such a notable concentration of tortoises (large breeding sized ♂♂ and ♀♀ and tiny ones) in late June – early July, there are now none I could see and no fresh sign – only dried up turds; not any recent racks or burrows. Three old digging sites; no nests; very dry here and almost no herb seedlings to eat so perhaps small ones have moved away a bit. Appears that most adult ♂♂ and ♀♀ also have moved on some time ago-probably most to higher areas.
Clearly late June phenomenon was due to garua collected in lava pockets here. In campsite and generally in this area only few and scattered herbs seedlings are only food available; very dry; food situation a bit poorer than Zone 3 nesting area now is.
#1282 – CL 36.3; CW 37.0. Temperature on finding – 33.2ºC; resting in shade, at 1230 hrs, inactive. Weight 9 1/8 lbs – Chatillon. W.g.i.'s clear but extremely thin and intermittent here and there. On trail just 30 m beyond campsite toward Cerro Gallina; in straight line sample.

Pg. 140.
On to nest depression and nesting area just 50 m down trail.
#1284 – CL 48.0; CW 50.6 – Temperature when first found 2-3 cm up rectum – 32.7 ºC. W.g.i.'s non-existent; in shade inactive – 1250 hrs; weight 20 3/8 labs – Chatillon. Not in straight line sample. – off to side of trail too far.
In this area located Nests #?7, 17, 22 – all with corrals and all OK; no sign of any hatchling having left any of these.
New Nest #65 – same area; old because very dried out, superficially anyway. Marked but no corral built. Must be at least several weeks old- very hard to detect so could have been missed before by Julio.
Till now (1305 hrs) not sunny and hot but noticeably warm because can feel it -= thermal, scattered radiation coming through light cloud cover. Now cooling off noticeably as

clouds have thickened, and some very light garua has begun. Will be interesting to see how tortoises body temperatures change (if I find any more).
Moved on to last open nesting area before trial becomes virtually all rocks till Cerro Gallina.
New – Found nest #66 here; also old and dried . . .

Pg. 141.
. . . out on surface considerably; probably at least 2-3 weeks old and perhaps older; Julio could have missed it of course; marked it but no corral built. Both this one and previous two found today in typical red soil of this area with hard caps.
New #1322 ♂ (very probably) – CL 50.6; CW 50.3. Resting under a tree; garua has been going for about 15 minutes – very light. Time 1320 hrs – temperature about 2-3 cm up rectum 31.6ºC when first found; weight 23.5 lbs (Chatillon); w.g.i.'s moderately thick. In straight line sample.
Also noted fresh tracks of a large sized (♀ scale) animal in this area, but could not find tortoise. Could well be a ♀ as are 3 reasonably fresh attempted shallow nest cavities here.
From here made a quick trip down toward Nests #19, etc. to see if I could find old trail from Zone 3 Nesting Area to here and nests found by Julio in this lowest "Cerrito" Nesting Area. This year – but could not find all of them and time was short. Found Nests #18 and 52 – former without corral, latter with one; both OK; no hatchling emergence yet.
Found 3 small tortoises (first one down near Nest #52, latter two close together near a flat rock collecting site only about 100 m from (SE) of Nests #7, 17, 22, 65). These 3 tortoises in normal enlarged sample area.

Pg. 142.
#1156 ♀ (probably) – CL 56.1; CW 58.8 at 1425 hrs; body temperature 3 cm up rectum is 29.3 ºC; sitting under a tree, inactive. Garua and breeze continuing. Weight 30 1/8 lbs; no lichens, algae, smooth scutes or flaking disease; w.g.i.'s non-existent.
New #1323 – CL 40.5; CW 42.6. Temperature 28.9ºC, 2-3 cm up rectum at 1500 hrs; animal active and moving now across an area where was no activity 30 minutes ago – almost certainly just left burrow - same is true for next animal. Weight 12.0 lbs. No lichens, algae, flaking disease, smooth scutes; w.g.i.'s mostly non-existent. With black #5 – magic marker (Julio).
New #1324 – CL 60.6; CW 63.7. ♂ probably – Temperature 27.8 ºC at 1505 – grazing in open. Weight 39.0 lbs. No lichens, algae, flaking disease; w.g.i.'s non-existent; scutes smooth only in very tiny central parts. With black #4 magic marker (from Julio).
Came back to camp and watched small painted #1 for 2 hours. From 1600-1730 he poked about, grazing, finally looking for a burrow and he burrowed at 1730. Till just a few minutes before 1600 I had not been able to locate him; however, when I left this area at . . .

Pg. 143.
. . . 1220 hrs he was burrowed in shade and resting and when returned at 1530 he had moved from that site – thus probably became active after garua started, sometime

between 1305 and 1530. At time this fellow burrowed (1730) his rectal temperature was 27.8 ºC. He made a nice little burrow, sidling down into loose dry soil about 2-3 cm and is up under a bit of dead vegetation. Soil temperature in loose soil he is burrowed in – 26.6 ºC. Soil temperature on surface in open but away from burrow and overhead protective cover – 25.0 ºC. Air temperature at his level in open – 23.4 ºC.
1 December 1970.
0700 hrs – Little fellow just twisted a few degrees for first time in his burrow – not really active but awake and looking about for first time since sunrise. Temperatures taken:
Air in open – 20.9 ºC.
Soil surface in open – 21.6 ºC.
Soil in his burrow – 22.3 ºC.
Rectal temperature of animal – 22.1 ºC.
Just a few minutes later he began moving about and now (0730) is grazing on small herbs. Garua was reasonably heavy and constant (for this altitude) last night, falling most of time from 2130 – 0500, then stopping. There are dozens of large flat rocks all over at this altitude and in and near these nesting areas; they are . . .

Pg. 144.
. . . well used by tortoises and this morning are being heavily used by tortoises for H20. Note from yesterday: three of young tortoises I was handling yesterday released urine and notably it was of a thin yellowish consistency and not thick, heavy, concentrated, dark amber kind found so often being released by them when under duress during the hot season or dry parts of garua times. One wonders if garua has been abundant enough here lately that they are getting sufficient water to allow urine not to be concentrated. Certainly appears in these nesting areas at this time that adults have moved back to higher moister, greener areas and small ones have scattered out in search of food. Real proof that adults are not here is that have seen none at H20 collection sites this a.m. whereas have seen almost all small ones from yesterday at these sites. Note: lots of large (adult ♂ and ♀) dry droppings, out only 1-2 months old maximum, in nesting area, especially a lot in parts around nests 7, 17, etc. and around nest #53 area.

Pg. 145.
Decided to make a quick round trip to Cerro Gallina area – will not take marking, weighting equipment so will only record numbers if marked.
#1282; #1284; #1322 – all in same areas as yesterday; drinking from pockets in lava.
One young one about ¼ way to Cerro Gallina – unmarked – about 45 cm CL.
Very dry and devastated by goats all way along here to Cerro Gallina.
Cerro Gallina itself- conditions same but even worst almost compared to last visit; at least now garua has produced a scattered covering of herbs in rocky barranco and pond beds around the areas. Otherwise it is very barren. Saw one unmarked tortoise in entire area, near where saw 3 last time – on N edge of open area with ponds. About 60 cm CL – too small to sex but ♂ probably.
To Zone 5 - #1237 – same area; grazing.
#1065 – in same area; grazing and foraging.
In Zone 5 – I have been feeling strange all morning and am now approaching the point at which it would be a great relief to vomit. As this feeling of ill being is getting worse am

going to simply breeze through normal sample areas in zone 5 but just count animals, and then head for the Caseta where I can get into bed, obtain some warmth and rest adequately.

Pg. 146.
Sample half around campsite, dry pond area, etc. – found only 5 tortoises, 2 being small unmarked ones from the other day in this same area, 2 more also unmarked and about 60-65 cm CL and one medium-sized ♀.
Eastern part of sample area – only located 3 animals, one same unmarked 65 cm CL one from other day, 2 more of about same size. This certainly seems strange in that this area is now greener and more covered with seedlings than any time since late last January, 1970. But it really appears that most medium to large-sized animals of both sexes have mostly moved upwards to El Chato area and even beyond; there must be a few hundred at least N of Reserve Border above El Chato area. This would fit well into the picture I have gotten on last two samples of this area above Chato toward and up to Moreno's - more and more animals moving up there with each passing month recently and even though . . .

Pg. 147.
. . . have painted dozens have seen only a few of these return to El Chato, and none below Chato area; also some of large ones and painted ones from lower areas (Zone 5, Cerrito nesting areas) are now in Chato area and above. So all circumstantial evidence leads to a picture of a general movement upwards from coast and lower zones, with some animals at Chato and higher areas staying largely stationary where there is abundant lush grazing and moisture. Has obviously been raining like hell at Chato for past month and is very lovely, blush and green – same above here. As noted above, are small pools of standing H20 and small mud wallows all around el Chato area now. Small (mud? – word unclear) ponds above Caseta also have H20 and are lots of animals all around and just above Caseta area now. Dwayne Maxwell, Ohio State University, Department of Zoology was up to Devine's on 26 November and say were tortoises scattered all over on Devine's land – abundant.
Am heading back now – just started vomiting and am getting chilled. Will try to record tortoises seen in mora and In Region 1 above Chato of this sample line if possible, but feel very weak.
El Chato Weather – 1600 hrs – Evap. 2.7 ml, refilled full; Rain 0.22 inches, emptied.

Pg. 148.
Region 1 – saw only 2 animals, both moving uphill along trail – one large ♂, one large ♀; both marked but was struggling to get up hill and did not check them closely.
In Mora enroute to Caseta –
#174 ♀ - 200 m E of El Chato turn-off from manga. Very large, all smooth ♀.
#1044 – near Camote patch.
#81; #47 (both painted) – just a bit more E of #13♀.
#450 – same place last saw over 1 month ago.
#50 painted – same place as other day.
#43 painted – near Devine's western most manga, but on Reserve Border.

Arrived at Caseta in a cold seat =- to bed. Will not even take weather tonight.

Pg. 149.
2 December 1970.
Recuperating at Caseta – following notes are from Julio San Miguel of his past months work.
28 October, 1970.
Region 4 – Weather – 0930 – Max 75.0; Min 63; Evap dry, refilled full; Rain 11.0 mm, emptied.
Zone 3 NA – Weather – 1030 – Max 85.0; Min 64.0; Evap dry, refilled full; Rain 7.9 mm, emptied.
Found Nest #50 – still very fresh and wet right at the surface! Very close to Nests #5 and 10 in brown soil just above red-soil main nesting and camp area. Could find no ♀ in the immediate area. (Am almost sure this one laid by #131 and she was suspiciously poking about here only 10 days or so before). No other nests or ♀♀ seen.
30 October, 1970 – El Chato Weather – 0900 hrs – Rain 2.25 inches, emptied; Evap 19.4 ml, refilled full.
Nesting areas below Cerrito – no new nests found; only 2 ♀♀ seen of large smooth shelled type – one unmarked, other #463.

Pg. 150.
11 November 1970 –
Region 4 – Weather – 1300 hrs – Max 80; Min 62; Rain 9.1 mm, emptied; Evap. dry, refilled full.
Zone 3 NA – Weather – 1400 hrs – max 82; Min 62; Rain 5.0, emptied; Evap. dry, refilled full.
Saw no new nests or ♀ but only searched upper main part of nesting area.
12 November, 1970. – El Chato – Weather – 0900 – Rain 1.25 inches, emptied; Evap. 27.0 ml, refilled full.
13 November, 1970 - Zone 1 – "lots of tortoises everywhere"
17 November, 1970 – Region 4 – Weather – 0900 hrs; Max 80; Min 61; Rain 4.1, emptied; Evap 35.0, refilled full.
Zone 3 NSA – Weather - 1000 hrs – Max 83; Min 62; Rain 2.2, emptied; Evap. dry, refilled full.
In Zone 3 NA searched over main area and lower areas (near nests 6 and 11) – found no new nests in main area but 351 nest in area below near nests 6 and 11. Was already dry . . .

Pg. 151.
. . . completely on surface so age unknown. He says it is in red-yellowish soil very near nest #6 (1970-71).
#19 painted ♀ - was moving around in main nesting a area; #34 painted ♀ in area below where nest was found.
19 November, 1970 – Chato Weather – 1000 – Rain 0.40 inches, emptied; Evap 11.8, refilled full.

19-20 November, 1970 – Cerrito nesting area – Found one new nest, #52 (see my notes above). Was fresh and wet above with a thin layer of dry soil over muddy hard cap – thus only a few days to 1 week old at most.
#67 painted ♀ - was on trail just above main Nesting area and campsite, moving downwards, perhaps to nest – she had no sign of having done any digging yet he notes.
23 November, 1970 – not checking for nests or ♀♀ today.
Region 4 – Weather – 0800– Max 78; Min 65; Rain 23.5, emptied; Evap 9.2, refilled full.
Zone 3 NA – Weather – 0930 – Max 80; Min 67; Rain 14.6, emptied; Evap 13.7, refilled full.

Pg. 152.
25-26 November, 1970. At la Torta Nesting Area – 24th getting there, 27-28 return.
♀♀ seen all big, smooth – scute ones –
#881 ♀; #587 ♀; two with #577, both big ♀♀; one without number; #199 ♀ painted; one with number. All in nesting areas. None had clear signs of recently laying but some were digging.
Found nests #53 through 63; all but one were in areas we checked carefully on past trip so is almost sure that all are new since 3rd week of October, 1970 This one which was very dry, and could be old, we will have to check since he forgets its number. #56 nest was laid night of 25th while he was there but could not find the ♀ responsible.
3 December, 1970. To Zone 3 NA very early to take nesting temperatures – I still do not feel well so will take temperatures 1 day at Zone 3 NA, next at Region4 and not do much . . .

Pg. 153.
. . . poking around for nests, animals, etc.
Enroute – data on weather –
Region 4 – Weather - 0700 hrs – Max 78; Min 62; reset both; Rainfall 9.1, emptied; Evap. 23.6, refilled full.
Zone 3 NAA – Weather - 0745 hrs – Max 83; Min 60, reset; Rainfall 4.9, emptied; Evap.. 35.0, refilled full.
General weather notes – Generally cool and cloudy most of day with some sun off and on (40-60% of time) from 0900-1300 more or less; then cool and cloudy till just before sunset; cleared then and cool, cloudless night till I dropped off to sleep at least (2230). Next morning cool and cloudy up to time left area at 0830 and continuing beyond this time.
Soil moisture blocks –

Nest	1000	1400	1800	0600
5 cm	NR	NR	NR	NR
22 cm	NR	NR	NR	NR

Soil

5 cm	NR	NR	NR	NR
22 cm	NR	NR	NR	NR

Pg. 154.

3-4 December, 1970 – Zone 3 NA Temperatures in Nest #1.

Position	0800	1000	1200	1400	1600	1800	2000	2200	0600	0800
1	24.8	33.0	45.3	40.8	38.8	27.3	24.3	23.2	21.0	25.1
2	23.8	29.8	36.5	37.8	36.0	30.2	26.5	24.8	21.8	23.8
3	23.7	28.1	32.6	35.1	34.8	30.6	27.5	26.1	22.5	23.6
4	24.5	26.4	28.4	30.6	32.0	30.9	29.4	27.7	24.8	24.5
5	25.4	26.1	26.5	27.8	29.3	29.8	29.5	28.7	26.1	25.5
6	26.0	26.3	26.5	26.7	27.8	28.9	29.0	28.7	26.7	26.3
7	26.4	26.8	26.8	26.8	27.1	27.8	28.5	28.2	27.4	26.7
8	26.8	26.8	26.8	26.8	26.9	27.3	27.9	27.7	27.5	27.0

Pg. 155.

3-4 December, 1970 – Zone 3 NA Control column in soil beside Nest #1.

Position				hour						
	0800	1000	1200	1400	1600	1800	2000	2200	0600	0800
1	25.9	33.5	49.1	42.5	37.0	25.6	23.5	22.6	20.9	27.4
2	24.3	29.6	37.0	36.7	35.6	29.0	26.6	25.1	22.5	25.0
3	24.2	28.2	33.1	34.7	34.1	30.3	27.8	26.1	23.1	24.3
4	25.2	26.8	29.2	30.8	31.5	30.9	29.7	27.9	25.5	25.1
5	25.8	26.7	28.0	29.0	30.0	30.5	29.9	28.7	26.5	25.8
6	26.7	26.8	27.7	28.2	28.5	29.1	29.1	28.8	27.5	26.7
7	26.8	27.1	27.2	27.3	27.5	28.5	28.7	28.6	27.8	27.0
8	27.0	27.2	27.2	27.2	27.3	28.0	28.4	28.2	28.0	27.5

Pg. 156.

Poked around area just a bit today –
Saw 31193 back in old stomping grounds near 2 favorite burrow sites, walking around and foraging on small plants and herb seedlings.
31144 just S of water collection rocks, foraging also.
#918 – moving around on rocks near nests #5 and 10 of this year.
#19 painted ♀ - was in water collection area in main nesting area this a.m. Then passed by one of main routes, checking beneath 2 large Opuntia enroute, to hub of tortoise highway to E. By late afternoon (1700) was there foraging on small herb seedlings.
#1269 – small fellow – in small nesting area to SE of main nesting zone, where usually hangs out in other words.

Pg. 157.

[blank]
Next three pages have rough maps which have been crossed through, probably signifying that they have been re-copied elsewhere and are to be disregarded.

End of Notebook.

Isla Santa Cruz Volume #13.
Field Notebook of Craig MacFarland

(Pg. 1)
4 Dec. 1970. Leaving Z3 NA for Reg. 4, 0830 hrs.
0900 in Reg. 4 – to instruments immediately to begin taking temperatures.
Weather notes – day largely like yesterday; no sun till between 1030-1100 and then out off/on about 40-50 % of time till 1600-1630; lost of light clouds passing over constantly so un-covered much of time; but always with sensible solar radiation coming through from 1000 - 1500 + -. Cool and cloudy till 1030-1100 and after 1600; cool and cloudy off / on (light clouds) till retired at 2230.
Soil moisture readings –

depth	1000	1400	1800	0600
5 cm	nr	nr	nr	nr
22 cm	nr	nr	nr	nr

nr = no register

Feeling poorly so not looking around here today; no tortoises obvious around campsite area; saw a few on main trail through central Reg 4 on way in but none painted; did not check numbers.
(Pg. 2)
Reg. 4 – Control column 4-5 Dec. 1970; in soil

Position	1000	1200	1400	1600	1800	2000	2200	0600	0800	1000
1	30.6	36.1	33.9	29.7	24.0	22.5	21.9	19.4	23.4	26.4
2	28.5	32.6	31.5	29.5	25.1	23.5	23.1	20.1	22.5	25.4
3	26.2	30.0	30.0	29.3	25.8	24.1	23.8	20.9	22.4	24.6
4	23.8	25.6	26.8	27.8	26.7	25.7	25.5	23.0	22.9	23.8
5	23.5	25.0	25.8	26.9	26.5	26.0	25.8	23.7	23.4	23.7
6	24.9	24.7	24.9	25.4	25.6	25.5	25.4	24.5	24.2	24.4
7	24.9	24.5	24.6	25.6	25.8	25.7	24.6	24.2	24.2	24.2
8	24.9	24.6	24.8	25.1	25.5	25.5	25.5	24.9	24.3	24.2

(Pg. 3)
Dec. 5 1970 – to Caseta in late morning; to CDRS in afternoon. Enroute noted nothing special ; sun out, so no tortoises evident along R.B. but lots of sign all along zone 1, zone 6, and to La Torta trail turn – off area.
(Pg. 4)
December 28, 1970 Jan, Bennett and I to Caseta
Enroute noticed that tortoise are further east than have ever noted them before save for #5 who has been on Aldazo land through much of garua season. Julio has not seen this one for over a month and none others wile crossing to Bellavista on Aldaz's land. Found 2 today about 3 km. East of Zone 6 turn – off and lots of sign along trail beginning here and extending all way to ½ km to other side of zone 1 turn – off and Poza de Manzanillos area. One was a med –large male unmarked, had come up from south and crossed trail. Other was #1001 large male who had been working back and forth along tail for 100 m or

so. Both in an area just east of La Torta turnoff by a few hundred meters – thus probably came up from regions below around (Pg. 5) La Torta and or inter-lying pond – pampa areas.
From here to Zone 6 was scattered sign of recent grazing and fresh and old droppings. Zone 6 area to and past zone 1 – P. Manzanillos area as described on recent trips – lots of grazed and mashed down areas north and south all along reserve border. Some trails heading off to north, so many of these animals must be north of R.B. in mixed fields and forests between R. b. and farms. Saw # 260 m (med- large) and # 735 m – med – small) in area just 100 m east of Z #6 turn off.
Saw # 268 just where trail leaves east – west R. B. and head NW toward Caseta. Another unmarked on about 1 km. From Caseta on trail and heading across it and to NE in very open Scalesia forest. #2 f (duplicate) still at Caseta pond #4. Lots of scattered sign all along trail from P. de Manzanillos to Caseta, heaviest concentration of it (huge grazed and flattened – herbs areas) just before and around Caseta pond #4. Pg 6
At Caseta found #31 m, #626, and an unmarked one. Still quite green and lush everywhere but has been rather dry for past 2-3 weeks with a lot of sun, especially in afternoon and herbs and Scalesia seedlings and saplings show it because are moderately wilted now. Tremendous quantity of Scalesia seedlings and sapling have grown up since beginning of garua season at threes altitudes; very little evidence of any of it being grazed either by tortoises or goats (latter abundant here still).
29 Dec 70 – to Reg. 4 today to take temperatures.
Around Caseta today - #31 m, #246 f, #87 painted; unmarked one from yesterday – new #1325 m c.l 73.2; c.w. 77.0; Bright, thickish (moderately) well developed w.g.i.'s; no deformities; no lichens; no algae; no f.d. grazing all (Pg 7) . . . around Caseta in open. While eating lunch, saw #31 m coming down from cook shack toward Caseta, ambling along looking about. In clear view of #1325 which was grazing just behind caseta on small grasses; clearly could see each other abut no obvious behavioral response. #31 continued on toward our cook tent and when about 5 m from small male, suddenly seemed to take explicit notice of him while in mid-stride and turned to him and kept walking. Small one had been resting on plastron grazing on low grass, but now looked up at #31 m and when the latter was about .5 m away, rose up, turned to side and began to move away. To this point the only threat offered by #31 was his talking approach – he had not hissed, opened mouth, or changed normal "straight –out" position of head and neck used during walking. As 3325 turned and began to move off, #31 m opened mouth and made a weak lunge with head at rear side (leg socket) area of escaping # (Pg 8) 325; the latter I'm sure did not see this "mouth – open" threat. Small one then continued to walk on, #31 m only turning about 60" (actually switching (last word not clear) on plastron because he had dropped onto it from walking stance when he lunged and watching him go #325 moved about 30 m away and began grazing again, while #31 m moved on around caseta and began grazing in front of it. Whole encounter only lasted about 15-20 seconds, with no real chase involved at all.
Enroute to Region 4:
#1104 – just below Caseta moving down trail – from Region 5 ! w.g i.'s clean and moderately thick.
3628 f – near pond #1; (C.L. 97.0; C.W. 110.0; no f.d. or lichens; b-g. algae dense in wide scute juncture grooves all over, but especially on rear of carapace. W.g.i.s non-

existent. Recent copulation or attempt (Pg. 9) evident because sign of males feet (mud) all over top of carapace. No red mud on her at all.
#1171 C.L. 61.9; C. W. 64.5; w.g.i.s clear and well developed and moderately thick. From Z3 N.A. ! No f.d., algae, lichens. At. C. pond #1.
#1296 – in Reg. 4.
No animals seen and only a few turds of 2-3 weeks age between C. pond #1 and Reg. 4 !
Reg. 4 weather data – 1515 hrs.
Rain – 8.5 mm (emptied) Max. 82.0 F; Min 63.5 F; Evap – 20.3 (refilled full).
20 Dec. 1970 – garuaed a bit between 1200-0200 last night. Today temps at Reg. 4 probe. Also will sample area for tortoises, probably for final time.
Soil moisture blocks –

Depth	0800	1200	1600	2000
5 cm	nr	nr	nr	nr
22 cm	nr	nr	nr	nr

nr = no register
Weather comments – 0600 –0700 – overcast, cool breeze; no garua
0700-0800 – same; very slight weak radiation out almost nothing sensible
0800-1000 – cloudy – a bit more radiation now coming through but still not much.
Pg 10
1000 –1200 – same as previous 2 hours.
1200 – 1400 – from shortly after noon till almost 1330 considerably warmer due to more weak radiation coming through clouds than during entire morning. Sun out briefly (less than 1 minute) several times, but still cloudy and relatively cool. From 1330 –1400 cool and heavy clouds again.
1400-1600 – cool and cloudy
1600 –1800 – cool and cloudy
1800 – 2000 – cool and cloudy; rained from early morning till about 0530; at 0600, 31 Dec. cool and cloudy but rain had stopped.
Pg 11
Thermocouple probe – Reg 4 30-31 Dec. 1970

Position	0700	0800	1000	1200	1400	1600	1800	2000	0600
1	22.4	23.5	27.2	33.8	34.6	31.1	26.5	24.5	21.1
2	22.9	23.4	26.4	31.0	32.6	30.7	27.2	24.9	21.7
3	23.4	23.4	25.6	29.0	30.8	30.3	27.5	25.5	22.5
4	24.3	24.1	24.5	25.5	26.6	28.0	27.2	25.8	24.0
5	24.5	24.3	24.5	24.8	25.5	27.2	26.2	26.2	24.6
6	25.2	25.0	24.9	24.8	25.2	26.0	25.8	25.7	25.4
7	25.2	25.0	24.9	24.7	24.9	26.1	26.1	25.9	25.5
8	25.6	25.3	25.2	24.7	24.9	25.7	25.7	25.5	25.5

Pg 12
Sample –
Western half – in woods:
NW #1326; too small to sex accurately; lying in open soil here basking since 0700 when we got up – near campsite. At 1015 cloacal temp 3 cm up rectum is 26.0 C (solid surface now 27.2 C) C. L 50.6; C.W. 54.3; No lichens, algae, f.d. only on underside of rear

marginals. W.g. i.'s present but extremely thin. Wgt. 24 5/8 lbs with chatillon spring balance.
New # 1327 f CL 61.6 CW 66.0; Temp (cloacal) 3 cm. In rectum 26 C also In open on lava rocks near previous animal. Also has been basking till now (1035) since about 0700. wgi's clear but thin; no f.d., algae, lichens; Wgt. 33 3/8 lbs.
#42 f; CL 101.2; CW 113.3 very large and all smooth shelled; no lichens; f.d. on slight here and there along scute junctures; b-g algae in deep, wide scute j. grooves, especially in rear areas. W.g.i's ext thin and incomplete. Sitting in woods (Pg 13) . . inactive at 1045. No clear sign of recent copulation or nesting. No red soil on rear which characterizes Z3NA.
Central area and eastern part; First around water collection site:
#1296 CL : 48.2; CW 50.8; w.g.i's very clear and nice; wgt – 24 ¾ lbs In edge of forest near H20 collection site. Temp (cloacal) 3 cm in rectum at 1300 hours – 29.7 C Resting in shade; some bright sun occasionally now; lots of strong radiation coming through clouds.
New #1328 – CL 44.2; CW 47.3;
At 1305 noticed had been grazing in open and just now moving into similar shady position to that occupied now by #1296. Temp of this one (3 cm up rectum) just as entered shade – 32.5 C.
Will look for another small one . which saw near here, earlier today -= Also are several others scattered about. More data on these below.
New #13229 CL: 48.0; CW 48.8. Just after noting behavior of 31328 saw #1329, at 1210 move into shady spot and settle down – took rectal temp – 33.4 C
At 1315 hr. – soil surface temp is 38.6 C, air temp at 30 cm is 27.2 C, but drops as low as 26.0 C when gusts of cool breezes blow occasionally. Pg. 14
#1328 – further data – No lichens, algae f.d.; w.g.i's clear and moderately thick; 10 marginals on rgt side, 11 0n left, supracaudal compensating on right and thus misshapen. Wgt 16 lbs. No smooth scutes.
#1329 – further data – No lichens, algae, f.d., or smooth scutes; w.g.i.s clear and moderately thick. Wgt. – 18 lbs.
While marking 1328 and 1329 notes #1296 moving again – cool now (1330) and solar radiation much weaker.
#1213 and 962 – noted both were in shade during period I was taking temps of smaller ones. 31213 remained so, 962 began moving between 1315 and 1330.
72 painted, large f in semi-open all this time (1300-1345) grazing , but actually well shaded.
#962 f CL 68.2; CW 72.7; no f. d. , algae, lichens; scutes smooth only in very centers; w.g.i's clear and well developed and thick.
#17 painted (130 f) and #95 both in dense shade prior to 1300 – have been (Pg 15) near their locations since just before 1300 and heard no sounds such as they would have to make in order to enter present locations.
This is interesting because was here from 1030 t091145 and all these animals were active in open. Even some brief basking, yet only 1 hr and 15 min later all but smallest ones and even one of these all in shade, inactive and smallest ones also entering shade at 1300 + -.
[Notes on growth and nesting and mating;
#72 f painted – very weak, ext. thin w.g.i's

#95 – m. thick w.g.i.'s
#17 f, painted – well –developed but rather thin w.g.i.s
1213 –
#72 f, painted – no clear sign of recent nesting; but has fresh dried mud of yellow-brown soil type on rear of carapace and legs so could have laid down below Z3 NA when laid once before this year. (did not find latter nest but is virtually a sure thing). No definite sign of recent copulation.
#17 f, painted – no clear sign of recent nesting or copulation.]
East of rocks and area around water collection site;
#121 f, painted – sleeping in open, i.e. unavoidably basking in weak solar radiation ! Has apparently just come up (through Reg. 5?) along a trail to east a bit of my trail = No clear sign of recent nesting or copulation but has old red soil of Z3 type worn into skin and shell on rear area. (Pg 16) w.g.i's clear and thick.
[Note – at 1415 noted #1328 in open area, grazing on herbs – shell quite worm – rectal temp. now reads 33.7 C]
#870 f, (painted #20) – sleeping under a tree in partial shade (1430 hrs; cool and very cloudy now). W. g.i.'s clear but thin; no sign of recent copulation or nesting. Old warn in, dry, reddish – yellow soil on tail. Repainted.
[Note – at 1450 again saw #1329 – now in open, grazing; has moved about 150 meters from where marked and last saw – probably a reaction to marking; saw him leave after marked and heading this way he had just stopped waling and started grazing when found now near pond. Cloacal temp – 34.4 C; soil where he is in open -33.4 C; air temp at 30 cm. -= 27.4 C He is quite warm – probably partially
(Pg 17) due to metabolic heat from long walk.
Around pond: saw none and no very fresh sign.
31 December 1970. To Z3 NA; will take straight line sample from then to Caseta on 1 January.
Enroute saw many of animals from yesterday's sample drinking at H20 collection site in Reg. 4 – much garua last night.
Reg. 4 weather – 0730 hrs
Max. – 79.0 Min – 65.5 Rain – 5 mm !
Rset emptied
Evap. – 3.9 ml. Not refilled
Enroute found 31149 at big boulder area drinking from a small pocket in a large well – worn pocket – filled boulder;
In zone 3 N. A. toured around a bit looking for obvious signs of large, nesting =sized females – saw none. Did find: #1193 about 50 m south of usual activity area and area of 2 burrows, i.e. near large Opuntia where have seen him before.
#1144 near Opuntia near 1969/70 nest #2.
3918 near 190/71 nest #10 – i.e. near entrance to N.A.
1 unmarked small one about 50 c. CL on rocks just east of weather instruments.
1100 – weather here – Max 84.0; Min 62.5 (reset both)
Rain – 9.7 mm – emptied
Evap. 28.3 ml – refilled full.
(Pg. 18)
Soil Moisture Readings

		1000	1400	1800	0600
Nest	5 cm	nr	nr	nr	nr
	22 cm	nr	nr	nr	nr
Soil	5 cm	nr	nr	nr	nr
	22 cm	nr	nr	nr	nr

Weather:
Dec. 31 – 0600-0830 – Cool and cloudy till about 0715 then bright sun out off and on alternating with strong scattered radiation ill 0800.
0800-100- - Mostly cloudy; but fairly strong scattered solar radiation through clouds about ½ time;
1000-1200 – Mostly same as 0800-1000 – more abundant scattered solar radiation; light breeze continues to gust off an don whereas almost none before 1000. Sun out infrequently for seconds to 5-10 minute periods.
1200-1400 – Hottest period of day so far- sun out maybe 50 –60 % of time, especially from abut 1245 to just before 1400. Breeze only occasional.
1400-1600 – Cool and cloudy largely ; some strong scattered radiation from 1400 to 1430 or so but since 1430 mostly cloudy and cool and breeze fairly frequently; cooling a lot; sun out only a few dozen second total for whole period
1600-1800 cool and cloudy
1800-2000 cool and cloudy; rained for many hours in early morning;
1 Jan 0600-0800 – Continuing to drizzle till just after 0800.
0820 –1000 warm solar radiation begins coming through clouds 0805, at 0915 sun out and remains so most of time. (Pg. 19)
Probe in Nest #1, 31 Dec. – 1 Jan , 1971

	Time								
Position	1000	1200	1400	1600	1800	2000	0600	0800	1000
1	39.6	47.3	49.0	37.1	28.2	25.1	21.4	24.6	41.1
2	29.0	39.0	42.8	38.1	31.0	27.4	22.7	24.1	33.4
3	27.5	35.4	39.8	37.7	32.5	28.8	23.8	24.6	30.9
4	26.9	29.7	33.1	34.5	33.3	30.9	26.3	26.2	28.0
5	27.6	28.0	29.8	31.5	32.1	31.2	28.3	28.0	27.9
6	28.3	27.9	29.3	30.0	31.0	30.7	29.0	28.7	28.5
7	28.7	28.1	29.1	29.4	30.3	30.2	29.4	29.0	28.7
8	28.6	28.0	28.5	28.8	29.5	29.1	29.1	29.0	28.9

Probe in soil = beside nest (control) – 31 Dec. – 1 Jan 1971

Position	1000	1200	1400	1600	1800	2000	0600	0800	1000
1	40.7	48.9	52.9	26.1	27.3	25.0	21.8	25.2	42.4
2	30.6	38.9	42.1	37.2	31.0	27.6	23.4	24.9	33.8
3	28.6	35.5	39.1	37.1	32.3	29.1	24.6	25.2	31.2
4	27.3	30.4	33.7	34.3	33.1	30.7	26.7	26.4	28.3
5	27.5	29.0	31.0	32.2	32.3	30.8	27.6	27.5	28.0
6	27.9	28.4	29.3	30.1	30.9	30.4	28.6	28.4	28.3
7	28.4	28.1	28.7	29.3	30.1	30.0	28.9	28.7	28.4
8	28.8	28.1	28.7	28.9	29.2	29.2	29.0	28.9	28.9

(Pg. 20)

Am collecting some data on activity and temperatures of animals today and tomorrow, but will wait to transfer from temporary notebook at end of tomorrows' notes when have completed everything.
Checked all nest here and in zones below throughout Reg 7 to Reg 8 border – no sign of young having hatched and escaped from any of these yet. And suspect some have hatched or will hatch soon.
(Pg. 21
Jan 1, 1971 Continuing temperatures in nest and thermoregulatory behavior observations on certain tortoises; will record latter at end of today's notes.
Enlarged normal sample of this area this morning:
#918 CL 58.8; CW 63.6 (to check growth) as always – between tent and new nests (#10 and #5) for this year – on rocks moving about wgt – 33 5/8s lbs; w.g.i.'s present and of medium thickness. Only 3 toes on each of all 4 feet; carapace scutes normal but many extra, small plastral scutes. Wgt 15 ¾ lbs
On rocks just east of weather inst. And in open over just S of them yesterday and today. Droppings full of Opuntia spines and remains.
#1144 – CL 59.2; CW 64.7 – to check growth. Wgt 38 7/8 lbs – w.g.i's clear, not? Very thin; eating cactus and had seedlings near 1969/70 nest #2; Opuntia parts is eating include flowers, torn open and buds only and both fresh and rather dried up pads. Recent notches
#1302 – small fellow- C. Temp when found cruising? Open lava in full sun at 1035 hours. - grazing and foraging for small herbs; 32.7 C Sun out now about 50% of time since 0915 Just west a bit of dry pond and about 50-60 m NW of where first found on last trip – w.g.i.'s clear but rather thin.
(Pg 22 - [Weather – 1100 hrs. – 24 hr period ends now]
Max. 83.5 Min 65.5
Rain 2.3 mm (emptied): Evap. 2.7 ml (refilled full)
#1193 CL 32.1 CW: 34.2
Wgt 7 1/8 lbs ; w.g.i's clear but extremely thin.
#1146 – coming west along pathway leading from highway hub to central Z3NA.
w.g.i's clear and thick
Note on #1193's activity area or home range.
(see Thermoregulation notes for details) = yesterday reached a pt. About 60 m east of where first seen early in day at 0915 – i.e. by large Opuntia which lies along one pathway leading from central z3na to hub. Opuntia was by at 0915 lies about 75 m south of his favorite 2 -burrow area of last garua and hot seasons. Now is returning along same path by which came yesterday – is about 15 m back down it.
End of sample-
Other animals noted, beyond sample area= #1296 in pond N.E to SE usual haunts.
W.gi.i's very clear and mod thick.
(Pg. 23)
#19 f painted – at side? Of highway; w.g.i's thin but clear and well developed.
#1242 – along highway – about 50 m. up it and just east of it in an open area foraging near an Opuntia tree w.g.i.s very thin.
1 unmarked female of 18 cm CL, resting in shade at 1130 hrs. -= same area where #1242 is moving abut; no time to mark – put an x on 4th vertebral (on lower half) w.g.i's very thin.

#129 painted – 2/3 way up highway resting in shade; w.g.i.'s well developed, but thin.
Saw fresh droppings from #19f, painted, 31144, and #1193 today – all full of Opuntia remains; also although moist, as expected these droppings all not as moist as those from tortoises in Caseta area – considerably more dry internally and externally.
Did note however concerning H20 economy, that both 1144 and 1193 when being handled, urinated freely and was clear, low viscosity type, no amber colored, thick, concentrated type seen at these altitudes in hot – dry season.
Return to Caseta – will take straight line samples of Reg. 6 through and including Reg. 1
Reg 6 – none seen and no recent sign; a few dry droppings only from past weeks
Reg 5 – also little sign'; #1149 in big (word not clear) area in shade inactive. An unmarked 60 c. CL animal male, in (Pg. 24) Reg. 5, just before Reg 4; inactive and in shade; no time to mark as is in dense brush.
Reg 4 – a number of animals around rocks recently to drink garua water each morning; except for this site, very dispersed here. Saw following ones on st. line through this area – (well after morning rain, now 1400; so not concentrated now).
#1213 at Reg. 4/5 border, in shade , inactive.
#72 painted female; grazing in dense shade
#1296 and #1328 – both inactive in shade

Reg. 3 – saw none and absolutely deserted it appears; very little recent sign along trail
Reg. 2 – ditto to Reg. 3
Reg. 1 – lots of animals and lots of recent activity.
Near Caseta pond #1
#1171; grazing in semi-shade
#596 (or 526) male – huge; same one often seen here; grazing in open, semi-shade.
#180 painted, moving along trail up toward caseta. (Pg. 25)
#129 (?) – 70 CL approx. = moving down trail, 150 m below Caseta
#1104 – sleeping in trail 50 m below Caseta.
Around Caseta itself, actively grazing - #246 f; #1006 f (painted #15), painted #16.
Seems to be a real paucity of animals at all lower elevations, but a lot of them around Caseta are, pond 1 etc. Will comment more on this and vegetation after sampling pond #1 area, Devine's and generally completing the sample line.
Took weather in Reg 4 on way through – 1400 hrs. Rain – 3.4 mm, emptied; Evap. 8.9 ml, refilled full; Max 81.0 F; Min 66.0 F.
Observations on thermoregulatory behavior of small tortoises in '"Z3NA 31 Dec. 1970 to 1 Jan 1971; copied verbatim from temporary notebook:
Methods: Temperature were taken rapidly with a standard Schultheis thermometer.
(Pg. 26 –30 blank)
(Pg. 31) [Note; most of page blank]
Caseta weather – 1900 hrs – Max 82.5; Min 69.4; Rain 10.0; Evap 7.0 (reading 7.0) (first time since 28 Dec. at 1300) Hot and sunny most of late morning and afternoon – garua heavy last night.
(Pg. 32)
2 Jan 1971. To La Torta with Julio San Miguel for last searching (probably) for nests and to check on any nests in which young may have hatched. Enroute to La Torta saw an amazing # of tortoises on reserve border, scattered all along through those areas I

mentioned in 28 Dec. 1970 notes as being ones where tortoise sign was abundant since all these areas are near forest it indicates animals are moving through forests at least, a great deal. They obviously prefer the open reserv border and thus were concentrated along it this morning, basking in the sun and grazing; forgot tape measure so will estimate sizes;
1 unmarked f, about 70 cm. CL – only 400-500 m down trail from Caseta. Pond #4
1 unmarked – about 60-65 cm CL – zone 1 turn off area.
#1214 – Zone 1 turnoff area.
1 unmarked one = about 55 cm CL – smallest have ever seen in this area; at Zone 6 turn off area.
#1259 – about 300 m east of Zone 6 turn off.
1 unmarked male of 75 cm. CL – 225 m east of Zone 6 turn off.
(Pg. 33
#825 m – 500 m east zone 6 turn off.
#173 m – 550 m east zone 6 turn off.
#636 m – about 85 cm CL; about 800 – 1000 m east of Zone 6 turnoff
#238 f – about 90 cm CL; about 800 – 1000 m east of Zone 6 turnoff; red soil of type from nesting areas ground into her carapace and shin at rear. – probably just came up from there . Old , all smooth female
#189 painted male – 500 m + - ; west of La Torta turn – off - thus has moved quite some distance since last saw on cow trail down to La Torta.
#169 m – in dense forest just 20 m. west of where trail to La Torta intersects reserves border – and 30 m south of R. B. itself – heard him banging around in here.
Things in a humorous mess – I forgot tape measure and Julio is hung over from Jan 1 = thus will not go today.
Caseta weather 1900 hrs.- Max 81.0; Min 69.5; rain 2.45; Evap –2.8 (reading 9.8)
Warm and sunny from 1000 – sunset , most of the time; no garua during daylight hours, only last night after midnight.
(Pg 34
3 Jan 1971 – to La Torta
Enroute to trail
#1257; still in burrow, beside trail, ½ km from Caseta w.g.i's clear but very thick. –0800
#1214 CL 58.9; CW 61.9; w.g.i's clear but ext thin; 50 m east of zone 1 turn off; sitting in middle of (sunny area?) trying to bask. – 0825 and cloudy.
#266 m ; CL 105.3; CW 118.4; w.g.i's clear and of moderate thickness; basking in trail, 100 m east of Z6 turn off. Red soil well worn into rear of carapace and skin areas indicating has been down below in nesting area recently. No lichens, b.g. algae in usual places; scutes smooth only in very centers; almost no f.d.
Enroute to La Torta
#1174 f; CL 92.0; CW 105.8; w.g.i.'s very thin; moving up trail, 100 m. S of reserve border; no lichens, almost no f.d. – a few spots on marginals; b.g. algae in junctures of usual places. Scutes smooth only in small parts but very worn; red sol ground well into rear of carapace and skin in rear so (Pg. 35) must have been in nesting area altitudes this year. Completely missing right rear foot – obviously get along well without it however because is large and healthy – but now does she make nests? Leg just a stump only 2/3s normal length – caused by what?

At Manzanillos ponds – 1.5 – 2 km below reserve border – 2 males, one in pond, one approaching it – 88cm CL and 106.5 cm CL both unmarked but not worth trouble to mark them today. Both with very thick but clear w.g.i''s some H20 in ponds but much less than on previous trip here (October 1970). Lots of use by tortoises here – much of bush and herbs eaten and mashed down, lots of turds from past 3 months.
#746 f; CL 94.8; CW 106.2; Scutes smooth in only central 1/15 – 1/8 or less, but worn. No. f.d.; no lichens; dried b-g algae on usual 2 areas in general coverage; w.g.i's clear and moderately thick. Faint, old traces of red soil on rear skin and carapace areas, so perhaps coming up from nesting areas below – No sign of recent nesting of copulation; in pond – pampa areas – First ones of plant #1 pampas at very upper end.
#1094 – in pampa pond zone, about 100 m S of where saw on Oct 1970 trip – now resting in shade.
(Pg 36
New #1331 f; CL 88.1; CW 94.3; No f.d., lichens, scutes smooth only in very tiny central areas; black-green algae dried on carapace in usual 2 areas; w.g.i.s clear but rather thin. No sign of recent nesting or copulation. Has soil – red –brown of this area well ground into carapace and skin. Just on other side of large barranca very close to where 2 slaughtered males were found the few months ago.
Scattered tortoise dropping rest of way to main camp site at La Torta but no more animals seen – very hot so probably missing some that are "hidden" in shade.
Took off to examine southernmost part of N.A. right away; will keep a running commentary on tortoises new nests, etc. But will simply list nest from former trips this nesting season to give data on any hatching and escape data.
#190 f (painted 199) – only 25 m from where saw here in Oct. 1970. Julio says she was also here on Nov. 24-28, 1970 trip = same area i.e. (Pg. 37)
Nest examined from previous trips
#47 - no sign of any escapees having left nest; nest appears OK
#62 – ditto
#63 – ditto
#48 – ditto
#12 – ditto – but see notes on page 39
#49 – ditto
#23 – ditto
#24 , #25, #53, 2 others (probably new nests – i.e. Since Nov. 70 trip by JSM) in same area – destroyed by pigs.
326, #27 – destroyed by pigs
#60 – destroyed by pigs
#61 and 6 others destroyed by pigs (4 older nests, 2 new ones) all in same area.
#46 ditto to #23 and above it.
#59 = destroyed by pigs; 1 new also destroyed by pigs.
#58 – OK – ditto to #23 and above; see pp. 47-48 for special notes.
#40,41, 42 - + 2 more "new ones" (probably older nests) destroyed by pigs all in same area – hard to say if other 3 mew – soil here is loose and nests even new ones hard to detect.
#39 – destroyed by pigs
#38 – OK ; ditto to 23 and above – protected temporarily till a corral can be built.

#55 – destroyed by pigs.
#37 – as with #38
#43 and #56 = destroyed by pigs; both in yellow brown soil.
#29 – as with #37 and #38
#44 – as with #29, 37, 38, etc.
#13, 14, 35, 36 plus 2 more recent nest near 13 and 14 and 1 near 35 and 36 all destroyed by pigs.
#34 destroyed by pigs
#57 destroyed by pigs
#54 – we could not find it again.
(Pg 38
Found a small fellow and painted him #5 with white paint (5th one from La Torta of small size that I've painted (4 in Oct. 1970). CL 31.5; CW 31.8; Wgt. 5 ¾ lbs; temp on encountering 29.3 C – 1320 hrs; In dense shade under a fallen Pisonia's roots – very hot and still in open and he was completely inactive. Just east a short ways from nest #47 – he's hideaway is in edge of rocks, but tracks all over pampa colorada. Located nest #62 from last trip (late Nov. 1970) of Julio – mapped; in red – brown soil in a large depression; in open full sun. Located nest #63 from Julio's last trip – very near, i.e. 3 m from nest #48; in full open sun save for a few leafless palo santo stems giving some rare, light, very partial shade; mapped also; also in reddish soil in a depression [marginal note: both (of these nests) definitely not here on 1970 Oct. trip]

- Found another small one – painted #6; in lower N.A. not far from nest #12 (50 m) – in a depression full of mostly rocks and small vegetation (Marginal note: depression is just below large open pampa colorada) , but a few soil patches. Tracks all over here; in dense shade under an Acacia prone log. Temp when found 31.0 C (1400 hrs) – Temp of soil surface in open (area?) – 50 C plus; air at 10 cm in (Pg 39) open is 31.2 C.

CL 33.9; CW 35.0; Wgt – 7 ¾ lbs.; no lichens, algae, f.d. or smooth scutes; w.g.i.'s clear and well developed but very, very thin; clearly well-developed growth increments for this altitude.
Nest #12 – no opening, so no young have left yet; decided to open to see if any have hatched yet; upon doing so could see that there were 7 eggs at least, probably at least 3 more but not sure and did not want to disturb them. All 4 in second layer and 2 I could see on bottom of nest appeared OK One egg on top of all others looked bad; incredibly it was only 8 cm below surface of soil (to its very top) – next 4 eggs were 12.5 cm down and bottom of nest is 24 cm deep; nest obviously crammed full of eggs and nest much of a flask – just a nice little columnar hole. The top egg surely has been getting overheated and was simply one egg too many to fit in hole at lower levels. Opened it to find that there was no sign of an embryo and yolk almost like a semi – hardboiled egg; yolk and albumin very darkish and (word not clear) to occupy only 1/3 of egg space – rest air – all due to drying out (from excessive heat, certainly). Recovered other eggs (Pg 40) . . . leaving them exactly in place; hard cap was very soft, crumbly and dried up and although eggs largely surrounded by a small air space, loose dirt has begun to crumble in on and around them.

#1316 – only 20 m from were originally saw and marked on 21 Oct '70. In semi-shad (75% shaded) and in breeze under an Acacia prone limb. Cloacal temp. = 31.1 C; air

in shade at 10 cm. Is 29.0 C; air in sun at 10 cm. 31.2 (thermometer hand shaded), so body temp is very close to mean of these two air temps. Completely inactive. Checked weight and measures because has nice mod thick w.g.i's; Wgt 9 ¾ lbs (+ 1 1/8 lbs in 2.5 months) CL 38.5 (+.9 cm); CW 38.0 (+.6 cm). Really has grown ! Must be eating Opuntia.

Nest #23 – in red soil but made under one side of a leafy Acacia; must be shaded (Pg. 41) . . . at least partially for 4-6 hours of warmest part of sunshiny days (i.e. 0800-1700). We were unable to find any more new nest in the whole southern portion of the nesting area or any of the small depressions along the trail from the upper and northern part of the N.A. to the southern part. No obviously fresh signs of digging and no females found save for #190 f which appears to live here – at least she has been resident during most of this nesting season in this same spot almost. Julio says he saw no new digging anywhere along trail to south or in southern part of N.A. =-only new digging I noted (i.e. not here in Oct. 1970) he sys was here in November 24-28, 1970 trip.

Besides 3 smaller tortoise I saw today, all in dense shade and hard to located, saw tracks at least (very minimum because making calculation based on tracks is widely separated areas) of 3 small ones from 1969/70 nests , 3 from probably 1968/69 year class of nests, and 6-8 larger ones of 30-40 cm CL size class; all (Pg. 42) all these tracks were partly out in open red pampa coloradas or small open soil – covered spots in depression to sides of the former. Most came from and returned to surrounding brush /rock areas making locating such small tortoises in a maze of possible shady resting spots impossible or nearly so. But is of interest that animals of this size wander about freely in open at least in cooler parts of the day, especially the morning. Lots of their tracks passed by and around bases of Opuntia trees where fallen succulent pads, fruits, and flowers are now abundant – tortoises obviously are eating these and there appears to be an overabundance of it; old droppings are full of Opuntia material and much of fallen material is partly or mostly eaten.

One thin noticed today as we were passing the barranco: there is really (Pg. 43) only one pass through the barranco; it extends for at least .5 km to either side of the pass and through all this distance in either direction is steep –sided and impassible to tortoises. The one pass area has obviously long been used by tortoises as it contains much lava which is "polished" and worn by the year of passages of tortoises. Tortoise droppings, both very old bleached ones, and others of only a few weeks to few months age are scattered all along this passage way; also here and there are scattered large lava blocks and plates worn especially smooth and with follows, pits, depressions and or pockets where rain water collects and tortoises obviously drink. The passage way connects the lower end of the huge "pampa" north of the barranca with the smaller pampa pond area on top of a sloping (word not clear) to the south from the peak or ridge of the barranco – this latter pampa – pond area is where the 2 slaughtered animals were found and where #1331 f is now located. Very hot and sunny from 1000-1600 today – not much breeze either.

4 Jan. 1971 – Searching upper and larger part of La Torta n.a. today – looking for new nests, tortoises, mapping and describing nest from Julio's 24-28 Nov. 1970 trip, etc. – same as yesterday. Will continue recording Nov. 70 nests and others as yesterday on (Pg. 44) . . .page 37.

New nest #67 – in campsite area, first nest found in this area of ½ - ¾ of a hectare. Julio suggests laid by #881 f at very end of November or earliest December 1970. Says this f was here digging each day (but had not yet been successful when he left) on 24-28 Nov. 70 trip here. Nest is in red soil, with a durable hard cap and is dry through hard cap, at least to 5 cm which is as deep as I checked it. Could well be as Julio suggests and there are no fresh signs of any adult females in the area now.

Nest 24, 25, 53, and 2 others in same area- all destroyed by pigs – incredible. Same as if one passed through and simply tore up everything in it path. Not at all possible to determine # of eggs in nest. New ones – one nest just to side of #53, center of other only .5 m from center of #24. All 3 others (including #53) in red soil of depressions to side of main pampa (Pg. 45) colorada. Julio says new one near #53 not here in Nov. 1970 trip. One beside #24 less sure = could have been old and missed. Also found an old nest with 8 dried up eggs (probably all infertile) exactly between center of nests #24 and new one – nest #24 in fact almost laid on top of these old eggs. Surely a nest from 1969-70. Not sure if dried up only or infertile, then dried – suspect latter, but eggs were very deep – 35 c. or so to top so perhaps just never started developing due to lack of heat. Probably down this deep because this spot is so well used and churned up each year.

Pigs really had a field day – destroyed nests 60, 61, 26, 27. #61 only a few meters from #46 but for some reason did not destroy #46 – yet destroyed #61 and 60 then which are all in same small depression of only 10 x 20 m. Of the other 6, Julio says he saw no signs of nests near any of them on Nov. 1970 trip but I am not also sure myself – looks to me as if 2 could have been new, 4 older ones we missed previously this year – but pigs got them all.

Nest #68 – a new one, just beside # 61 by about ¾ m from center of one to other; not destroyed and is obviously only (Pg. 46) very recent so pigs passed by before it was laid. In same red-yellow soil – OK condition, very strong hard cap; moist to within .5 cm of surface so only a few days old at most!

New nest #69 – see map for location in red soil of a depression to side of large pampa colorada. Dry but appears to be reasonably fresh – cant tell age for certain; marked and put rocks and braches over it till Julio and Galo can return to build corrals.

Near here also the smashed remains of a young tortoise of about 28-30 cm CL – clearly killed and ground up by pigs also.

Also a small fellow about 25 m from here walking in open; painted #7; at 0900 temp. of tortoise (cloacal) is 30.6 C Cool and breezy still but strong solar radiation coming

though clouds. CL 21.8; CW 22.3 (Pg. 47) Wgt 2 1/8 lbs. W.g.i's very clear but a bit thin; no f. d., lichens, algae , or smooth scutes; just walking about completely in open.

Another small fellow of about same size – painted 38; in shade at 0945; cloacal tem is 31.9 C; to side of same large pampa colorada but in semi rocky (plate lava). More densely vegetated area along border of open area-= tracks of his lead to resting place from out in open pampa however. CL 19.4; CW 20.0; WGT – 1 ¾ lbs. No lichens, algae, smooth scutes; w.g.i's clear and well developed and mod. Thick; obviously very healthy. [Marginal note: Besides these 2 young found today saw tracks and at least 5-6 others of 20-25 cm CL and 8-10 of 30-40 cm CL sized tortoises.

Nest #59 and another one only .5 m beside it (latter seems of its age also) both destroyed by pigs completely – were in yellow-brown red soil.

Nest #28, 45 and one very fresh one (2 week max, I would guess) destroyed by pigs all in same area of yellow-brownish soil. They tried to dig out #58 but failed; we removed hard cap to see if digging had affected eggs, but were 6 inside all OK and with moist, wettish, mud packed tightly around them; 2 in bottom of nest, 4 in second layer. Removed nest and put temporary cover of rocks on it till Julio can return to place corral around it. (Pg. 48)

On return to Caseta noted only a few animals – 2 new ones at small manzanillo pond both unmarked – 1 about 60 cm CL male; 1 female – 80 cm CL. Both with mod. Thick well-developed w.g.i.s; both gorging on water.

1 very large male, all smooth grazing on reserve border about 200 m west of La Torta turn-off – 136.5 CL - #849

At Caseta – 1800 hrs. – weather Max – 84.0; Min 67.5; Rain 0.0; Evap – 4.4 (reading 17.7) Very hot and sunny from 1130 till sunset. On previous day was sunny from 0900 till sunset Jan says.

The La Torta situation: Though cutting deeply into my data this indicates certain interesting aspects about pigs predation on nest and young.

1. clearly are eating some young, and those up to 30 cm CL seem quite susceptible – i.e. Up to 5 –6 lbs body weight. (Pg. 49) One found this trip, 2 on previous one – previously though was due to feral cats (see Oct 70 trip notes) but now am reasonably sure due to pigs since one found today had pig tracks and destroyed nests near it – also two previous carapaces were just like this one discovered today. larger tortoises i.e. 25-40 cm and upwards are present in area in abundance and have not found any destroyed carcasses yet so perhaps pigs eat only smaller ones, and perhaps smallest ones (25 cm CL and smaller) carcasses not found because pigs can easily devour all of the tortoise without leaving some remains as is not case with 25035 cm. CL size classes. Will have to examine n.a. more carefully for more sign of this predation.

2. clearly can detect nest of up to 5-6 months age with great accuracy. In areas where were several known marked nest the pigs literally opened virtually every one; only missed 1 (#46) which was in an area close to other nests they destroyed. [Marginal note: Also tried and failed to open nest #58 but clearly found and tried to open it]. All other nests missed were isolated in other areas (usually in or close to planadas); destroyed virtually every one on depression of northern 2/3s of nesting area. Also, no extra effort expended in digging around nest in a searching fashion – virtually (Pg. 50) . . . every destroyed nest was opened directly from over its center right through top or side of hard cap and all eggs destroyed. No false holes dug; in other words can detect nests directly and easily and open them only – probably by odor because many nest not detectable, at least to humans by sight, after only 2-3 months old. [Marginal note: Perhaps pigs can not detect nest from previous year or years because have found several old 1969/70 nest full of dried up eggs beside others destroyed ones - in one case, dried egg shell even visible. (??)

Data calculations – Nest marked prior to this trip at La Torta – Northern Zone – 29; Southern Zone 7; Pigs probably did not go through S. zone – all nest there OK.

1. Destroyed by pigs in n. zone – total of 37
    a. destroyed by pigs – of previously marked one – 23
    b. destroyed by pigs – nest not found previously – 14
    c. undetermined - #54 nest – 1
2. Of 14 nest not found previously –
    a. Probably old and simply not discovered by us on previous trips – 7
    b. Probably new since most recent trip – Late Nov. ’70 – 7
3. New nests not destroyed by pigs – 3 – all reasonably fresh; probably 1-3 weeks old depending on nest – probable that were laid after pigs passed through. % of nests found and destroyed by pigs – 23/29 = 79.3 % and only 1 nest that pigs attacked survived without eggs being destroyed; hard cap too thick!

(Pg. 51) 5 Jan 1971 – To Caseta pond #1 to do enlarged sample.

#1104 – about 1/3 of way to C. pond #1, grazing on grass in open.

#129 f (CL 71.5; CW77.2) Grazing on small viny herb in open, about 50 m further down from #1104. No lichens, algae, but dried (perhaps b.g. algae) substance in 2 usual areas – w.g.i’s clear and well developed and moderately thick. No deformities; scutes smooth only in very small central parts.

#4640 – on south side of pond grazing on herbs in shade of woods; no red soil on her rear area at all; recently may have been copulated with as has muddy smears on tope of carapace CL 105.9 ; CW 118.1; F.d. restricted to a few old area on very rear of carapace; no lichens; b.g. algae in deep wide scute – juncture grooves on rear of carapace; very old and all smooth, worn, shell w.g.i's clearly but extremely thin.

#526 male (probably this # and not 596) – on west side of pond at small manzanillo pond; basking and sleeping in open on edge of pond; w.g.i. very clear and thick. Covered with lichens and algae, will return to him later to check this later.

#701 female (painted #8, but paint almost all gone; repainted) Sleeping in ½ shade (Pg. 52) . . . ½ sunlight in edge of woods just beyond #526's location. CL 78.4; CW 85.7; w.g.i's clear but moderately thin. Thick b.g. algae on rear 1/5 of carapace but dry; no lichens or f. d.

#127 female – beyond last 2 (always?) near next dry manzanillo pondlet. Sitting in shade, resting. No red soil on rear now –obviously has been in highlands since last saw in this area. Perhaps a recent copulation attempt as top is covered with mud tracks. W.g.i's clear but extremely thin CL 100.8; CW 115.0

#526 – lichens and algae; photos 35 of Roll # --- and 1-6 of Roll # ---. Bright yellow =green algae all over sides (upper 2/3s of all costals) and all over all but first of vertebrals, in lower spots and depressions. Lichens of 2 or 3 types, all seen here and on S. Cristobal before; some of same ones seen on Duncan. (Pg. 53). . . . also. Flat pale grey – green fructuose type; flat pale grey-green painted on (word not clear) and two patch of yellow type – rough surface kind. First type on last vertebral, lower half of 4th vert., and upper ends of last costals; 2nd type on same but excluding 5th vertebral; yellow type only on middle central upper part of left last costal. Dry b-g algae on 2 usual areas all over.

#1171, #180 painted, 628 female – all seen on previous days and no around where trail enters pond #1, grazing in shady spots.

Area from small pond up drainage to level of tent and caseta:

#242 male – CL 87.4; CW 92.4; w.g.i.'s clear but very thin; bit of f.d. on rear of carapace; scutes smooth in central 1/20-1/8 or less ; no lichens; b-g algae in usual 2 areas but dry. Moving in tall grass into shady burrow.

#31 male – near small manzanillo pond just west of tent; grazing on grass in shade.

At Caseta: #246 f, #3 painted, #15 painted; On 3rd of January Jan was on way up to Devines noting a few animals; she saw the following just in going up central manga to mouse; #112 painted coming down (Pg. 54) . . .trail to Caseta.

#30 (18 painted) just on R. B. in forest above Caseta.

1 unpainted male in same areas as #3 female

#91 painted in pungola ? grass of manga

#84 painted in pungola ? grass of manga

#37 painted in pungola ? grass of manga

#154 in banana patch

#106 at upper end of banana patch, but in pangola grass.

1 unpainted male just above banana patch in pangola grass.

She says were at least 3-4 more but forgets #'s and did not record them – all were painted. None seen above location of last unpainted male just above banana patch. On going up in a.m. was sunny (0930- 1045) but animals out and active (sunny from + - 0900 on); on return at 1230 hrs. was still hot and saw almost no tortoises; plus, all those seen were in dense shade, mostly sleeping 2 grazing in shade. Appears that real hot season is beginning and tortoises should soon (Pg. 55) start disappearing more, some into forests, some to lowlands to feed on Opuntia which is now abundant – many fallen fruit, flower buds, flowers, and pads – all succulent. This, of course, will all depend upon the heavy rains' absence or presence. [Marginal note: Caseta weather – 1900 hrs hot and sunny all day. Max 84; Min – 70; Rain 0.0; Evap 5.8 (reading 23.5).]

6 Jan 1971 To Devine's by central manga to count animals. –

#16 painted – just coming onto manga out of Caseta upper ponds area ; w.g.i.s clear and mod. Thick

#1194 – from Reg. 4 – w.g.i.'s clear, but thin – CL 67.6

#314 Male – CL 124.7; CW 135.5 w.g.i.'s clear and thick; extensive f.d. all over rear ¼ and front marginals area; b-g algae in same places; no lichens; scutes smooth on central 1/15-1/5 or less. No red soil on him anywhere.

[Marginal note: Nos. 1194 and 314 just above C. upper ponds grazing in pangola.]

#83 painted – thick w.g.i.s – ½ way up ; grazing ; clear sign (a few days old and even fresher) of at least 4 animals which recently left manga and went out into mora – herb mixtures on either side (1 west, 3 east)

#9 painted and #188 painted 2/3's way up – grazing – thick w.g.i.s

#87 painted – just below first fence in manga grazing. Thick w.g.i.s

#38 painted – same as #87; and to east 50 meters of Solanum grazing; Thick w.g.i.s

#1238 CL 91.6; CW 97.2 W.G. I.'s thick; at first fence, trail coming from west at this altitude. (Pg. 56)

Sampling big green grass – mora – herb area between eastern and central manga at level of lower half of banana patch:

#57 male CL 128.7; CW 133.1, w.g.i.'s thick; grazing on grass and Commelina in open at level and just east of lowest end of banana patch.

#95 male painted CL 122.5 – to check growth (#220 male) – same area; eating grass in open w.g.i.'s thick

#103 painted – just below fence near eastern mangas beginning; in dense shrubs and herbs moving along; w.g.i.'s mod. Thick.

#156 painted, thick w.g.i. 's just west of fence near eastern mangas beginning at lower corner of potrero. Repainted; grazing on Commelina in open.

#109 male – w.g.i.'s thick – bad f.d. all over rear and front marg. Areas. Very large can't measure because is in mora.

#119 male? (from Reg. 4. area!) w.g.i.'s very thick.

Large male attacked, chased and rammed little one from rear; then tried to mount – unsuccessful because (Pg. 57) both ended up in dense mora - all aggression or copulation attempt? No sign of sniffing or other olfactory behavior before attempted mounting . Both in fields at alt of lower banana patch, but to east a ways. Interesting that small fellow shoes to move directly into dense brush and mora when attacked instead of making an escape attempt in open field where both had been grazing prior to attack. Strategy was very successful because larger male became hung up in tall mora whereas little fellow scooted along in less dense growth below and easily moved away from attacking large male.

#335 male; CL 127.4; CW 138.6 w.g.i.'s clear but only of medium thickness, few tiny spots of f.d. on rear and sides of large patches of it on front margs. No lichens; heavy b-g algae on rear area and front marginals. Scutes very worn but smooth only in central 1/10 –1/3. Red soil well ground into lower areas of rear of carapace indicates was down in lowest zones – probably during last hot season – i.e. as with #31 male. Just east of fence – in open eating Commelina; east i.e. of eastern manga.

Back toward middle of bananas and working through open fields to east of these and upwards. #49 or 9 male (40 cut poor, but probably real) CL 121.0; CW 136.3; Pg. 58 . . . . In shade, just east of and even with middle of banana patch sleeping. No lichens; b.g. algae thick but dry on front marginals and rear ¼; F.d only in a few spots on front marginals, Scutes smooth only on central 1/20-1/8 or less (but very worn all over). W.g.i.'s clear and very thick.

#165 painted – w.g.i.'s thick in open grazing on grass just east of center + - of banana patch; moving into elephant grass to shade at 0950.

#104 painted – w.g.i.'s thick – in open grazing 50 m distance uphill from # 165 p(?); then moving into dense Tournefortia grove for shade at 0955.

#106 painted – w.g.i.'s medium sized; in Scalesia woods east of and level with upper end of banana patch, grazing on herbs.

#91 painted – w.g.i.s medium thick; in same woods; also found small 10 x 10 m pondlet there which is now full of soupy mud and is walking up and down through mud up to level of lower curve of costal, "drinking" small mount of very thick muddy water which he is (Pg. 59) churning to surface by movements. Has moved several hundred meters and about 200 feet in altitude up from where Jan saw him on 3 January.

Worked all up and down through banana patch – lots of sign, (droppings, trails, burrows) from past 1-2 months activity. Very dense growth now (2 meters +) of herbs, especially nettle and I simply can't see very well; found fresh trails from today (turds and matted grass) in widely separated area of 3 tortoises (2 medium, 1 large on male scale) and found #166 male; CL about 152 – can't measure well because is in bush); huge – all smooth; w.g.i.'s clear and moderately thick. Has certainly been traveling – from mora up onto old man Barrera's lane, then east to Devine's western boundary line; [marginal note: at alt. About 25 feet above upper end of banana patch]; sleeping in Tournefortia grove now. B.g. algae thick in usual areas; bright y-g algae also profuse – all over depression of lower (Pg. 60). Half of 4th vertebral and along low areas generally of other vertebral and costals – can neatly see how it is growing only in non – abraded areas. Also has some patches of fructiose grey –green lichens and "painted –on" type grey – green lichens in same depression of 4th vertebral – only 1-2 cm diameter patches.

1 male – w.g.i.'s thick apparently has staged up here ever since June. At another small pondlet full of soupy mud, Azolla and some water (more than in pondlet where #91 was trying to drink) – drinking in pond and walking though mud, then out to other side and eating grass; all in open grassy field at 1100 –1120 – very hot and sunny now. – This pondlet is at almost same alt. , a few feet lower than i.e. Maternidad pond and just 150 m south of it , distance, in a pasture.

He is highest up animal I have seen today, and first sign since #167 well below here directly ; no sign of tortoises in fields or Scalesia. (Pg. 61) forest between these 2 large males; so 31 either came up a good while ago and sign has largely vanished, or he came up more to east, i.e. probably directly north from banana patch.

#2000 male – CL 134.0; CW 146.1 – only notch is in #2000??? Why? W.g.i.'s moderately thick; in same huge field of elephante and other grass, only 25 m more toward maternidad from #1 male burrowed into shade of elephante grass.

Lots of turds all over fields here and around this pondlet; signs there 2 or at last 1 of them has been eating grass here for at least 3-4 weeks; also some turds along a grass manga which leads directly here from banana patch below so could be that they came

up via this little manga. No droppings or other sign from last 2 tortoises to Maternidad pond and house (of Devine) Returned down central manga checking for tortoises to upper end of banana patch from house – saw #154 painted grazing in area just to north and 20 feet alt above upper end of banana patch near central manga.

Will go up eastern manga tomorrow to complete the sample.

Saw a very good example of fact that solar radiation controls tortoise activities very directly at time and that mud and (Pg. 62) or water in ponds can act as a heat sink and allow much longer exposure to strong solar radiation. Than equivalent exposure in open air on dry ground. To wit: sun first came out at approximately a few minutes past 0830 hrs. today and then remained out almost constantly, save for a few periods of several minutes when clouds passed by, till almost 1330 hours. By 0830 I had discovered 5 animals, 4 large males and one small male (#'s 57 m, 220 m, 335 m, 109 m, (large ones) and 119 m (small one)) and had a clear view of all of these in a large open field of grass and herbs, with shade near-by in form of Tournefortia grove, individual Xanthoxylum trees or dense 1 –1.5 m high shrubs and herbs. While doing some searching near these 5 kept my eye on them and found that by 0930 all but #220 m had already moved to shade after (Pg. 63) slightly less than 1 hr of direct strong solar radiation and that #220 m was heading for shade in fact at 0930 (he reached it by 0940) . From this time on found 7 more tortoises between 0930 and 1100 and 5 were already burrowed or grazing in dense shade; 2 0thers (#165 and #104, both painted #s) were heading into shade at 0950 hours. They were grazing in open fields and tracks indicated had been in open since before sun came out and up till time radiation caused burrowing.

Then at 1100 found '31 large – medium male in muddy pool as described above – tracks showed he had been in open field for quite sometime this a.m. , probably since before sun came out fully at 0830 (+ a bit); he clearly sometime before I saw him had entered pondlet full of mud (soupy kind) and some water up to about ¼ of his depth (i.e. about a few cm. Above curve in costals at lower ends) mud also covered legs, tail, and other skin –covered areas up to lower side base of neck. Point is that this animal was able to stay in sun to 1130 when finally burrowed in (Pg. 64) shade of tall elephante grass; i.e. was able to stay out at least 1.5 hrs longer than any other animals have seen today in direct sunlight because was sitting in mud /water for a good portion of time solar radiation was strongest- this served to cool him enough to allow him to remain in open when all others had to seek shade to keep cool enough on dry land. This opinion and my observations are reinforced by fact that # 2000 m of nearly same size as #1 male was in open in same area as #1 but on dry land and when I first saw him at 1100 was already well burrowed in shade of elephant grass and completely inactive – am not sure when #2000 male actually burrowed but would guess well before #1, i.e. probably around 1000 hours at (Pg. 65) latest.

Caseta weather today – 1900 hrs. hot and sunny 0830 – 1330; then cloudy, light, cool breeze till sunset – very strange reversed weather pattern for Galapagos. Max 85.5; Min 64.0; Evap – 4.7 ml (reading 28.2) – refilled full today; Rain 0.0 mm

After 1330 when very cooling breeze set in and clouded over densely and completely so that solar radiation became very weak, found on return that most tortoises returned to open and began grazing again – till 1630 – 1800 period when they burrowed for night.

7 Jan. 1971. Finishing yesterday's work.

First Caseta upper pond area normal sample –

Fields below ponds - #18 painted (#3 f) grazing in open w.g.i's mod. Thick – she obviously has not migrated down to nest again this year – surely nested only once.

#181 painted – grazing in open, w.g.i.'s thinnish, also obviously has not been down to lower altitudes in recent months.

#46 painted – grazing in "woods' just below ponds and above fields. (Pg. 66)

Ponds: New # 1332 f – CL 77.3; CW 79.7; w.g.i.'s clear and thick; no f.d. or lichens; dry b-g algae in 2 usual area; scutes smooth only in central 1/10 – 1/15 or less. Noticeably oblong in shape. Grazing in open near pond #2.

#9 painted – coming to pond #2

#314 m – at pond #3 – looking around for water perhaps.

#3 painted – eastern end of ponds – grazing in open in dry bed.

#352 f – large – burrowed up under dense vines and can not extract here; scutes mostly smooth save for outer 1-2 inches borders of old worn growth rings. About 90 cm CL + - a few. No sign of recent copulation and no red soil on rear of carapace so doubtful has been below here to nesting areas at all in past year almost -= but this is rather hypothetical. In woods just above a bit and to east of ponds.

No time to do up Devine's eastern manga to first fence (i.e. where left off sample yesterday) Steve Devine says he saw 4 painted animals and 1 unpainted one along here between this fence and caseta upper ponds about 3 days ago so will use this as my sample # since he made this (Pg. 67) trek on horseback and in cool, cloudy part of day; can't do otherwise.

Finally, Steve and Bud Devine say have seen no animals higher than #1 male and #2000 m since I was last sampling on their land, i.e. none near Maternidad pond, house or higher up; this would agree with my observations because searched over their areas some yesterday and saw no droppings, burrows, trails, or tortoises.

In afternoon to Zone 5 to sleep so we can go to Cerrito nesting area early tomorrow. Enroute noting animals in mora and counting through El Chato.

#18 painted (3f) – junction of (gallery?) forest and mora above Caseta – has been here for over a week.

#15 painted – ½ way to top first hill

#43 painted – 2/3s way to top of first hill

#819 just beyond #43 painted.

#785 – (from C. pond #1, smallish one) – only 75 m east of rt turn and camote patch.

#98, 81 painted, 331 – all grazing at camote patch.

At El Chato – 359 painted near pond #2

Weather – 1615 hours – Rain 0.44 inches (emptied); Evap. 32.6 (refilled full)

#1122 f – in same exact pampita on s. side of El Chato where she was on late Nov. 1970 trip.

(Pg. 98)

Passing though El Chato pampas – saw 13 large males, 3 smaller tortoises. Pampas on S. side Chato along Zone 5 trail – 3 large males, #122 f.

#1063 f – 3/4s way to Zone 5 from El Chato, no recent sign of nesting but has old bright red type soil worn into shell and skin in rear areas. Julio has seen her in Cerrito N.A. before, this past nesting season. Probably recently involved in a copulation or copulation attempt – muddy tracks all over top of carapace.

In Zone 5 near campsite: #1181 m sleeping in edge of woods (1730)

#507 huge male – back down from El Chato – sleeping in dry pond in old famous site where was for months in 1969 garua season – 1730 hrs.

#296 m – from El Chato – sleeping in pond also – heard enter it at 1810.

#826 f – about 200 m S of Zone 5 along trail; sleeping under a Pisonia tree at 1800. No recent nesting sign at all; has old worn in red soil as with #1063 f; also same sign of a copulation. (Pg. 69)

#140 male painted – down from reserve border area above El Chato – in dry pond along trail south of Zone 5. Certainly has moved some distance.

3 + - 60 cm CL unmarked tortoises in camp area.

1 48.8 cm CL unmarked tortoise in woods near camp.

Why such a great # of tortoises easily visible in Zone 5 camp – dry pond area now and others along trail just south of it toward Cerrito? Were almost none in these areas in late Nov. – early Dec. 1970; only one then were smallish (e.g. 60 cm CL) and were none of these larger animals here. Suggestive that these large males at least and perhaps females also are returning to lower areas now that hot season has begun (was hot for at least 3 solid weeks of December and has been for much of January 1971 so far – this could have prompted movements). One could argue that they are beginning move to lower areas for Opuntia forage since H20 is lacking above in Chato and higher areas and since prospect is for another season of increasingly hot, dry weather and gradual drying and disappearance of forage etc. all altitudes, save for Opuntia in cactus forests. But if so, what (Pg. 70). . . .is direct advantage of moving south now when forage form at least 600 feet altitude to highest areas tortoises go to north here are still lush with grasses, Commelina, and other herbs, and this forage though drying has just begun still contains a lot of moisture as well as food value. Clearly not all or even a large proportion of tortoises are moving south even here and no strong sign of it at all occurring in Caseta – La Fe area or areas north of and to La Torta. (in latter case in fact seem to be moving higher if anything). Will have to wait and see.

Egg – found an egg lying singly in semi-open forest just west of camp at Zone 5; no female near and no digging sign. Has been here at least a short while as is discolored a bit on bottom where was lying in soil and has algae growing in same place. Fairly normal but a bit oblong egg =- 65 mm x 58.4 mm and 54.8 mm. Fairly fresh because no rotting yet at all; but very cold; no sign of any embryo; we ate it - very good yolk, but albumin too thick.

8 Jan 1971 – On to Cerrito N. areas to look for nests, construct walls etc.

- A small fellow, with white . found in dense woods on lower southern side of Cerrito; almost to base of the hill where rocks begin. [Marginal note: not one of two seen on side of hill before] CL 23.1; CW 24.8; Wgt. 2 5/8 lbs. Temp on finding 24 C and moving along cool and cloudy; no sensible s. radiation; 0735 hours. No lichens, algae or smooth scutes; w.g.i.'s clear but very thin (not much forage here now); two spots of f.d. just starting on rear. Certainly a N.A. near here at base of Cerrito.

- #567 male a huge one – started following his clear trail through soil just above Cerrito to where we found him at base of Cerrito just approaching Rocks; trail very directly to south, using ours and using it in places and then veering off and using his own path – From Chato. More clear evidence that are moving down to Opuntia zone now that hot weather has begun!! Looks as if he has not been grazing at all – trail direct and no (notes say now instead of no) grazing or browsing sign along it at all! Has Chato type red soil on him; w.g.i.'s clear and thickish.

- A small female, CL 66.2; CW 67.2, un marked; in old and most upper N>A. near 1969/70 nest #16

- No nest in the area – only 1 attempted nest (using cloacal fluid) but hit rocks.

- (Pg. 72) – Nest 31; in red soil, good hard cap, in depression just west of 1969/70 nest #16. We are building wall today around it. No sign of an escapes yet; in a very rocky area, not much but a few patches of red sol certainly not (as with 1969/70 #16 area) a major nesting area.

- Nests #33 and 64 – both OK; no escapees yet; built corrals around both.

- Nest #7, 17, 22 – all OK. Corrals from previous time prepared (goats). No escapes yet.

- Nest #65 – all OK – no sign of any escapes ; corral built

- A small fellow walking in open sun and then into shade; cloacal temp as entered shad was 34.3 c; CL 17.35; CW 17.7 cm ; Wgt 520 gms; [Marginal note: While handling he urinated thick, amber colored type and very little; time 0930]. No f.d., smooth scutes, algae or lichens, w.g.i.'s clear but ext. thin. Painted #1 on rear in white; has 4 very clear neat, clear e.g. rings on each carapace scute – 4 years? Soil surface temp in open sun – 43.4 C; air at 3 cm in open (his height) – 31.6 C; Air in shade at 3 cm where resting 29.5 C; soil surface in shade where resting 32.4 C.

- #1283 CL 41.3; CW 44.5; Wgt 8 ¾ lb. W.g.i.'s non existent; coming to watering site at a full gallop just after a brief shower; but no H20 collected- not enough rain; C temp 30.6 C;

- New # 1333 CL 35.2; CW 36.7; Wgt – 12 5/8 lbs. No lichens, algae, f.d. or smooth scutes; w.g.i.'s almost non-existent – extremely thin; at watering site mentioned above. Took temp when first found – after cool , cloudy period of 30 minutes and brief rain 1040 hrs. C. temp. 28.4 C.

Nests #66 and 18 OK; no escapes yet; corrals built. 3 found near flat lava plate area between nest # 18 and 52. – i.e. area where #1324 etc. were on early Dec. trip. All in shade – sun is out and hot for over 1 hour.

#1324 CL 60.7; CW 63.8; wgt – 38 7/8 lbs. Temp cloacal – 28.9 C; w.g.i.'s non-existent.

1 other – painted 32; CL 43.8; CW 47.5; wgt – 17 lb.; Cloacal temp – 28.0 C; w.g.i.'s non –existent; no l, a, f.d. or ss.

1 other – painted #3; CL 39.3; CW 41.8; wgt – 12 5/8 lbs ; cloacal temp – 30.4 C; no lichens, algae, f.d. or s.s.; w.g.i's clear but extremely thin.

#52 nest – OK; no escapes yet. 2 more small ones near here also near H20 collecting lava plates; 1 other painted #4; cloacal temp – 32..5 C no lichens or algae, smooth

scutes; bits of f.d. on underside of rear marginals. CL 36.1; CW 38.7; wgt 9 3/8 lbs; w.g.i non existent;

#1156 – found on early Dec. trip. Cloacal temp. 28.6 C; CL 56.4; CW 58.6 wgt – 27 5/8s lbs.; w.g.i.s extremely thin. 1210 hrs. Both just by nest #52 in shade in exact same spot; head of small one to side –rear of larger; no aggression ; sleeping . #1156 was in shade only 5m from here on early December trip.

(Pg. 74) – nests #9 and 19 = both OK; no escapes; very low altitude ; both in pale brownish soil, only 10 m apart.

1 unmarked tortoise in shade beside these; painted #5; CL 54.6; CW 55.6; Wgt 22 1/8 lbs; Cloacal temp 30.4 C (1235 hrs). No lichens, algae, ss (but very worn), f.d. or w.g.i.'s; female probably.

[Extensive marginal note: Largish area of pale brown soil; nest 10 and 11 from 1969/70 here; other old nest also present; not any sign of pigs every entering and all old nests with baby tortoise exit holes; area all soil and about 10 x 20 m in size – a rectangle. Pure rock in all direction; obvious smoothed tortoise highway into it form nest #52 area above – i.e. about 400 – 500 m further in distance to this area.]

Nest #21 – this is nest Julio found in which female had placed 4 eggs right at surface with just their tops barely exposed; one was broken open when he found nest, fresh and other 3 were cracked and missing about ¼-1/3 of shell on top halves but membranes were OK He removed 1 broken egg – OK and fresh but could not tell if fertile – checked nest today and opened it. – only 15 cm deep – then a plate rock over entire floor; so female could not dig any deeper – other wise a normal flask with small undercut; not really any distinct layers, but 10 remaining eggs were , more or less, 3 on top as described (4 counting broken one), 5 below these, and 2 resting in bottom of nest 2 on bottom (had) top about 7.5 – 8.0 below surface of nest. Five on second layer were 4.5 cm below surface of nest. No hard cap present and no sign female used urine in making nest. Therefore probable she had been digging for some days, ran out of urine and also came to ultimate time when had to lay. So she dug where and to extent she could with this resulting nest. Many of eggs obviously nearly cooked or bad, almost certainly due to overheating. Left 2 of bottom layer and 2 f second layer because, at least externally appear OK. Replaced them in exact positions and depth where laid and covered again with loose soil as female had done.

Eggs examined: could not determine if any were fertile; no sign of it but must have rotted early as impossible to say for sure if development ever began or would have begun in a normal nest. – 3 top eggs – all dried to nothing – yolks powder dry. 3 of 2nd layer eggs – 2 eaten out by worms, other one completely rotten and still moist inside but dried to about 3/4s normal volume only.

Very interesting data – obviously female occasionally really have difficulty finding an adequate nest site. This site completely surrounded by 100's of meters of pure rock – only a small 30 x 30 cm square of red – brown soil and she chose it; is on goat

trail, or rather, (Pg. 76) . . . just beside a NE – SW running one – perhaps she descended by this route and failed to get lower down to good soil of nest #9 and 19 area.

Nest #4 – OK; no escapes yet; a bit higher along same goat trail than #21 nest and in exactly same type of site but soil patches a bit more abundant; still almost entirely rocky area with only a few patchlets of red brown soil. NO old nest here.

Nest #32 – yellow brown soil – a few areas and patches of yellow brown soil in a very rocky area; some old nest here; OK; no escapes yet. Clear tortoise highway through here paralleling goat trail just to south of nesting sites. Space for only a few nests maximum. Built corral.

Nest #70 and fresh digging just beside Nest #32; former 10 m further on from hole; in hole lot of cloacal fluid used but a big rock in floor center at an angle 4 to 12 cm depth hit by female) . This new since Julio's last trip here (late Nov.) looks as if female failed at hole and moved on a bit and made nest #70; latter OK but eggs only about 8-10 cm down (Pg. 77) . . .it looks (we peeked in via one side of hard cap) One egg apparently laid on surface and since smashed by female or goats. – is obviously this years egg, recent and was lying right on top of small hard cap. Female did use cloacal fluid on nest 370 and is built up against some small plate lava blocks; fully in open is with as with all nest in entire Cerrito area we have found form this or previous years.

Large dead male tortoise of approx 120 cm CL. Died naturally – was all dry when found and cause unknown – out in open in a tremendously dry, hot area; just between nest #4 and nest 70 and 32, along tortoise pathway.

#84 male CL 117.4; must have come here recently (near a small pond slightly east of nest #32 and 70) from above – w.g.i's thick and dry b.g. algae and (herbage?) all over rear of carapace in low places; severe? F.d. in usual areas also; sitting in shade of tree near pond. Looks as if came down a wide trail which is near –by , (tortoise – smoothed lava highway with some red soil) via Cerrito or just east of it. (Pg. 78).

Nest #20 – OK; no escapes yet; thus all 18 nest in this entire nesting area below Cerrito which we have found now are protected.

Beginning return to Caseta now – Enroute: found 1 of about 30 cm CL along trail (crossing it west to east) in an area of pure rocks, lots of Pisonia trees etc. north of highest part of nesting area; no time to weigh or measure; w.g.i.'s clear but thin; lots of small herbs and seedling scattered over rocks still so must be eating these; is at least 300 m north of nearest known resting areas and no soil anywhere around his vicinity for at least this distance which could be used for nesting.

#567 male's trail looks as if has progressed onto rocks at S base of Cerritos west but failed to locate him (1535 hours – perhaps already burrowed"?)

#140 male painted – under same bush where saw last nigh and at 0730 this morning in first pond, about 300 m below Zone 5 on trail. (Pg. 79)

#826 female; burrowed, just above this dry pond and about 75 m further south down trail from where she was this morning at 0725. In passing through pampas to south of Chato a bit along tail and all around Chato on trail saw about 15 large males, a few burrowed, some just sitting in open under trees, about 1/3 still active (1715-1745 hrs). **Notably found males painted # 21 and 151**, both from Commelina covered pampas above reserve border and El Chato for at least most if not all of garua season. These two add evidence to those found yesterday and today in Zone 5, Cerritos and nesting areas, i.e. large males and 1 large female all of whom seemed to have been (and are) heading down to lower zones now that very hot weather is beginning (see end of yesterday's notes).

#'s of animals at El Chato have seemingly decreased (i.e. since last Nov.) somewhat but not much; still are lots of large males and smaller tortoises also; pondlets there are all dry now, having dried out during hot , sunny weather in December. But abundant forage is still present and lots of green moist grass and herbs all over. Pampas there.

El Chato weather – 1730 hrs.; Rain 0.035 inches (emptied); Evap. 3.0 m. (refilled full) (Pg. 80)

Caseta weather – 1800 hrs. Max 76.0; Min 69.0; Rain 2.65 (at night) Evap. 4.6 (reading 8.3; 3.7 yesterday) Cool and cloudy almost all day ; no rain; sunny and hot just before noon time between 1330 and 1400, then cool and cloudy again. Very pleasant day says Jan.

Two comments on La Torta and Cerritos N. areas.

1. Nesting activity all over now; appears that final nesting at least for area we search regularly was sometime after Julio's trip in last week of Nov. 1970 – i.e. nest #70 completely dry when we found it so probably minimally 2-3 weeks ago.

2. Contrast is sharp between notable growth of La Torta smaller tortoises recently [see Oct. 70 and Jan 71 trip notes; almost all small ones (from 60 cm CL on down) there have nice well – developed w.g.i's and one case of marked growth was recorded over a 40 day period] and lack of growth of same sized animals in Cerrito nesting areas (see Dec. 1970 and today's trip notes) Difference is probably almost (Pg. 81) absolutely certainly, related to abundance of Opuntia in 2 areas. At La Torta Opuntia trees cover the area and fallen, succulent pads, fruits, flowers, and flower buds are common everywhere in such abundance that huge numbers are on the ground, remaining uneaten. Droppings of many smaller animals seen there are full of Opuntia remains (spines, skeletal material). In contrast large Opuntias are extremely rare all over Cerrito nesting areas and in fact during entire search today saw only a few dozen trees, with nothing but old dried up fallen pads beneath them. Apparently competition is strong for these fallen parts and they are eaten up quickly by goats and tortoises. Tortoises in

Cerrito nesting areas lack w.g.i.s in most cases and their droppings (more rare than at La Torta) contain only remains of herbs and dry stems. Both areas have only very few scattered types of herbs, in fact in some areas of many acres there is nearly nothing. Difference clearly must be found in only food readily available at La Torta in abundance is Opuntia fallen parts. Note that every small tortoise found at Cerrito n. a. today, save for 2 (#'s 1 and 5 painted) were sitting in shade near lava plates which are smooth and pitted and worn by years of tortoise use – i.e. the main area where light garua or rain water collects. In contract, though probably rains about same amount at La Torta, and there are same type of H20 collection spots, small tortoises are well spread out and active there, many near Opuntias and their track and partially eaten Opuntia fallen parts testifying to great use of Opuntia as food and large trees as feeding sites. No concentrations of small animals about H20 collection spots was seen at all then and this is a doubly reinforced argument because has not rained in Cerrito area for at least 1 week, yet when we where in La Torta had rained only 1-2 days (nights actually) before. So not possible to explain concentrations we saw at Cerrito today as effects of rain last night or just recently.

There are large stands of Opuntia at lower altitudes in Cerrito N.A. region, but near Cerro Gallina and more to east also rather than anywhere close to nesting areas; these are far away (kms) from these nesting zone and as general observation indicate that tortoise of 40 045 cm CL and smaller sizes do not move long distances. (Pg. 83) . . . from areas they are hatched within, must mean that the smaller size classes have to survive on herbs and seedlings for forage in areas like Zone 3 N.A. and Cerrito (with only very limited amounts of Opuntia in their diet) . Small hatchlings and tortoises of larger size up to 40 – 45 cm CL in Opuntia covered nesting areas on the other hand have the benefits of both herbs/seedling and fallen Opuntia parts. Would not surprise me if natural survival (ignoring effects of feral predators) of hatchlings and smaller size-class animals is greater in Opuntia "covered" nesting areas.

Since there were almost no adult animals in either La Torta, Z3NA, or Cerrito N. areas which had either not come down from higher areas just recently, cant' say much about growth of these in relation to Opuntia. Can say however that few large animals which live + - permanently in these areas, e.g. #787 f and 131 f in zone 3 N.A, #190 f at La Torta, eat great quantities of whatever Opuntia fallen parts are available. Especially in Z3 NA where I have extensive observation on #'s 131, 787, 1144, and even some smaller animals, (e.g. #193?) have found that their daily movement are largely directed at moving from one Opuntia tree to another looking for fallen parts and scarfing up any (Pg. 84) available secondarily if garua occurs they check lava water collection plates.

Activity patterns. Jan noted that yesterday and today in morning #31 large male at Caseta was moving around at just a bit past 0530; first night he did not burrow till just a few minutes before 1800 and last night not till 1730 hours.

This morning in zone 5 I noticed that 2 of 3 huge males near camp were active at about 0630 and one small (60 cm CL) tortoise was active a bit before 0600. At El

Chato this afternoon late were some animals still active at 1730 on passing through, a few were burrowed in proper sense of the term, but most were just lying sleeping or looking about under shrubs or guayavillo trees in semi open or open sites.

Am not sure it is greatly significant in terms of thermoregulation but notes on passing through El Chato both last evening about 1630 –1645 and tonight fro 1715 – 1745 that (Pg. 85) only a few huge males were burrowed of about 15 saw each time; few were active also; instead most were simply lying up under bushes or trees, but without being at all burrowed down into soil. Clearly seemed to have ceased activity for day because was cool and cloudy for several hours previously each day and thus not a phenomenon of still being in shade because of afternoon strong sunlight. Point of interest is that in garua season virtually all animals in Chato area make classic types of burrows into dense bushes or herbs with partial excavations down into soil beneath them. Now most all under some type of vegetative cover, often nothing more than a bush or tree with canopy several to dozens of feet above them, and almost none have excavated themselves a soil wallow by normal swiveling movements. Theoretically then, could be that with much warmer nighttime temperatures now and much higher minimums are not going to trouble to wallow in as the do almost religiously in garua season when nights are much cooler (5-18 F colder almost always – minimum that is). Fly in ointment of this theory is that many , perhaps most (do not, unfortunately have count or %) of tortoises along (Pg. 86) mora trail and around Caseta are still at least burrowing up under dense shrubs and many make soil wallows also. However have seen #31 male, # 16 painted, #246 f and a few others spend night recently in Caseta area virtually in open on top of ground with no wallows and only tall herbs covering sides of carapace a bit; and have seen just up under thinly canopied bushes with no soil wallows. On Devine's land most seem to still be constructing soil wallow (dense shrub combination type burrows. So evidence is suggestive but still too qualitative. Still lack statistic to answer the questions.

Animals at Caseta - #'s 43 painted, 181 painted and a small (60 cm CL + -) unpainted one (she failed to see if was notched) passed through Caseta area from above and latter 2 continued on toward C. pond #1; former veered off into Blechum covered areas to east.

#1255 – just west of Caseta in open grassy areas.

(Pg. 87) – 9 Jan. 1971. – Doing nothing today – Weather 1900 hours – cool and cloudy till almost noon; hot and sunny only from then till between 1520 –1600.

Max – 83.0; Min 72; Evap – 3.6 (reading 11.9); refilled full at this time; Rain 0.0

10 Jan 1971 To CDRS – By Caseta pond #4 saw painted #108. Julio San Miguel took weather for me yesterday at Zone 3 N.A. and Region 4.

Region 4 – 1000 Max. 85; Min 65; Evap dry; Rain 0.3 mm.

Zone 3 N.A. – 1030; Max 86; Min 64; evap. Dry; Rain 0.0

He checked all through main nesting area and area south of it examining all marked nest – none with openings, thus no escapes yet. No new nest, no large female and no signs of nesting.

Tortoises noted;

#1193 – in main Z3 NA

#1266 – in planada at entrance to area where this years nests 6, 51, 11 are located

#1198 – same area. (Pg. 88)

Notes from Julio for very late November and December 1970 work.

Weather data – Zone 3 NA – 9 Dec. 1970 – 1000 hrs.; Max 82 Min 62; Evap. 35.0 (refilled full); Rain 0.0 (emptied).

14 Dec. 1970 – 1000 hrs.; Max 82 Min 64; Evap 25.1 (refilled full); Ran – 2.4 (emptied)

21 Dec. 1970 - 1100 hrs.; Max 82; Min 60; Evap. 28.0 (refilled full); Rain 0.0.

24 Dec. 1970 – 1000 hrs.; Max 83; Min 62; Evap. 16.0 (refilled full); Rain 0.0

Reg. 4 - 9 Dec. 1970 – 0900 hrs.; Max 77; Min 62; Evap. 28 (refilled full); Rain 0.0

14 Dec. 1970 – 0900 hrs.; Max 75; Min 62; Evap 18.2 (refilled full); Rain 5.3 (emptied)

21 Dec. 1970 – 1000 hrs.; Max 75; Min 63; Evap 20.2 (refilled full); Rain 0.0

24 Dec. 1970 – 0900 hrs.; Max 78; Min 63; Evap. 13.1 (refilled full); Rain 0.0

El Chato – 11 Dec. 1970 – 1000 hrs.; Evap 20.5 ml (refilled full); Rain 0.20 inches (emptied)

22 Dec. 1970 – Evap 25.2 ml (refilled full); Rain 0.30 inches (emptied)

29 Dec. 1970 – Evap. 14.8 (refilled full); Rain 0.22 inches (emptied)

Observations in nesting zones- Checked all through Z3NA on 9, 14, 21, and 24 Dec. 1970 – no new nests seen, no large females, no signs of further nesting attempts, no escapes from any known nests.

Cerrito N.A., - 11-12 Dec. 1970 – no new nests, large females, recent signs of further nesting attempts; no escapes from any known nests. However did not check southernmost part of NA – i.e. nest 9, 19, 20 , etc.

Summary of Julio's trips to nesting areas to look for nest this year dates only of trips I was not on.

La Torta- No changed my mind – all is in previous notes so will not compile yet.

(Pg. 90)

28 Jan. 1971 – to Caseta- Weather data taken recently By Julio San Miguel –

19 Jan. 1971.

Reg. 4 – 0930 hrs. Max 86: Min 64; Rain 4.2 mm (emptied); Evap 27.0 (refilled full)

Zone 3 N.A. – 1000 hrs. Max 86; Min 62; Rain 3.2 mm (emptied); Evap 35.0 (refilled full)[Marginal note: no signs of any escapes from any of marked nests]

El Chato - 1330 hrs.; Rain 0.32 inches (emptied); Evap. 23.0 (refilled full)

25 Jan 1971

Reg. 4 – 1000 hrs.; Max 85; Min 65; Rain 6.5 mm (is this mm or inches); emptied; Evap dry! (refilled full).

Zone 3 N.A. 1030 hrs. Max 88; Min 64; Evap. Dry! (refilled full); Rain 5.9 mm.[Note this one is clearly mm]

El Chato – 1400 hrs.; Evap goats destroyed shade and instrument not replaced.; Rain 0.60 inches – emptied.

[Marginal note presumably for this date: No sign of escapes from any marked nests]

(Pg. 91) – By Galo Torres

28 Jan 1971 – Reg. 4 – 0910 hrs; Max 82; Min 66; Rain 0.0; Evap – 11.4 (not refilled full) [Marginal note: no sign of escapes from any marked nests]

Zone 3 NA – 1015 hrs.; Max. 86; Min 68; Rain 0.0; Evap – 13.3 (not refilled full)

In Reg 4 Galo saw #'s 890 male, 95 f?; 415 f, and 1103 m (note has returned below)

In Z3NA he saw #'s 132, 918, 1193 and 1076. Note that Galo recently has passed through many of farm areas above and has taken #s of many tortoises]; will record this information and other of his observations later in this volume.

Caseta weather – 1900 hrs. – coolish and cloudy almost all day. Max ----; Min ----; Rain 1.1 mm; Evap. 22.3 reading.

(Pg. 92) – 29 Jan 1971 To Chato –

Enroute - #18 painted – forest /mora border above Caseta

#111 painted – near top first hill

#450 – first valley

#785 and #10 painted – 100 m east of Camote patch

#98 m – at Camote patch

#47 painted and 1104 at Camote patch

#210 m; CL 92.8; CW 88.3; w.g.i's clear but thin. – 200 m w of Segundo Herrera's central manga.

#164 m; CL 105.7; CW 111.1; w.g.i's clear but thin; 300 m east of pond by R. B. above Chato.

#174 f; CL 100.4; CW 113.3 – old, large and all smooth; no sign of recent copulation or nesting. 50 m. further west from previous animals;

At El Chato – just noting painted one mainly #33, #5, #173 painted all at pond #1 area. [Marginal note: Weather – 1300- 0.02 inches rain; evap destroyed by goats; will not continue it this year]. General view of tortoise density at Chato seems to be about same as when last sampled here in December – perhaps a bit less dense and noticeably distributed along pampa/forest interface. (Pg. 93)

Where can seek shade quickly on hot, sunny days as against in open fields of grass when were located all through garua season.

Noticeably a bit drier here now than on last visit in January at end of garua season. Has been raining some but evaporation is much higher now and grass and herbs are beginning to dry – this is obviously true all throughout the reserve, as we saw on ascent from coast yesterday.

Manzanillo apples are just beginning to approach mature size now at these altitudes.

Caseta weather – 2100 hrs.

Hot and sunny from 0900-1430 + - today, coolish and cloudy rest of time. Max – 88 F; Min 70.5 ; rain 0.5 mm; Evap – 26.4 (reading) 4.0 ml since 1800 yesterday.

Camilo Calepucha went up by Juan Guerrero's and above to S. Rosa – Bellavista trail today – enroute saw: #100 painted almost at J. Guerrero's house; 1 unmarked one at house; #192 painted 1 km above house! – female from La Torta. (Pg. 94)

30 Jan 1971

To Z3NA to take temperatures of nest #1; Enroute: #9 painted – 150 m below C. pond #1, moving south on trail.; #82 painted, #77 painted, #95 all in Reg. 4 near lava plate water collection are (no H20 there now).

#1076 and #127 f near 1969/70 nest #13, i.e. several hundred meters above Z3NA proper; latter moving deliberately south toward nesting areas.

In Z3NA near camp .- #918, #1330

Reg. 4 weather – 0815 hrs.; Max 86; Min. 66.5; Rain 1.2 mm (emptied); Evap. Reading 23.3 thus 10.0 since 28th (not refilled now)

Soil moisture reading –

	1000	1400	1800	0600
Nest 5cm	nr	nr	nr	nr
22 cm	nr	nr	nr	nr
Soil 5cm	nr	nr	nr	nr
22 cm	nr	nr	nr	nr

NR= no register – i.e. below 20% line.

(Pg. 95) – weather cool and cloudy most of day with strong sunlight only between 1100-1630 + - then mostly off/on sun vs. shade

Probe (thermocouple in nest #1, Zona 3 NA; 30 Jan. 1971

Position	1000	1200	1400	1600	1800	2000	2200	0600	0800
1	35.0	41.1	55.4	41.0	30.6	28.3	27.0	25.1	27.7
2	32.6	36.4	47.2	43.5	34.6	31.1	29.5	26.5	28.0
3	31.7	34.2	42.6	43.0	36.1	32.5	30.6	27.4	28.2
4	30.0	31.6	34.8	37.98	36.4	34.1	32.6	29.2	29.0
5	29.8	30.3	31.6	34.1	34.3	34.0	33.1	30.5	29.9
6	30.1	30.0	30.6	32.4	32.8	33.4	33.0	31.1	30.6
7	30.0	29.6	30.3	31.6	31.7	32.3	32.0	31.1	30.5
8	29.8	29.6	30.1	30.4	30.4	30.7	30.7	30.7	30.3

(Pg. 96)

Checked all marked nests – no escapes yet at all; thus won't check Cerrito or La Torta this trip either.

Probe (control) in soil, Z3NA 30 Jan. 1971

Position	1000	1200	1400	1600	1800	2000	2200	0600	0800
1	34.4	45.6	58.4	39.0	29..4	27.3	26.2	24.9	27.8

2	32.4	36.6	46.2	41.4	34.0	30.9	29.3	26.0	28.5
3	31.6	34.3	41.5	40.6	35.4	32.2	30.7	27.8	28.7
4	30.1	31.3	34.5	37.0	35.5	33.7	32.3	29.5	29.2
5	29.8	30.2	31.9	34.4	34.3	33.6	32.7	30.2	29.9
6	29.9	29.9	30.6	32.3	3.2.6	33.2	32.8	20.9	30.5
7	30.1	29.9	30.3	31.4	31.9	32.0	32.0	31.1	30.5
8	30.1	29.6	30.2	30.7	30.8	31.1	31.1	31.0	30.6

(Pg. 97) -- 31 Jan 1971
Weather Z3NA – 0830; Max 87; Min 70; Rain 0.0; Evap. 5.0 (reading 28.3, refilled full)
To Reg. 4 to take temperatures
Enroute – a mall 1969/70 hatchling moving across trail just 50 m above #13 1969/70 nest. In good condition; w.g i. small and thin but clear; wgt 155 grams; SL 92.6; SW 80.8; H 43.5; CL 105.5; CW 119.0; some growth rings clearly laid down since hatching – lots of tiny rings. Marked with knife – sing vertical line on 5th vertebral . Was out grazing on small malvaceous seedling at 0930 -= cool and cloudy till now mostly.
Reg. 4 weather 1030 hrs.; Max 85.5; Min 67.0; Rain 0.0; Evap 6.1 (not refilled)
Soil moisture readings in Reg. 4

	1400	1800	0600
5 cm	nr	nr	nr
22 cm	nr	nr	nr

(Pg. 98) Weather about same as previous day at Z3NA
Reg. 4 control probe – 31 Jan 1 Feb 1971

2	36.6	40.6	35.2	20.3	27.6	26.4	23.0	27.3	33.6
3	33.7	35.4	33.4	30.7	28.6	27.5	23.9	26.7	30.9
4	28.9	30.1	31.3	30.5	29.6	28.8	26.1	26.6	27.5
5	27.8	29.0	30.0	29.7	29.6	28.8	26.9	27.2	27.3
6	27.3	27.6	28.1	28.2	28.4	28.3	27.5	27.4	27.3
7	27.1	27.5	28.0	28.0	28.2	28.1	27.5	27.4	27.3
8	27.1	27.4	27.8	27.8	28.1	28.1	27.5	27.4	27.3

(Pg. 99)
1 Feb. 1971
Jan took Reg. 4 weather at 1000. (forgot temperatures)
Rain 0.2 mm ; Evap reading 10.7 ml; (thus 4.6 ml. Yesterday)
To Caseta - #526 m, up from Caseta pond #1 and moving north of Caseta along trail toward C. upper ponds area.
2 Feb 1971 To CDRS
22 Feb – Following notes from Julio San Miguel. Has made other trips to Cerrito NA and Z3NA in between these 2 time (1 Feb – 11 Feb) but will have to get notes later – see later in this volume. Also notes for Jan and Feb. from Galo Torres on tortoises seen in farm areas remain to be entered.
16 Feb 1971 – Cerrito N.A
Galapagos seen in NA

#897, #545 (#140 painted), 4 unmarked ones, (2 small, 1 tiny, 1 f adult)
(Pg. 100)
He checked all nests; '#'s 7 and 17 have openings so young have left; at 1300 saw a hatchling in corral of nest 317 moving in shade. Brought to CDRS to measure (#4 in tortoise house of 1970/71 year class).
Nest #18 – also opening; 3 rotten eggs inside; he did not count how many you had left this nest.
Chato rain – 0.0
17-19 Feb. – La Torta –
Galapagos – all in n. area
#572 m, "#1303 m, 2 males without nos.
1 huge male without no.
3 small males without nos.
1 very small male without no. marked #1341; no measures
checked all nests – 3 with openings in hard cap where young had escaped. (Pg. 101)
#29 – 6 hatchling escaped ; 1 rotten egg
#44 – 4 hatchlings escaped; 2 dead hatchlings trapped in nest
#12 – 11 hatchlings escaped; 1 dead tortoise in nest.
25th Feb. 1971 – Came up late yesterday to Caseta with Joe Haratani. Doing not much till tomorrow morning. In Caseta pond 31 area saw: #51 m; #526 m; #100 painted; #116 painted male; one more large female (couldn't reach in bush to check #)
26th Feb 1971. To Reg. 4 early to take temperatures:
Enroute saw #31 m moving steadily south in mid Reg. 2 – perhaps on way down to Opuntia forest as last year? At reg. 4 in H20 collection are (rained lightly during night): #'s 962; 1256; 184 painted, 183 painted; 82 painted, 77 painted, 2 others of 60 – 65 cm CL size – failed to get their numbers.
Reg 4 weather 0930; Max 89; Min 64; Rain – 9.9 mm(emptied); Evap – dry (refilled full)
Soil moisture readings at Reg. 4 site. NR at 0800, 1200, 1600, 2000 at 5 and 22 cm depths
(Pg. 102) coolish (but very warm air really) and cloudy almost all day.

Temperatures in soil at Reg. 4, 26-27 Feb 1971

Position	0800	1000	1200	1400	1600	1800	2000	0600
1	26.2	29.0	36.6	37.9	32.4	27.3	26.1	24.3
2	26.3	28.5	33.4	35.2	32.9	28.6	27.3	25.3
3	26.4	28.1	31.5	33.4	32.9	29.5	28.1	25.9
4	27.5	28.1	28.8	30.0	31.2	30.0	29.4	27.3
5	28.4	28.2	28.4	30.4	30.0	30.0	29.6	28.1
6	29.0	29.0	28.5	29.1	29.8	29.5	29.5	28.7
7	29.0	29.0	28.5	28.9	29.7	29.5	29.5	28.8
8	29.0	29.0	28.5	28.9	29.7	29.5	29.5	29.0

(Pg. 103)
27th Feb. 1971 To zone 3 N.A. to take temperatures and examine nests.
#121 painted f – at big boulder region moving around.
Soil moisture readings

Nest	0800	1200	1600	2000

5 and 22 cm – all nr
Soil
5 and 22 cm – all nr.
Weather 1200 – Max 91; Min 65; Rain 6.8 (emptied); Evap; dry (refilled full)
(Pg. 104) Weather 0600 –1030 sun out off/on about 50-60% of time
1030 – 1540 – cloudy all time weak radiation variable
1540 – sunset – sunny all time
0600 nest a.m – cool and cloudy
Nest 31 probe; 27 –28 Feb. 1971 Z3NA

Position	0800	1000	1200	1400	1600	1800	2000	0600
1	30.6	48.9	39.7	38.9	41.4	31.5	28.0	25.0
2	28.4	36.7	38.1	37.5	38.6	34.5	30.2	26.8
3	28.2	34.4	37.0	37.0	36.9	35.3	31.4	27.5
4	29.3	31.6	33.9	34.0	34.4	35.1	32.7	29.3
5	30.5	30.7	31.7	32.2	32.9	34.3	33.2	30.3
6	31.2	31.2	31.1	31.4	32.0	33.0	32.9	31.3
7	31.3	31.2	31.1	31.3	31.6	32.5	32.5	31.4
8	31.3	31.2	31.2	31.2	31.5	32.1	32.0	31.6

(Pg. 105)
Soil probe beside nest #1 ; 27-28 Feb. 1971 Z3NA

Position	0800	1000	1200	1400	1600	1800	2000	0600
1	34.3	51.4	40.6	39.0	39.1	30.3	26.9	25.1
2	29.8	38.4	37.9	37.5	38.6	33.9	30.2	27.1
3	29.4	35.4	36.7	36.8	36.9	34.7	31.5	28.2
4	30.0	3.17	33.7	33.9	34.3	34.6	32.9	30.0
5	30.7	31.1	32.4	32.6	33.1	34.0	33.0	30.6
6	31.5	31.2	31.6	31.8	32.3	33.1	32.7	31.4
7	31.7	31.5	31.5	31.6	31.8	32.8	23.5	31.7
8	32.0	31.6	31.5	31.5	31.5	32.4	32.4	31.9

(Pg. 106)
Nests – checked all nests in this area, #s 1, 2, 3, 5, 10, 50, 15, 16. Only two show signs of probably escape activity, #s 1 and 10.
Will open #1 tomorrow, probably to check on its condition. Has no hole in surface anywhere, but soil beginning to leak inside in a few spots indicating that young are probably digging inside.
Nest #10 – hole size of one tortoise right up through center of the hard cap; made only a small hole to inside and quickly discovered 7 live hatchlings and 3 eggs; also could see that most hatchlings had healed umbilical scars and look fat and healthy and have been digging – rasping signs on roof of nest cavity. They are sitting in an air space beneath dry chunks of cracked hard cap and on top of some loose soil they have rasped off of hard cap underside. (Pg. 107) Two eggs look to be perhaps OK. Removed other obviously rotten one and recovered nest as found it with dry hard cap clods (in hole I made covered by loose soil on surface. Did wait to see if young can escape voluntarily. They must have begun to dig immediately because soil is caving

in and falling into nest more, only a few second after I finished covering nest hole and young. Perhaps the light entering the nest stimulated them.
1 rotten egg – 60.8 mm x 63.0 mm
Will examine nest after giving chance to escape, young all now about 15-20 cm down in a group under hard cap rubble pieces which in turn covered by loose dry finer soil
2000 hrs tortoises in nest 10 have continued to dig sporadically since 1430 and one (at least , perhaps more) is now only 8 cm down and can see a bit of his carapace from surface; continuing to dig will check in a.m.
No sign of digging all day at nest #1 since initial sign seen at 0745 on arrival . Perhaps avoid digging in heat. (Pg. 108)
28 Feb. 1971
0615 Nest #10 – cont to dig during night because a bit more coved in; will examine more carefully later this morning.
Nest #1 – fresh, sign that have been digging inside during night1 Fresh marks where soil is caving in some – thus perhaps do dig more in evening, night – time, and early morning hours.
0745 off to south to check nests there.
Nest #1 – digging continuing - (word unclear) from soil blocks seen moving and soil is caving in.
Enroute to south – via pond near and slightly to west NW of campsite - #127 f – at pond. #1302 small fellow in same area (15 m away) from where marked . Cloacal Temp about 27.0 C at 0755 under cloudy skies = active and moving around foraging (Pg. 109)
#1330 small one – 150 m south of 33 central(or control) area. Alongside trail toward La Fe. Active
#1076 – at first big open red soil area near nest but on trail.
1198 – same as 1076; both resting in burrows beneath Pisonia –0820 – sun out- CL 56.1; CW 57.3.
#1159 – at nesting area near nest #6, resting in deep shade.
Most of these animals save for 1159 and 127 f have well developed medium to thick w.gi.s.
Nests: #30 – no escapes or sign yet
#51 – same
#6 – 6 young hatched, a infertile egg = clutch of 7
Infertile egg – 61.2 x 62.2 mm
All 7 eggs in one layer, bottom of nest at 24 cm
2 young hatch and escaped, but 1 of these caught on surface inside corral by either a cat or rat and head and leg eaten off – perhaps exhausted by digging out and thus easily caught.
4 young hatched and trapped inside – clearly hatched long time ago – all deformed and yolk sacs full inside and probably mostly absorbed judging by lack of plastral bulge. (Pg. 110) 2 of these dead, 2 alive. ‘all deformed to one extent or another due to pressure of fine soil which was packed in all around eggs and thus deformed the young as were hatching. Since Julio San Miguel accidentally open this nest early in season and then filled soil back in on top of young there is possibility that normally all t would have escaped?. Two live ones to CDRS.

Nest #11 – no escapes or sign yet.
#1266 CL 39.1 CW 41.2; out near path, about 50 m west of normal stomping grounds; in shade of a Pisonia with a 55-60 CL tortoise which is unmarked w.g.is are very very thin and intermittent.
#114 m painted – same area- out on trail in red- soil area – near where first discovered and painted him last year. W.g.i. s clear and no red mud on the expected places had he been in this are for past months – surely has just come down from higher areas where was during garua (Pg. 111) season
#1144 – in shade near 1969/70 nest #2 in central Z3NA
#690 m ; CL 120.0; CW 140.5 (very domed and shortened anterior-posteriorly)
#918 [parenthetical comment above pertains to 918 too] beneath large tree in shade near 1969/70 Nest #2 – just NW of it aways.

Measures of young from nest #6

	SL	SW	H	CL	CW	Wgt
One	68.0	61.4	-	80	88	70.0g
Two	65.0	60.0	-	85	91.5	73.0g

To Caseta to feed and water them and then to CDRS

Measures of young from nest # 10

Painted #	SL	SW	H	CL	CW	Wgt
1	68.6	56.6	39.1	83.0	91.0	85g
2	73.7	62.0	37.8	86.0	96.0	90g
3	77.8	68.9	35.3	89.0	97.5	95g
4	79.0	66.1	36.3	87.0	95.5	93g
5	76.2	65.9	31.8	86.5	100.5	85g
6	77.0	64.8	39.0	91.5	101.0	90g
7	77.0	66.7	36.0	87.5	99.0	90g

Eggs – 1 rotten from yesterday; 2 others –
One – 62.3 x 60.5 mm; rotten ; 2 cm embryo present $1^{st}/2^{nd}$ cycle borderline
Two – 63.7 x 60.5 mm; rotten; infertile
(Pg. 112)
These 3 eggs were uppermost ones sitting in interstices of 8 eggs which were below in one layer on bottom of nest (20 cm deep at bottom), and covering entire bottom of nest; thus probably 3 last eggs laid and perhaps this is reason were not as successful as 8 below. [following was crossed out in pencil; One of 7 young had escaped] Other 7 digging out yesterday and till now (1130 hrs). Clearly would have escaped so I unearthed them and will take to Caseta; will return them here and release them in a short while (some days hence); 4 were digging out in more or less a tight group, 1 on top, 2 just below him side by side, and one below these, 3 others were deeper down and also digging but had not progressed much. Top one was only 5 cm from escape when removed them. All had been digging some days previously because was about 2-3 cm of loose soil on
(Pg. 113) . . .top of their egg shells and they were above this debris. Took some photos of fake escape – Roll 26, #'s 1-20.
Some difference in their ages - #1 looks younger than other 6 – yolk sac feels bigger inside and umbilical scar not so completely closed up and dried as in other 6.

Nest #1 digging had apparently ceased by 1000; opened at 1230 and all were inactive. 10 young and 1 rotten infertile egg (60.0 x 59.1 mm) = 11 for clutch size. Young were all healthy, all in one group on one level in nest with all but about 5 cm of hard cap already cut through (digging out directly above them) and all clearly have been digging to achieve this status of being in a single layer. About 3-4 cm of loose broken up small dirt chunks and soil beneath them and on top of their egg shells below. As in Nest #10 was a nice air space of about 6-8 cm. Between hard up above them where they were digging and loose soil they were sitting on top of! Note this – important for (Pg. 114)
Allowing freedom of movement when digging their way out I think. All healthy and with yolk sac inside and umbilical scar clean and closed; all appear + - same age.

Painted #	SL	SW	H	CL	CW	WGT
8	75.8	67.3	34.4	89	97	75g
9	75.8	63.3	31.7	89	95.5	70g
10	75.0	63.9	33.6	89	98.5	73g
11	74.0	65.5	33.0	84	94.5	70g
12	72.5	65.2	31.6	86	94.5	68g
13	75.0	64.8	33.1	86	96.5	72g
14	77.0	65.0	34.9	92.5	97.5	78g
15	73.8	66.9	31.6	88.5	94.5	70g
16	75.1	63.5	33.8	92.5	99.0	74g
17	77.1	67.0	31.7	88	97.5	80g

to Caseta for now with hose of nest #10; will return and release them soon probably.
Weather 1330 on leaving – Max 88; Min 63; Rain 0.2 (emptied); Evap. 5.1 (refilled)
#121 painted f – in shade – same position in big boulder area
Reg. 4 weather – Max 86; Min 62; Rain 1.3 (emptied); Evap 10.1 (emptied – refilled).
(Pg. 115)
1 March 1971
Around Caseta ponds #2 and 3 and general upper area (not a sample):
97 painted, 103 painted, 154 painted, 160 painted, 1219, 1013, 907
Around Caseta – 1135, 713, 3 f, 47 painted
To Zone 5 for night; 1500 hrs leaving Caseta.
Enroute: #81 painted – top first hill
#450, #15 painted, 1 unmarked one of about 58 cm CL at bottom in first row area.
#47 painted, #98, 3 others in Camote patch area.
At Chato: #134, #139, #144 painted. Weather 1630 – Rain 1.10 inches; (emptied)

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2 March 1971 – At Zone 5 - #507 huge m, 1181 huge m, 225 huge m, 989 (or 289) lg. M, 1 more lg. M, 2 small 60 cm CL sized ones, 56 lg. F, 777 lg. F, 65 painted lg. F, Lots of sign all over this zone. [Marginal note: in dry pond, camp area]
#56 and #777 and #65 females all prob. Copulated with mud on backs;
#202 m CL 140; CW 147 and #167 painted lg. F. copulation attempt; not successful – small one is very successfully twisting swiveling and even lifting his front end up and saltating forward in short jumps; male seems to be trying to use tip of tail to intromit and it is wet with fluid. (Pg. 116)
#897 lg. M – 300 m below dry pond near trail
#142 (perhaps 162) huge m – 30 m further down and off in woods from last animal.

#140 painted lg m – at last dry pond bed on brail – exactly where was on my last trip here in early Jan 1971.
1 small fellow in semi-open woods, eating herbs, on side of Cerrito where begin going around it.)830; cool and overcast; Put a horizontal scratch on his 4th vertebral because is unmarked CL 41.6; CW 41.8; wgt 10 lbs.; cloacal temp 25.5 C
#5678 – in dense pega-pega forest on pure lava boulders, about 200 m south of where saw on Jan. 71 trip. (was at SW base of Cerrito then)
Unmarked f – with hole in #10 scute (Galo's) CL 97.0; CW 112.5; large, old and all smooth. Resting under a Pisonia in uppermost Cerrito NA., i.e. near 1969/70 nest #16.
(Pg. 117) – Nest #31 – very shallow but expansive (horizontally) nest. Rocks in bottom all over like small plates stopped f digging deeper. Bottom of nest 18 cm from surface; eggs in approximate 2 layers, total of 14. Nest 20 x22 cm diameter, with upper group of eggs only 7 c. below surface. Hard cap right down on eggs and they all surrounded by mud (wet recently only by rain). Bottom layer of eggs (special note) – 7 total; 4 hatched of which 2 escaped and 2 alive and trapped inside in wet mud – never would have escaped – very deformed by pressure of mud which was dry until recently and now is very moist due to recent rain. These 2 to CDRS. 3 others all rotten and eaten out by insect larvae; no embryo sizes.
Upper layer of eggs- 3 in total; 2 rotten and infertile; 2 with embryo in late 3rd incub. Cycle- dead and rotten; 1 with embryo in early 3rd incub cycle – dead and rotten; all probably cooked to death by heat.
Upper middle layer – 4 eggs in a layer between other two – actually overlapping each – tops about 2-3 cm below tops of upper layer of 3 eggs. 3 hatched and escaped; 1 hatched and alive and trapped inside by wet solid earth – never would have escaped. This one to CDRS for raising if lives.
Clutch = 14 eggs; fertile 10; addled or uniden. 3; infert 1; hatched 8; (Pg. 118). . . escaped – 5 and trapped 3. Died during incubation 2
Two holes in hard cap one to either side but eight up through its hard muddy part – each about size of one –two tortoises digging out.
Nest #33 – no signs of any escapes yet.
Nest #64 – 1 very small exit hole size of 1 tortoise at edge of hard cap and up (word not clear) through loose dryish soil; opened just this corner and found that 1 egg has hatched and single young one escaped. Egg was at higher level in nest – top or 10 cm from surface and at very side of nest. Hard cap soil very solid, wet and unified as a mass; surely due to recent rains; can't see other eggs but hard cap obviously is covering them and they are obviously mostly or all deeper down in nest cavity under it; so reconstructed corner of nest where 1 had escaped and will wait results later. This one probably hatched and escaped early because egg was up high (Pg. 119) where received much more heat.
Tortoises in area near campsite and these nests:
#1064 f; CL 94.4; CW 103.4 old, worn smooth; in shade sleeping (cool and cloudy); w.g.i.s nonexistent. No definite sign of recent copulations.
#66; CL 69.2; CW 75.9 (#64 painted) walking around, 30 m from where first saw and painted. W.g.i.s very clear but very thin. 1 more unmarked - 60 cm C.L sized.
Nest #7 – very narrow flask –shaped nest and very deep. Bottom of nest (no rocks at all, just very hard dirt at 32 cm; clutch – 8 eggs; 4 on bottom 4 in true second layer. 4 on bottom all rotten and unhatched (probably too cool for proper development).

1. 61.4 x 59 mm = addled ; no clear embryo sign but perhaps was fertile
2. 61.9 x 59.7 mm – addled; prob. Infertile
3. 61.4 x 59.9 mm = live embryo inside – about 4.5 – 5 cm long – developing
4. 60.1 x 60.0 mm – same as #2 addled

Top 4 eggs; all hatched; 2 escaped; two trapped in loose dry powdery earth and died trying to get out (Julio had open this nest – thus 2 probably would have escaped. (Pg. 120)

Of great interest that top four eggs were hatched probably weeks to even 1 month or more ago and yet #3 above is in early incubation. – proves difference in incub. Time caused by position in nest cavity of eggs; #3 egg was about 2 c, higher than other 3 on bottom, this perhaps being what allowed its development whereas others rotted; tope four eggs' tops were about 5 cm above that (top of) #3 egg. One of 4 hatched eggs was very small – about 51 x 50 mm + - and hatchling was small but OK and hatched. Was perhaps last egg laid?

Nest #17 – nest similar to last one – deep and narrow; 8 eggs; 2 hatched and left nest – from upper most eggs at about 11-12 cm depth to tops; 6 remaining ones look OK so left them and reconstructed nest on top with clods and sticks to provide a semi-natural air space over (Pg. 121) the eggs to allow hatching; 1 egg in wall is rather imbedded and at 17.5 cm from surface; 4 more in nest layer (2 hatched ones were on top of these) at 17.5 cm to their tops; 1 egg on bottom, 19.5 cm to its top. Will see if any of these can hatch and escape. Logical at least for cover 5 of the 6 eggs) that are still incubating while 2 have hatched and left which were higher in nest.

Nest #65 – no escape sign yet

Nest #22 – no escapes sign yet – but can hear young digging below.

Nest # 66 – Small hole to one side where an insect or centipede dug in' just opened a tiny corner of nest and fund eggs right there on surface almost – 'Top one only 4 cm down to top from surface; could see 3 more – 1 to top at 5.5 cm down (looks bad but will not remove, 2 at 6.5 cm down to tops, both just now hatching (can see with large yolk sac on one of these). These 4 eggs all at corner of had cap and covered by "loose", dry, but solid hard cap and surrounded entirely by loose dry soil. Restructured this (Pg. 122) tiny corner of nest and will examine later to see if young escape and why eggs laid so shallowly in nest.

Top egg obviously bad so removed; rotten and containing a 5 cm. Long dead embryo, probably killed by heat in hot season.

Nest #18 – Appear to have been 10 eggs; nest 23 cm deep, rocks on bottom and dug to this level; several turds in nest on top of racks; then 4 eggs, then 6 eggs above these and in the lower nest interstices; lower 4 all hatched and escaped; upper 6 tops only 9 cm below surface; 5 with embryos, 1 hatched and died in nest, 4 died at end of incubation period just as began to hatch out (why?), one egg eaten out by insect larvae and thus unidentifiable; but 9 of 10 definitely fertile. One explanation for death of 5 – were all embedded in loose dry powdery soil because Julio had opened nest and re-closed it; lower (Pg. 123) 4 eggs were not so embedded and thus were able to hatch out into an air space and then escape; thus probable that all 9 would have escaped had he not opened nest.

Nest #8 – 8 eggs; hole narrow but deep; 25.5 cm at center; in very hard brown dry soil in a very abnormal site for a nest because is soil type when flooding causes cracking and

drainage; 3 young hatched and escaped, 1 died during hatching; 4 eggs which look OK and will replace for further check; un hatched eggs and hatched ones intermixed as to level in nest; no red layers – all eggs just jumbled in because rocks all around in sides of nest in its bottom and at surface female dug between many rocks; lots of rocks used in hard cap, up to ½ - ¾ first sized ones; eggs all embedded in very hard solid dry mud; i.e. mud all around them and hard cap of it right down on top of them. 3 escapees went through one small hole right out through thick dry-mud, hard cap –incredible given its durability. 4 remaining eggs. (Pg. 124)

1. 63.5 x 62.9 mm
2. 64.3 x 62.0 mm
3. 64.8 x 63.0 mm
4. 69.1 x 64.9 mm

Nests 9 and 19 – no sign of any escape yet. In this latter area: #68 f painted, drinking profusely from H20 collected in lava pockets on large pates just above nests a short ways.

A small fellow, painted Now, #6; CL 21.6 cm ; CW 21.7; Wgt 2.25 lbs; No f.d., lichens or algae; w.g.i's present but extremely thin and incomplete; fat and healthy; shit full of stems and very well-digested leaf remains of herbs.

Nest 21 – of remaining 4 eggs, 2 hatched and escaped (bottom 2); top 2 rotten – 1 with 2^{nd} –3^{rd} cycle embryo (5-6 cm long one) and 1 eaten out by insect larvae so impossible to say it original fertility or lack of such. (Pg. 125)

Nest #4 – 13 eggs; 3 had hatched and left from central cavity area; 4 more had hatched and dug up as a group apparently to with in 6 cm of surface by rasping away hard cap; all there fat and healthy and would have escaped because were within only 1-2 cm. Of hold out through side of hard cap and loose soil at its edge used by first 3 escapees (see #'s 7-10 below for measures of these young). 5 eggs were rotten and almost dry, 2 prob had early embryos (1^{st} cycle), other 3 undetermined because eaten out by insect larvae. Tow of these and 4 young above also in central cavity. Were 2 layers (intersited) in central cavity and its overhand of a total of 9 eggs. 3 other rotten ones and 2 more hatchling were off to side of central cavity a bit embedded in solid dry mud of hard cap unlike other 9 eggs which had been in a partially open cavity beneath dry hard cap. This young one deformed a bit but Ok (#11) but would not have escaped naturally.

Measures of the 5 – (Pg. 126) . . .

Painted #	SL	SW	H	CL	CW	WGT
7	75.6	66.6	37.7	89.5	98.0	85g
8	74.8	65.7	34.8	87.5	99.0	83g
9	72.0	67.0	34.7	87.5	00.5	78g
10	72.3	61.0	38.0	87.0	90.0	76g
11	74.8	59.5	33.5	84.5	94.5	80g

Released in area – all five off in different directions all around compass and rapidly

Nests 32 and 70 – no escape sign

Painted #12 CL 37.5; CW 38.9; WGT . 9 1/8 lbs; moving along trail just above nests of 32 and 70; no f.d., l, a, ; w.g.i's non – existent but healthy and fat. [at dry pond area]

#339 m huge at dry pond area drinking collected H20 from rock hollows

Nest #20 – no escape sign yet at all.
On return – (raining entire way)
#1321 – drinking at flat rock H20 site just above nest 64 and 33 on trail (word not clear) to north.
At pond just before Zone 5 (lowest dry one in Zone 5 area on trail – i.e. just above Cerrito) –
#140 m painted, 4 large to huge males, 2 very large females, 2 smallish (Pg.127) tortoises (female scale) all drinking and walking about where puddles are forming. In zone 5 right around campsite noted about 15 tortoise of varying sizes all active, eating wet grasses and herbs, drinking from puddles, etc. Only 2 of all these were burrowed by (1800 (between 1730 and 1800 did so); at 1845 in very faint light still saw a couple of large males walking about slowly and drinking but by 1900 all visible ones were in burrows. Heavy rainfall in this area today, probably about 1 inch, resulted in great amount of activity. Heard 1 mating occurring between 1800-1830 but did not check it out because too wet and tired and rain continues.
3 March 1971 Zone 5 area immediately around campsite and pond (not a sample), just casually observing). All following tortoises out in sun active, in specific most drinking H20 in collected puddles and pools, some grazing, some matings. All females but #777 and 65 p. had fresh mud prints of males on carapaces or were actually copulation. Huge males and females:
989 m; 225 m; 11 m; 194 m; 1181 m; 655 m; 139 m; 1182 f; 56 f; 777 f; 57 f; 65 painted f (472 f); 789 f CL 92.0; unmarked old all smooth female CL 90.5; CW 103.2.
(Pg.128)
Also – 3 small ones in 50 –55 cm CL size class, all unmarked; 3 in 60 –65 cm CL size class all unmarked, 1 about 70 cm CL also unmarked.
Also saw two copulations.

1. #655 m and #57 f – lasted about 15 minutes but still doing on as we left (1030); not successful up to this time; female resisting rather strongly by swiveling under male and as result he was mounted on her side and or front during entire period. Crammed up under some dens Clerodendron molle bushes and thus not able to maneuver very adequately; had broken off many twigs and limbs of shrubs but eventually were both u against hard resistant basal portions of shrubs which limited male's ability to move. Characteristic groaning (rhythmic) accompanying each thrust movement; did not see "courtship" so can not describe it. (Pg. 129)
2. #225 m and 1182 f; This copulation attempt began about 0700 and was still occurring at 1045 when we left! Did not see courtship or preliminary stages. In first position male was mounted correctly on rear and rhythmically groaning with thrusts and otherwise behaving as I have previously described 'normal' G. e. porteri mating. Female was passive, with all legs ¾ withdrawn, head withdrawn, and not attempting to swivel or escape; occasionally she gave a small jerk forward by propelling herself with 4 legs partly extended and plastron still on ground and with head withdrawn but these movements were ineffective and she did not move at all forward. Male was in a position such that his tail passed between the lower edge of his own carapace's supracaudal scute and a lightly raised lava rock. With each thrust of his tail up under her carapace and toward her tail and cloaca he thus

> was pinching his tail and genital organ at just about the position of his cloacal opening. This was obviously preventing him from successfully intromitting his tail into her cloaca. This position was held from 0700 to about 0955 when he dismounted and the female (Pg. 130) . . . immediately made a dash for it; he caught her again within 20 m, mounted and quickly achieved a successful copulation -= still continuing when we left at 1030 hrs.

During both portions of this copulation was able to witness how male tried to and finally achieved intromission. Essentially it is done by thrusting only tip of the tail, i.e. about 2-4 cm of it (variable distance with successful thrusts) into her cloacal opening. The tip of his tail was moist and slimy and thus I took this mucousy material to be seminal fluid which is passed to the female not by the penis but by the tail tip. Never was able to see the penis so I do not know if it ever actually is protruded out of the cloaca in order to place sperm on tail. If so, this movement is not obvious and I will have to check more carefully to observe it. (Pg. 131) . . .Between thrusts the tail slips out of the females cloaca and backwards away from it, but the narrower slender portion of the tail (i.e. portion posterior to male's cloaca) remains under female's carapace (lower lip). With next thrust tail goes forward as male rocks whole body backwards and tail tip enters cloaca a short ways, then slips out again quickly as thrust ends and male rocks forward again to rest position. Tail does not enter with each thrust; in fact majority of thrusts I witnessed were not successful, i.e. only some were; female kept tail curled up flush against body in sideways position to male's tail (perpendicular to it). Not sure if this aids male or not or whether is an avoidance response of female as is most of rest of her mating behavior or is a purposeful aid to male; these questions await further observation; also must observe more closely to see if male's tail tip is grooved or hollowed at all to aid in conducting or holding sticky semen on its route to tail tip. (Pg. 132).

Between forward thrusts of tails and during some thrusts (especially after several unsuccessful ones) male often twists tail tip from side to side as he moves it forward; this behavior may occur for other reasons but appears that male does it in order to search out position of females tail and cloaca for when he strikes her tail while thrashing and twisting his own, he then zeros tail tip in on her cloaca and attempts penetration sometimes successfully, sometimes not till several thrusts and 'searches' later.

At El Chato – on south side (last pampita on trail toward Zone 5) - #10 f and #6815 m successfully copulating – tail tip entering her cloaca and with semen on it.

Weather at El Chato – 1200 hrs – 1.45 inches rain

#1196 – at top of first hill in morn on Caseta – El Chato trail (i.e. near Caseta) Pg. 133

At Caseta, drinking and grazing in hard rain - #1006 (15 painted) = has moved 10's of meters in 2 days, from mora to here; #713, #1135 Much rain at Caseta – almost 60 mm. Since March 1 at 0700 (actually no rain fell till March 2 cerca 1000-1200 hrs – at 1900 today this much, so 60 mm in about 31 hours.

Measurements of deformed tortoises (some to be taken to CDRS - painted with hatch marks for now) From nest #6 (Z3NA)

Mark	SL	SW	H	CL	CW	WGT
18 = #1 see page 111, this volume						
19 = #2 see page 111, this volume						

From nest #31 (Cerrito area n. zone) – to CDRS

I	71.8	62.3	34.2	86.5	92.5	80g

II	62.5	55.4	38.4	82.0	86.0	64g
III	62.3	61.5	46.7	88.0	96.0	78g

Very compressed and rounded by egg confinement_ more recently hatched of the three
[Marginal note: arrow from #18 and 19 above – appear very healthy now – thus will release in Z3NA tomorrow or day after with 17 young from nests 1 and 10.
[Marginal note: arrow from numbers I, II, and III above, painted #8, 9,10 respectively and to tortoise house at CDRS on 7 March; #8 and 9 blind in one eye each! 1971
(Pg. 134)
5 March 1971
To Z3NA to excavate nest #50 for CDRS incubator experiments on nestling escape and to check nest for escapes and to release young of nest 1, 6, 10.
Z3NA weather – 0800
Max – 90.5; Min 68; Rain 64.0 mm (emptied); Evap – 17.0 (refilled)
Enroute saw 2 large adult females, neither with any signs of recent mating activity on carapaces.
#128 painted in Reg. 5 , 200 m above (N) big boulder area
#133 painted, 30 m east of trail abut 150 m North of 1969/70 nest #13 area.
Both were eating herb seedlings.

Released #'s 1-7 from nest #10 and 18 & 19 of nest #6 at nest #10 all in a group at 0825; immediately all took off rapidly for sticks; no attempts seen to eat; left in scattered fashion all around (360 degrees).
Release #'s 8-17 of nest #1 at that site in similar fashion at 0935; took off independently but all at once, scattered over an (Pg. 135) arc of about 225 degrees with center of arc about due southeast. No particular orientation toward rocky areas or rock piles nearest to nest; in fact 7 out of 10 headed off in directions where rocky more jumbled and densely vegetated areas are furthers away; only 3 went due Northeast toward closest lava pile which lies about 15 m from nest site.
By 20 minutes from release time 2 of these there had reached foot of this lava rise and began up it and third was only 2 meters behind.
At this time, closest animal to nest site is 12 m away from it, furthest is about 22 m away; 5 have reached jumbled lava piles, 4 are near them but still in more open scattered rocks, dead veg. And soil areas and only 1 is crossing open bare soil; this latter one is heading to WSW toward furthest rock pile, which lies about 35 m away.
Three notable things:

1. do not remain stationary at all in open; they began moving as soon as released and moved quickly away in straight line paths (virtually those first chosen) with no halting to explore or look about; this results in rapid scattering and separation and gets them quickly into more densely covered (Pg. 136) area with rocks, vegetation, trees, etc. and away from each other and open areas; i.e. they become dispersed rapidly and very difficult to see within first 15 minutes of release.
2. When first released saw 3 separate ones nibble at abundant herb seedlings (only a few mm tall) which have sprung up in droves all over open soil patches of N.A. in past few days as a result of rain. But each only did this momentarily for a few seconds at most and then continued on rapidly; all other 7 never attempted to eat abundant seedlings or debris they were passing; not even colored plastic and

objects near my pack which four of them passed immediately to side of (such thing greatly attract adults but young hatchlings not so at this stage anyway).

3. No hiding attempts – all kept walking at 0915 looked around for releasees of nest #10; all 7 from the nest well beyond it – 25-50 m. (Pg. 137) . . . away and still moving rapidly; all in rocky very obscure (previous word not clear) areas even though had two long alley-ways of open soil heading out from nest (i.e. about 60 degrees of 360 possible_ - avoided these eventually, even when began down them and all in rocks. None have flipped once. #18 and 19 both within 3 meters of nest still both flipped over and unable to right themselves- probably due to deformed shapes – thus could be an added selective advantage against such hatchlings even when do escape from nest!

Nest #50 – Nest structure: [sketch of sock like shape with smaller bump on heel area which represents profile of nest in side view; part of nest bottom higher due to rock 17 cm deep in center; deepest part 23 cm.]

[sketch of nest in top view rounded oval with expanded diameter in forward undercut area, and large rock in opposite (back) wall.

11 eggs – 10 already hatched; 1 rolled out, no embryo sign, but small crack in shell on bottom = probably broken as laid and probably first and certainly one of first 4 eggs (prob first because in center of nest under deepest part of undercut – overhang.) (Pg. 138)

4 eggs in bottom layer all in forward 1/3 of nest on same level and all up under overhang as far as possible; 7 eggs above these, basically all on same level in central area of nest; 3 of eggs on bottom – young still lying in shells, with large yolk sacs, i.e. just hatching. 4th, bottom one is rotten one mentioned above.

7 other eggs – all hatched, basically in 2 time groups judging from yolk sac regression, although precisely difficult to say. 3 towards rear of nest have nearly completely closed umbilical scars and eggs were lying about 3-4 cm higher than other 4 due to rock position.. 4 others with ½ regressed yolk sacs, thus probably hatched out 5-8 days ago; thus total hatching period extended over at least 10 days – 2 weeks I would guess and was directly related to position of eggs in nest according to depth. (Pg. 139)

All very healthy and no deformities due to pressures in nest, etc. Young completely surrounded by saturated, moist soil, all of it loose and crumbly, due to rains of past few days. Hard cap still present and solid + - but crumbled easily and obviously was no deterrent to water soaking fully into nest. Cap entirely wet also; i.e. No air space at all between cap and around young. This would be expected in this medium brown, crumbly soil which lacks clay – like qualities of red soil just below here. Nest #10 was an example of a dry nest (no rains had occurred when young began escaping it) and they were surrounded by some loose crumbly dry soil. However, wetting clearly caused hard caps lower surface to fall away and down around young and thus were completely surrounded by moist loam in effect and this loam extended about 3-4 cm above uppermost young before more solid, yet relatively weak and crumbly, wet hard –cap began. Clearly would have escaped this.. . . . (Pg. 140) nest now because digging out in moist loam would have been easy [marginal note: cf. 1969-70 incub experiment with young at CDRS (nest #17)] and lack of its pressure on them is indicated by no deformities and ease with which all hatched out. Soil around them

was like a moist Wisconsin garden after turning it over with a garden fork before planting time. Whether they would have escaped dry nest is more questionable but probably all would have escaped easily, as witness nest #10.
Soil moist well below 23 cm also, just how far down am unable to detect.
These young to CDRS for incubator experiments. Note: as with eggs positions, young though not separated by more than 1=2 cm of roil between lower and other and not even that between upper 7 , were in 3 layers.

1. 3 on top – then no soil
2. 4 in next group below these 3 as stated soil around all of them but none between3 groups. (Pg. 141)
3. The about 1-2 cm of moist loam and below it 3 in hatching process.

Reg. 4 weather – 1100; Max 86; Min 68; Evap 15.7 (not refilled); Rain – 81.6 mm (emptied)
#1296 and #184 painted in w. instruments area. All other tortoises appear to have gone to pond for mud wallowing.
#117 painted at bottom of Reg. 2 moving south through forest steadily. Later in afternoon – noted #181 painted in field just below Caseta upper ponds while photographing birds.

6 March – to CDRS
7 March 1971 – Measures and weights of nest #50 tortoises, painted temporarily for identification when escape from nest.

Painted #	SL	SW	H	CL	CW	WGT
1	70.0	62.2	40.3	90.0	102.5	90.7
2	69.9	63.0	36.4	86.5	97.0	83.2
3	69.2	60.0	37.7	87.0	98.5	82.2
4	69.8	62.0	38.7	89.0	99.0	83.7
5	68.3	59.6	39.3	88.5	100.5	81.2
6	67.6	61.6	34.4	87.0	95.0	81.4
7	67.2	58.8	37.4	88.0	95.0	81.4
8	69.9	59.5	38.2	87.0	96.0	85.2
(Pg. 142)						
9	65.1	59.4	40.1	91.0	97.0	71.2
10	68.0	59.5	44.3	90.5	97.0	91.0

Notes from Julio San Miguel – early February 1971 work.
3 Feb 71 – to barranco above La Torta – Tortoises seen #12 m, #266 m, #194 f, a f without 1 leg; 2 mall unmarked ones.
5 Feb 1971 – Zones 6 and 1
Tortoises seen - #410 m, 1 unmarked large male.
8 Feb. 1971 – Naranjo – males #494, 759, 210, 675, 677, 680.
Zone 4 – males 3982, 660, 532, 97 (last one is a duplicate)
9 Feb. 1971 – El Chato – males 240, 1361, 192, 511, 204, 375, 284, 208, 130, 198, 485, 151, 168, 281, 144; females 856, 855, (latter copulating with male #144)
(Pg. 143)
El Chato rain gauge – 0.30 inches

Zone 5 – males 681, 205, 291, 35, 139, 1188, 225, 68, 708, 979, 507; females 402 (painted 65), 77.
10 Feb 71 – Reg. 4 – 0800 weather – Max 86; Min 67; Evap –dry (refilled full); Rain 1.8
Zone 3 - 0830 weather – Max 89; Min 66; Evap. Dry (refilled full); Rain 3.0
Reg. 4 - #'s 890 (painted 77); 1103 (painted 82); 754 (painted 9)
Z3NA - #'s 1076, 918, 1144, 131 f (painted 39).
Experiments at CDRS in artificial incubators on hatchlings escape from nest.
8 March 1971 Built two hard caps for incubators, 10 cm thick in center and with sides sloping all around. Were made 50 cm x 40 cm in surface dimensions. Will allow these to dry out in drying oven for several days; in meantime (Pg. 144)
all young from S. Cruz nest #50 and S. Cristobal nest #3 will be kept in dark till artificial nests are constructed and expts begun. Actually only two young from S. Cristobal nest #3 have begun hatching; others 6 eggs still intact.
11 March 1971.
Nests constructed, young being placed in case of S. Cruz nest as were found in field exactly according to position and depth; 10 young in all. Unavoidably light reached them in construction of nest but only for a few minutes. For San Cristobal nest #3, placed 6 eggs and 2 hatched young in nest all in one layer at 20 cm. Depth; i.e. nest 20 cm deep at bottom.
Nests almost round, but ¼ of their side surface are lass walls through which observations will be made from front of (Pg. 145) incubators. Hard caps placed over nest and filled in around eggs so no light will enter nests. Nest are heated from 0700 – 1600 daily by 2 60 – watt bulbs; maximum temp on soil surface and in air above nests reaches 38 C by 1300 – 1400 each day and remains so till 1630 –1700 then cools off to nighttime ambient. Nest vary between 28-31 C during 24 hr period internally where tortoises and or eggs are located. (this was determined by recording for a week with tempscribe inside nest).
20 March 1971
Watch the nest for 4 nights between 11 and 20 March 1971 for about 2 hrs each night. Used a flashlight with 3 sheets of red gelatin filter for illumination and detection scope for viewing only in infrared. Gelatin filter does not take out all visible light, but almost all of it. Only visible rays reaching hatchlings and egg were very far red ones. (Gelatin filter from Mole _Richardson co, 937 N. sycamore Ave. Hollywood, Calif. 90038). (Pg. 146)
Indication from observations was that young did not detect this light or at least did not respond to it because only digging activity I saw was oriented in upward direction or out of nest and not toward light, i.e. Towards glass wall. This contrasts with what was observed when removed wooden panel in front of glass wall (in specific Nest #50, S. Cruz) one afternoon: tortoises then all began moving agitated toward glass, i.e. Light source of normal daytime scattered light, and attempted to dig out in this sideways or horizontal direction.
Observation for these 4 nights were originally scribbled down in temporary notebook – will summarize them here since overall observations similar and often repetitive; night ob observation were 13, 15, 17, 20 March 1971, all dark, non-moonlit nights during hours observations were made. (Pg. 147)
San Cristobal Nest #3 (originally laid at CDRS and incubated there till this expt. Begun at sea – side incubators). At beginning of exit were two hatched out (eggs #I, II) , 3 just

beginning to hatch (eggs IX, XI, V) and 3 eggs intact (eggs X, VIII, III) By 20 March 1971, egg IX, III, v had also hatched, VIII remained unhitched and on sign of hatching yet, and eggs X, XI had begun to hatch but appeared to have died in process (both very very small hatchling and premature) Incidentally, eggs X, V, III all produced albino tortoises. Will check egg X and XI when exit. Ends. Till night of 20th virtually no activity was observed in nest save for hatching process. Hatchlings simply laid in nest inactive and resting. On 20th were 5 completely hatched out animals, 2 apparently dead ones trying to hatch out, and 1 unhitched egg. On this evening when opened . . (Pg. 148) Nest at about 2010 hrs and began observations, 5 hatchlings were all moving around some; activities were not pronounced but 2 tortoises on top of other 3 were scratching independently at two different places on sides of nest; 3 below were also moving now and again , mainly just shifting positions. Over two hours I watched them, were active at most about 20% of time; almost always if any were active all were; several times after long periods of rest 1 of upper animals would begin digging and scratching at side in an upward direction and this would rapidly induce digging by the other upper one and movements by lower 3 would follow this. In general, not any progress was made in actually getting out of nest but was interesting that movements by one induced all others to be active. (Pg. 149)

Nest #50, S. Cruz – On nights of 13 and 15 March observed no real digging or escape activity by the 10 hatchlings. All of them were lying quietly in a large pile occasionally small shifts in position occurred but this never resulted in any digging activity. However on nights of 17 and 20 March notes considerable digging activity. On each night when opened incubator all were lying quietly but were alert. Perhaps removing the front wooden panel was detected by them because most had heads out and were looking about and pumping gular areas (i.e. sniffing). Within about 15 minutes of this disturbance activity began again. First, one hatchling began to move and dig (an upper one), and within seconds another began moving, then another, until virtually all of them were moving. By this time (17th) they had rearranged themselves in nest so that there were 5 tortoises in upper layer and 5 in bottom of nest below these. Five upper ones were able in fact to reach lower part of hard cap where it joined side walls because they were elevated on the lower animals' dorsal (Pg. 150) . . . surfaces. The upper 5 were digging largely individually at different spots in the softer upper soil of the sides where the hard cap joined the sides rather than into the very solid hard cap itself. Two of them were in fact digging side by side in the same place and 3 others at individual sites on the night of the 17th. On the night of the 20th , 1 was digging at an individual site and the other 4 were divided such that 2 were digging in same area in 2 different portions of the upper nest sides, When the 5 bottom animals were active, they were mostly scratching and moving generally in an excited fashion, sometime digging bit into side wall in a slightly upward direction (but mostly just generally moving). Mainly, their activity caused soil "pulled" into the nest by the (Pg. 151) upper 5 tortoises to be filtered down below them also and added to the bottom of the nest. This resulted in the whole group of tortoises being slowly and gradually elevated as the soil was moved from the nest upper side to its bottom.

For long periods of time, also, all or most of the bottom 5 were inactive just resting and lying still. Also, lest a mis-impression be given, should note that all 5 upper ones did not all always dig simultaneously; for some time periods only 1, 2, 3, 4 or all 5 would be

digging. However, generally, social facilitation was the rule and not the exception, with all 5 of them digging; most often also, some or all of the bottom animals were digging or at least moving to some extent.
21 March – night – 2000-2100, 2130-2230 – S. Cruz nest #50 hatchlings continuing to dig; getting rather close to escaping. Social facilitation continuing; 6 of them now in upper layer digging concertedly (Pg. 152) in 3 places; 3 in one area at rear of nest, 2 in another at front –side of nest up against glass; 1 in another area on side of nest; 4 on bottom moving off and on; more inactive that active in general – i.e. about 40% of time upper ones are digging. They are also active. Upper ones digging about 30-40’”%” of time, i.e. dig for 15-20 minutes, then rest for 30 minutes, dig a few minutes, rest 5-10 minutes or so dig again etc.
S. Cristobal nest- All 5 digging off and on, mostly all along one area in rear of nest. Sometimes only 2-3 dig and others rest, but highly variable. Resting about 90% of time, followed by short digging spells. Digging also at upper side of softer nest soil where hard cap meets nest wall. Not digging into hard cap itself, i.e. same as S. Cruz hatchlings. (Pg. 153)
22 March 1971 – 0630-0900
Was very lucky and witnessed escape this a.m. of S. Cruz group. Two (side by side) dug out simultaneously at rear of nest where 3 had been digging earlier. Third one still digging here also, but to side and behind other two. Within ½ hr two digging in front of nest (against glass position) open up a hole to outside and 1 of them dug out alone and 2nd one followed him. Others then all rapidly left nest once holes were made and light entered nest. 3rd one digging in rear of nest followed first two out of large hole they made; 4 more exited, singly, out of this hole but virtually on each others heels, Finally, one remaining tortoise left by this same hole about ½ hr later.
2030-2100 – S. Cristobal; 5 continuing to dig, but resting most of the time. (Pg. 154)
23 March 1971
0915-1030 – Went up to check S. Cristobal nest and found 2 with front ends of bodies just out of hole side by side at rear of nest. Watched them dig out, followed immediately by the third. All 3 were digging vigorously and simultaneously
1300 – Returned to find that two remaining one had come out of nest by same hole.
Expts, in sum definitely indicate that social facilitation does occur and could be important in determining nest escape success. However, definitive field experiments demonstrating actual selective pressures still lacking. It is certainly true that digging as a group must greatly enhance pressure exerted on nest hard cap and points where it joins nest inner walls and also must make it more likely that an opening will be created in hard cap or beside it where the (Pg. 155) young can escape. Also is true, however, that young do not emerge from nest as do hatchling Chelonia mydas , i.e. by bursting forth as a small ball of fury and exertion made up of 10-15 hatchlings. Clearly only 1 or 2 and perhaps occasionally 3 make the final hole or holes to the surface through which the remainder escape. Field data clearly supports these incubators experiments. But scratching at hard cap by a group of tortoises (.e. – 408 or so) of them at once certainly enhances crumbling and progress and cutting through it so that final digging out can occur by 1 to a few of the hatchlings.
Note on Cristobal tortoise:
#3 X = died during hatching; very small; albino

#3 XI – died during hatching; very small; normal pigmentation
#3 VIII – died embryo – large 3rd cycle one; died during incubation.
(Pg. 156)
Observations by Galo Torres for month of March on weather and nesting, mating, animal locations, etc.
Reg. 4 –

Date	Time	Max	Min	Evap	Rain
Mar 10	0830	88	68	dry	0.0
Mar 20	0800	88	68	24.0	23.0
Mar 27	0830	85	65	3.3	125.6
Zone 3 Nesting Area					
Mar 10	0930	90	67	22.0	0.0
Mar 20	0900	90	66	dry	25.0
Mar 27	0930	88	64	10.5	100.4

Evaporometer refilled on each occasion and rain gauge emptied.
Visits to various nesting zones:
Zone 3 NA – he only checked nest 2, 3, 5 because did not know of others.
Mar 10, 1971 – In Reg. 4 while Enroute saw #1050 f (painted #183) and #1213 m? . In nesting zone found following tortoises: #918, #1302
Nests 2, 3, 5 have not changed – no escape signs yet.
(Pg. 157)
Mar 20, 1971
Nest 3 – no escape signs yet
Nest 5 – all escaped; 7 egg shells inside indicating clutch size.
Nest 2 – 9 eggs; 8 hatched and escaped; 1 liquid addled egg inside with no sign of embryo in it.
Tortoises encountered in nesting area - #910 m, 412 m (painted #120), 1020 m, 20 f (2 holes in 2000 scute), 411 m, and two unmarked recently escaped hatchlings.
Tortoises in Reg. 4 – 236 m (painted 117); 415 m (painted 184), 709 f (painted #72); #1297. Many of his sex determinations are incorrect.
March 27, 1971 – Nest #3 = still no escape sign.

Cerrito nesting area
8-9 March 1971 – Nest 19 – no escape sign yet
Nest #9 – 8 eggs; 6 hatched and escaped, 2 remaining ones rotten and no embryo
Nest 32 – has no escape sign yet
Nest 40 – (does he mean #70) = he says already checked by me but not so.
(Pg. 158)
Tortoise seen in nesting area:
New 1020 f, new 1353 f marked but not measured, 1012 f, + 4 hatchlings found wandering in nesting area.
Tortoises in Zone 5: 777 f, 472 f.
March 22-23, 1971 – Tortoises in NA
New 440 m (painted #62) and 1357 f newly marked but not measured – in copulation; #1280 f, #168 m , #469 f (painted #61), #66 f (painted #64), 1025 f (painted #68); #171 m and 1118 f copulating; #1045 m; 463 f.

Nests:
#33 – no escape sign yet.
#64 – he found signs of 12 eggs – i.e. 9 escaped young , 2 young inside digging out (released) , 1 rotten non-embrioned egg deep in bottom of nest (marginal note: plus 1 hatchling escaped)
#22 – 11 eggs; 10 young escaped; 1 rotten, non embryonated egg in bottom of nest; eggs not in 1 layer but several.
#17 no escape sign
#7 – 8 young escaped ; no other sign [Marginal note beside #17 and #7; something wrong here ?- see my notes.] (Pg. 159)

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3. Gray, J.E. 1853. Description of a new species of tortoise (Testudo planiceps) from Galapagos Islands. Proc. Zoological Society 1853, pp. 12-13
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5. DeSola, C. R. 1930. The liebspiel of G. e. vandenburghi (Testudo vandenburghi) a new name for the Galapagos tortoise of the central volcano of Isabela. Copeia pp. 78-80. Ann Arbor, 1930

(Pg. 160) (unnumbered) last page of volume
Photos = Roll 270 , 1-20; young escaping from nest #10, Z3NAA on 28 Feb. 1971
21-end Zone 5 – maybe no good; ASA probably wrong
Roll 271 1-28 (not finished) – Zone 5; tortoises after a big rain storm.
Roll 272 – a few shots of releasing 10 hatchlings at nest #1 on S. Cruz in Z3NA – March 5, 1971.

End of notebook.

Isla Santa Cruz Volume #14.
Field Notebook of Craig MacFarland

(Pg. 1)
Notes from Galo Torres continued –
22-23 March, 1971 – Cerrito Nesting Area –
Nests –
#65 – no escape sign.
#66 – found evidence of 11 eggs; 4 young escaped; 2 dead trapped young inside – 1 caught in earth (wedged in), 1 very small and apparently prematurely hatched; 5 rotten, non-embryonated eggs all in 1 plane near surface – only 5-15 cm deep but he failed to measure. All of these near escape hole!
#19 and #52 – no escape sign yet.
La Torta – 11-13 March, 1971 –
Nests –
#'s 12, 23, 47, 48, 49, 62, 63, 28, 58, 67 – no escape sign from any (#12 is a mistake here); says he saw nests #44 and 39 but already finished for year by Julio San Miguel.
Tortoises - #1307, #1309, #491 ♀, #1313, #171 ♀, #738 ♀, . . .

(Pg. 2)
. . . 15 very small sized tortoises and following new ones all found in nesting area:
New #1354 ♂ - CL 105; CW 117.
New #1355 ♀ - CL 90; CW 95.
New #1356 ♀ - CL 96; CW 102.
17-19 March 1971 –
Tortoises found in nesting zone #1314 ♀ (painted #197), #1317, plus 8 very small ones of 1 year and less of age.
Nests –
#47 – no escape sign yet.
#69 – 9 eggs; all escaped. [Note: CGM apparently questioned and subsequently accepted this nest number]
#63 – 7 eggs, all escaped.
#48 – 11 eggs, all escaped.
#23 – 10 eggs; 7 escaped; 3 deepest ones ("very deep") rotten - no embryo sign.
Killed a large ♂ pig near nesting area . . .

(Pg. 3)
. . . on this trip and opened stomach – no sign of tortoise remains among food present.
14-15 March, 1971. #419 ♂ and signs of other tortoises on land of Arturo Varga (where is that?).
15-16 March, 1971.
#777 ♀ and #294 ♂ in copulation –16 March in Zone 5.
24 March, 1971 – tortoises on land of Juan Guerrero and neighbors –
#200 ♂ - J.G.'s farm.
#824 ♂ - J.G.'s farm.
#727 ♀ - Icasa's farm.

#274 ♂ - farm of Moro Escobar.

(Pg. 4)
11 April, 1971. – to Caseta – Very green all the way to Caseta; tortoise sign not very abundant; especially noticed lack of much recent fresh tortoise sign from E of Zone 6 turn off to Caseta area; but some scattered sign all along; most of sign (many wallows, trails, etc., around Poza de Manzanillos and Caseta Pond #4.
12 April, 1971 to Zone 3 NA – o check nests.
Enroute – Around Caseta: #'s 1108; 713; 1135; #408 – just below Caseta.
Around Caseta Pone #1 - #'s 357; 503; 1168; 1044; 314 ♂; 7 painted; 87 painted; unmarked semi-old smooth worn ♀, 89 cm CL. Note: not a sample, only looked at about ½ of area.
Region 2 - #14 painted; 161 painted – 125 m below Pond #1 near manzanillos, both wallowing and grazing.
#103 painted – in mid-lower Region 2 moving down trail.
Region 3 - #819 ♀ (bright red mud on back) moving uphill in mid-Region 3 in dense forest, not using drainage or human trail clearly; an unmarked ♀, 85 cm CL 35 m behind 3819 and moving in same direction but coming from drainage; looks as if both are crossing from one drainage to another, so perhaps still using drainages for landmark . . .

(Pg. 5)
. . . orientation. #416 – lower Region 3.
Region 4 - #183 painted, 99 painted, 962, 718, 2 unmarked ♀♀ (1 large, 1 medium), 1 medium unmarked ♂ - all grazing along central trail area; all have obviously been wallowing recently.
Region 4 – Weather – 1030 hrs. – Max 88, Min 65; Evap. 31.0, refilled; Rain 54.6 mm.
Region 5 - #742, 1197, plus 1 small unmarked one (circa 50-55 cm CL) all in big boulder area grazing.
Zone 3 NA – Weather –1200 hrs – Max 90; Min 63; Evap. dry, refilled; Rain 33.3 mm.
Water – Ponds are full all around Caseta Region, even small ones immediately near house and tents; also all low areas where Clerodendron molle thickets grow are full of water all through Region 4 and big boulder area. In Zone 3 NA can see that was shallow standing H20 in small dry pond area as evidenced by some tortoise mud wallows, but these have now dried-up and area is covered by tiny herbs. In all these H20 covered areas are abundant tortoise mud wallows, sign and animals indicated a lot of recent use – see more below on vegetation and water.

(Pg. 6)
Nests – Zone 3 NA –
#15 – very nice nest exit hole about size of 1 tortoise hatchling, (oval–shaped) in side of hard cap where it meets normal soil surface. Took a few photos to show intact hard cap and exquisite little exit – Roll 274, #'s2-4. Nest wet throughout by rains, 25.5 cm deep at center, normal flask, eggs all in 1 layer more or less save for 1 stacked on top of bottom 9. Thus 10 eggs in total, 9 lower ones all hatched and escaped. Upper one rotten, addled and seemingly infertile. Top of this upper egg was 14.5 cm from top of hard cap. No feces in hard cap and cap was right down on top of upper egg.

#16 – saw this one laid; just to check will try and check out number of eggs in reality with my count now – I do not . . .

(Pg. 7)
. . . remember how many the ♀ laid here. Eggs were not all in 1 layer quite. See notes on laying for details on these aspects. Appeared to be 6 eggs remains with tortoises escaped, 3 eggs all at same level (20.5 cm to their tops from top of hard cap) rotten, addled, and seemingly infertile. Exit hole's size, form and location exactly as in nest #15.
#3 – No escape sign yet at all; so opened nest; 7 cm from surface of hard cap, digging directly up found 1 live but moderately thin hatchling. He had reached this level all alone because other 5 eggs did not hatch at all. Nest wet throughout and hard cap very solid and all of one massive piece; very likely this one would never have gotten out. Nest and soil very cool because nest surface completely shaded all the time by solid canopy of 0.75-1.0 m high herbs. Five remaining eggs all liquid and addled and no sign of embryos at all.
This one young one has the following measurements: SL 77.7; CL 68.1; H 36.0; CL 86.5; CW 100.0; Weight 92 g.

(Pg. 8)
Poking around Zone 3 NA for tortoises –
1. #38 painted – near water collection area.
2. #120 painted ♀ - in area near 1969-70 Nest #12. Muddy sign of recent copulation on carapace.
3. One unmarked small fellow in small nesting area just SE of main Zone 3 area; CL 44.8; CW 45.2. Weight 15.75 lbs.
4. #917 huge ♂ - same area as above small unmarked one; grazing on herbs. CL 141.8; CW 151.5. Flaking disease in usual areas and along sides somewhat; no algae in green condition but looks like dried remains of it in usual areas; some of pale-blue-green fracticose lichen on rear. W.g.i.'s clear and thick.
5. Fresh sign of one in area – i.e. size of #12698 who is usually here.
6. #780 ♀ - CL 102.1; CW 114.3. Huge, all smooth worn shell; Resting in shade along trail from last area to highway hub. Muddy sign of recent copulation on carapace.
7. #1242 – heading from hub to Central Zone 3 NA via trail which leads to nests #15 and16 area (1970-71 nests).

(Pg. 9)
Up by small dry pond area:
8. One unmarked one – CL 47.0; CW 48.1.; Weight 20 lbs.
9. One unmarked one – CL 57.05; CW 57.5; Weight - wouldn't cooperate.
10. One unmarked one – CL 46.0; CW 47.2; Weight – wouldn't cooperate.
11. #918.
12. #1302.
13. One unmarked one about 55-57 cm CL.
14. #690 ♂ - CL 120..3; CW 141.0. W.g.i.'s thick and clear; no algae or lichens; flaking disease light in usual areas; scutes smooth in central ¼ or less.
15. #1020.

16. A medium – large ♂ burrowed under Clerodendron by pond beg; can not reach him now to get number.
All these animals still very active and grazing between 1700-1730 when I encountered them; obviously staying active much longer than in garua season.
#690 remained in shade from when first saw at 1200 till 1630; then went out of resting – shade position and grazed till 1815 when simply sat down in open for night (in ¼ m high weeds, but not at all "burrowed").

(Pg. 10)
Of 5 animals near me, only one resting by 1800, and this one the same large ♂ by dry pond bed- has probably been resting all afternoon and never became re-activated again.
Other 4 all still active at 1800, 3 small ones and #690 ♂; 3 small ones are #'s 8, 9, 12 on list above.
All burrowed at about 1815, each swiveling down into soil a bit and with part or most of top of carapace exposed; sides of carapace protected by small 1 dm high herbs; #690 ♂ did not burrow as indicated above.
2030 hrs – One of 3 small ones lumbering about for past 30 minutes and finally re-burrowed in a more protected spot (i.e. vegetation over top of carapace). Perhaps mosquitoes forced move as they are fierce and all tortoises are covered with them, lined up in rows . . .

(Pg. 11)
. . . along scutes junctures and all over any exposed skin. This small fellow is one of 3 above that had back and top of carapace exposed.
The above 16 animals were not a normal complete sample because did not cover entire normal sample area and did not look as carefully as during sampling. Probably 50% more individuals here than I found. Why big influx – probably due to lush herb growth all over open soil–filled areas.
13 April, 1971 – All 5 animals near are up and active between 1530-0600; amazing!
Nests – in lower zone 3 (i.e. lower Region 7).
Nest #11 – very deep nest – 28 cm in deepest part in center; no rocks on bottom so ♀ may have had leg extended to fullest. Eggs in two "layers", 7 on bottom, 7 on top of these; all upper layer and 3 of lower ones hatched and gone; 4 of lower ones rotten, liquid, and thus perhaps infertile, at least no signs of embryos. Nest deep and cylindrical; no feces in its top at all; not really a good solid hard cap because pebbly soil, but somewhat of one was whole and intact. Escape hole out one side of hard cap. Exit hole size of 1 hatchling.

(Pg. 12)
Nest #51 – 9 eggs; 6 hatched and escaped, 3 inside, rotten, liquid and no embryo signs; nest typical shape, 25 cm deep at deepest, all eggs in one layer on bottom; rock bottom to nest. No feces in hard cap; hard cap well-formed and solid, and exit hole exactly as in nests #15 and 16 (and #11 also). Obviously was a bit of an air space between hard cap and eggs.

Nest #30 – 8 eggs total; all rotten, liquid, and without sign of embryos; nest looks normal in shape and is 24.5 cm deep in center (rocks in bottom). Eggs piled up in more or less 3 layers, i.e. nest not of broad diameter; probably an infertile clutch in its entirety.

(Pg. 13)
Lots of tortoises grazing all over these "pampas" in lower red-soil open areas; herbs thick all over 1-5 dm tall, and can hardly see any soil at all; all trees and shrubs leafed out – generally lush as hell.
Tortoises noted:
Near Nest #51, 11 and this area –
#1159.
One unmarked 45 cm CL animal.
One unmarked 50 cm CL animal.
#31 ♂ - down from the Caseta – just moving into H20 collection rocks from NE. No other sign of him here so just must be arriving!
Flat plains out near trail –
#1144 – (from main Zone 3; i.e. has traveled some 500-800 m straight line distance).
#114 ♂, painted #1.
On unmarked little fellow – CL 28.5; CW 28.1; Weight 4 1/8 lbs. W.g.i.'s thick and scutes show incredible growth! Along mid plastral line about 3 mm fresh scutes laid down on either side. Same along edges of dorsal vertebral scutes – 1.5-2.5 cm all way around them.

(Pg. 14)
#34 or 434 ♀ - probably latter) – CL 98.0; CW 117.0. Very old and all worn smooth.
#1114 – CL 57.4; CW 62.1; Weight 34.75 lbs. Sex indeterminate; w.g.i.'s clear and thick.
One unmarked tortoise about 45-50 cm CL.
One unmarked tortoise about 55-60 cm CL.
Zone 3 NA – Weather – 1100 (before leaving) – Max 89; Min 68; Rain 0.0; Evap. 3.8, refilled full.
#1302 – check for growth – CL 33.3; CW 34.9; Weight 8 3/8 lbs. W.g.i.'s clear and thick.
Down in campsite area and beyond it 400 m to SE – really moving around.
Other interesting notes from this morning and last evening.
Checked temperature at egg level in probe beside nest (nest open so can't use that probe now) at several times yesterday and today. This is of interest because herbs . . .

(Pg. 15)
. . . began growing and covered this entire nest position (and the whole nesting area soil-covered area) throughout March so that now nest are totally shaded all day by herbs about 3-6 dm high and very dense.

	Time			
Positions	1400	1800	2000	1000
6	26.5	26.8	26.7	26.1
7	26.1	26.3	26.3	26.0

8 26.0 26.1 26.1 26.0
(Both days hot and clear all day).
Note the very sharp difference in temperatures between now and late February due to shading and soil being wet completely throughout now versus dry and open, unshaded soil of late February and before.

Return to Caseta –
#528 – just before big boulder area.
#127 ♀ - at big boulder area; near a pond; no clear recent signs of copulation.
Region 4 – 1330 hrs – Weather – Max 87.0; Min 69.0; Evap. 5.3, refilled; Rain 0.0 mm.
Many tortoises in Region 4 – saw over 20 just making one quick circle round the area near instruments and water collection sites – among those seen were the . . .

(Pg. 16)
. . . following: #1296, one unmarked large ♀ with copulation sign; painted numbers 183, 184, 72, 77, 18. #18 painted (63 ♀) had no recent copulation sign.
Copulation - #77 and #72 in process of copulating.
Rest of ascent to Caseta:
#1245 - just below Pond #1.
#134 - painted at Pond #1.
#538 - at Pond #1.
Other notes from trip –
Water availability described above; herbs relatively dense in all zones, becoming more lush as altitude increases; especially dense herbs in nesting areas and Region 4 and other zones with open soil spots; grasses and herbs very dense in lowest part of Zone 3 NA where trail heads off to La Fe.
Tortoises very active and grazing all day, most individuals active 0600 - 1800 except when sun is hot and out from 0800-1000 to 1530-1630. Great influx of tortoises obvious in Region 4 , Zone 3 NA (both parts) but no concentration around Caseta or pond near it – why? Probably because during previous months was abundant . . .

(Pg. 17)
. . . food in higher areas, but just now – i.e. past 3 weeks more or less, open areas in lower zones became covered with edible herbs and grasses.
Saw a long involved mating attempt between #114 painted ♂ and #434 ♀; ♀ passive, then trying to escape after mounted; ♂ smelled rear on approach, then mounted – probably unsuccessful, because ♀ moving a lot and penis never extruded.
14 April to Devine's –
Caseta upper ponds - #46 painted, #160 painted, #11 painted, #785, #15 painted, #106 painted ½ way up central manga to first fe3nce. Devine maintains that there are "dozens of tortoises on his place from Reserve Border up to and including Poza Maternidad.
Notes from Wardens – (we were on continent from 21 May – 11 June , on Duncan just prior to this and I was on Alcedo, 18-30 April).
El Chato – Weather – 25 April 1971 – 0930 – Rain 0.60 inches (JLS).
9 June – 1000 hrs – 0.74 inches (JCS).
17 June – 0930 – 0.13 inches (JCS).
1 July – 1.50 inches (JCS).

(Pg. 18)
Region 4 –

Date	Observer	Hr.	Max	Min	Rain	Evaporimeter
26 April	JCS	1100	88	68	5.7 mm	dry
6 May	JCS	1200	86	64	0.0	30.0
8 June	JCS	1600	84	60	8.2	dry
16 June	JCS	1000	80	63	9.8	14.5
30 June	JCS	1000	80	62	24.0	23.5
Zone 3 NA						
26 April	JCS	1230	90	66	3.7	dry
6 May	JCS	1300	88	66	0.0	dry
8 June	JCS	1700	70?	58?	7.0	dry
16 June	JCS	1100	84	62	9.0	17.5
30 June	JCS	1100	85	60	17.0	29.5

Visits to various zones
17-29 April – La Torta Nesting Area – no ♀♀ - nothing – JCS
26 April 1971 – Tortoises in Region 4 –
314 ♂; 1215; 14 painted; 127 painted, 416 ♂; 11 ♂; 207 ♂; 105 painted; 694 ♂; 191 ♂. (JCSM).
8 June – Zone 3 NA –
#892 ♀ - 300 m above nesting area in distance.
#127 – in Zone 3 NA – digging and looking for a nest site. (JCS).
9 June – El Cerrito – Many tortoises and much activity in Chato and zone 5; nothing of note at Cerrito Nesting Area. (JCS).

(Pg. 19)
15 June – Zone 1 and 6 – few tortoises only (JCS).
16 June – Zone 3 NA – 1st nest of year found, very fresh; in central Zone 3 NA, only 15 m from last years Nest #1; made by #127 ♀ who was not in the area this day as far as could be determined. (JCS).
17 June – El Cerrito Nesting Area –
Zone 5 – copulation - #655 ♂ and #826 ♀.
In nesting area - #65 ♀ painted digging recently , but still no nests (JCS).
23-25 June – La Torta – (JCS and GT). Large unmarked digging in campsite area all 3 days they were there.
Females now there – 3591, #193, #196 painted, #199 painted, 1 unmarked one.
Wet days – small and tiny tortoises active everywhere in this nesting area.
Examined 3 old nests (1970-71). No escape signs from any of these nests.
#68 – very hard strong, completely humid cap – rains seem to have hardened it if anything – all eggs hatched, but all young trapped and dead inside (6 young).
#46 – cap same ; all eggs hatched but also all young trapped and dead inside (8 young).
#38 – cap same – 5 young inside, all thin but alive and healthy; released in this area. No other eggs.

(Pg. 20)
30 June - JCS – in Region 4 – many tortoises drinking and grazing.
Zone 3 NA - #130 ♀; #39 painted♀ (#131).
1 July 1971 – JCS in El Cerrito Nesting Area.
Many ♀♀ - #'s 1357; 1023; 1250; 1318; 862; 161 painted; 348. #440 ♂ and #472 ♀ copulating. Still no nests, but some digging.

(Pg. 21-23)
[Blank]

(Pg. 24)
15 April 1971.
Came to Chato late yesterday afternoon; large ♂ and ♀ were mating at 1800 in bushes but could not get numbers.
This a.m. to Cerrito Nesting Area –
Enroute no time to do detailed observations so just counted animals mostly:
1. Through Chato and S side pampas along first portion of trail to Zone 5 –
#144 painted and 1 large ♀, 5 large ♂♂.
2. Trail to Zone 5 – 2 large ♂♂, both going down toward Zone 5 along drainage; 1 smaller ♂ moving upwards along drainage.
3. Zone 5 and trail just S of it to first ponds – 1 adult ♀, 3 adult ♂♂ and #140 painted exactly where last saw him over 1 month ago.
4. To Cerrito Nesting Area. – An unmarked 44 cm CL small one moving up side of Cerrito along trail; #1320 moving up along trail about ½ - ¾ km above nesting areas – in very rocky area, eating herbs.

(Pg. 25.
Nests and other observations:
Nest #33 – still no opening so opened; nest of normal flask shape with very strong, deep undercut/overhang. [Illustration shows 9 cm undercut with no rocks evident; 27 cm depth in center of nest with rocks in floor of nest on rear half]. Deepest part in center 27 cm from surface of hard cap to bottom of nest. Rocks so ♀ dug as deep as possible?
10 eggs, 7 in one layer on bottom, 3 on top of these; 4 of those on bottom (most of 7 at 26.5-27 cm depth, i.e. Bottom of egg there, tops about 20-21 cm deep) hatched and young in nest. Other 3 and upper 3 all rotten, and all appears definitely infertile as have not decomposed much. Nest very cool inside when opened, 27 ºC. Four young (note that were in a group) about 18 cm down and had been digging but to n avail; hard cap was solid like a wet, moist brick of clay all above them; they were in a small air space of about 5 cm depth but apparently unable to dig out. Can't say if ever would have been able to but doubtful; besides very wet solid hard cap, vegetation has rooted all around in it making digging even harder. Of course, if hard cap . . .

(Pg. 26)
. . . dried out in later months perhaps could have escaped if as it cracked and loosened a bit. No feces in hard cap or nest. Released the 4 in this area –

Measurements.

SL	SW	H	CL	CW	Weight
79.0	71.0	37.4	97.0	105.5	90.0 g
78.0	69.5	31.0	95.0	102.5	87/0 g
80.8	71.4	37.7	93.5	106.5	93.0 g

Lost one inadvertently while measuring. Released and watched ½ hr; made no eating attempts though wandering through lush herbs and must be hungry but strong "drive" or something similar to reach protected areas.
Tortoises in this area:
#64 painted – thick w.g.i.'s
#465 ♀ - CL 64.98; CW 70.5 – thick w.g.i.'s
One unmarked ♀ - CL 65.2; CW 71.5.
#1064 ♀ - CL 94.0; CW 102.0; recent muddy copulation sign all over her; w.g.i.'s present but thin.

(Pg. 27)
#1322 – CL 51.2; CW 50.5. Weight 24.25 lbs. W.g.i.'s clear and moderate thickness.
One unmarked (probably ♂) – CL 51.7; CW 52.2. Weight – won't cooperate.
Both within small soil area just to S of Nest #33, grazing.
#61 painted ♀ - fresh copulation sign on rear.
Nest #7, 17, 22, 65 area –
31284 – CL 48.6; CW 51.2; weight 22 7/8 lbs.
Nest #7 – Galo reopened and counted shells I had left in nest – this clear sup confusion between our notes; also notable that we each counted 8 eggs, in fact the true number.
Nest #17 – 6 eggs still there –
Measurements –

	mm	x	mm
1	60.7		59.4
2	60.4		59.8
3	60.6		60.3
4	63.6		61.5
5	63.0		60.7
6	(impossible to measure because partly broken)		

Conditions and positions
Top egg (#6) – Rotten, addled, no embryo sign.
#'s 1-4 (middle 4 eggs) Rotten, not addled, but no embryo sign. All definitely infertile; little decomposition.
#5 (bottom egg) – 34d incubation cycle (early) well formed but dead embryo; perhaps just too cool at such great depth.

(Pg. 28)
Nest #65 – not a nest – mistaken identification – noted originally as this possibility.
One unmarked small one CL 46.3; CW 49.0. Weight 17 7/8 lbs. W.g.i.'s clear and moderately thick.

Nest #52 – No escape sign yet, so opened it. Normal flask shape but with rocks at a high level in rear 1/3 of nest and rocks in sides also. In front of nest two small rocks lying

parallel on front – sides resulted in ♀ digging an extra deep shaft there where 2 eggs were laid. [Diagram shows nest progressively shallower toward rear with 1 egg on top level, 7 eggs in middle level and 2 eggs in deepest level toward front of nest.]
Deepest point in nest 25.5 cm at bottom of nest below two lowest eggs which rested at this depth (apparently ♀'s limit because not any deeper and no rocks here).

(Pg. 29)
Seven eggs lying with bottoms at 22 cm; all in same layer – one egg with bottom at only 10 cm and top 9.5 cm below top of hard cap (i.e. soil surface). No feces in hard cap or nest. Of 2 bottom eggs, 1 hatched but definitely trapped completely, on side and embedded in hard brick-like wet soil; because of depth must have hatched solo and been covered by soil (which later was wetted) from others digging out. Other egg at this level has a n early 3rd cycle embryo in it, dead and rotting. Live one will be released; is OK, but recently hatched (1-2 weeks) because umbilical scar just closed and body still somewhat rounded.
Topmost egg rotten and addled and no embryo detectable.
Seven middle eggs all hatched and all these young were in a group digging at same level, all spread out and on same level at only 4 cm from surface (tops of carapaces); finely crumbled wet soil they had been digging away from hard cap was below them piled on 2 eggs and 2 trapped, live young . . .

(Pg. 30)
. . . one below. They had all clearly been digging as a unit to be so even in one level and could see how nearly whole, slightly-domed underside of hard cap had been rasped away; they were coming straight up as a group and was clear that those near sides where hard cap was thinner would probably break through first. Then other must follow this one's or ones' lead. So these 7 would obviously easily escaped on their own in a few days; bottom one however was trapped. Interesting that these 7 having better luck than 4 in nest #33. This forms a very interesting addition to social facilitation experiments at CDRS.
Measures:

	SL	SW	H	CL	CW	Weight
1	72.3	68.3	26.3	88.0	97.0	90 g
2	77.4	69.6	37.1	91.5	102.5	94 g
3	74.0	68.7	34.9	88.5	99.5	87 g
4	74.6	68.4	26.4	89.5	99.5	87 g
5	70.0	65.0	34.0	84.0	96.5	80 g
6	74.6	67.8	35.5	88.0	99.0	87 g
7	73.0	66.9	36.9	89.0	100.0	85 g

(Pg. 31)
Bottom trapped one - #8 – not worth measuring because still all balled up. All released at nest site; scattered rapidly for ½ hr, no attempts to eat even though walking through lush herbs that almost cover them.
Nests – all 4 remaining eggs infertile; only slightly decomposed.

#463 ♀ - CL 94.8; CW 106.2; resting under a tree half way between Nest #8 and Nests 9 and 19. Very fresh scratches on back where a ♂ attempted copulation; a very old smooth worn ♀.
#68 painted ♀ - 75 m uphill from where was last month when was here – near Nests # 19 and 9 – sleeping in shade; Recent copulation sign all over her back.
#220 ♂ - not actual number probably (duplicate) but only mark he has; CL 145.5; CW 152.2. At Nests 9 and 19. Old and very worn; flaking disease all over as with #507 ♂.
Nest #19 – very small little nest cavity wedged down in amongst rocks on all sides, but not bottom; very narrow; only 5 eggs! One on bottom, sitting with top at 17 cm, bottom (of egg) on bottom of nest at 23 cm. One above this one a bit and 3 on same level at 7.5 cm to tops from top of hard cap. All rotten, addled and no sign of any embryos; three very little rotted and appear definitely infertile, other . . .

(Pg. 32)
. . . two more questionable.
Nest #32 – no exit sign; 14 eggs upon opening: very small nest, no rocks in bottom but all along sides; eggs really jumbled in, difficult to even describe layers; descending and their condition:
1. Top egg's top at 4 cm down; dried out and addled; no embryo sign.
2. Next 2 eggs tops' 6 cm down; both with 3rd cycle embryos appear to have been unable to hatch because shell cracked a bit and membranes perforated but not out (of course insect larvae could have done this). Only sure thing is died late in incubation period.
3. 8 eggs jumbled in central areas- all as in 2. above.
4. 1 egg at 21 cm depth to its top; same as 2. also.
5. 2 eggs at 23 cm to their tops. Both as in 1. above but . . .

(Pg. 33)
. . . not dry; addled so can't determine fertility for absolute certainty. 11 certainly fertile; strange results for a nest; no definite sign even got to hatching stage? No feces in nest construction.
Nest #70 – only sign of 3 eggs - all very shallow; 1 rotten and infertile, 2 hatched and gone; rotten one's top only 7 cm down, other 2 about 2 cm deeper. No feces in nest construction.
Nest #20 – 12 eggs, really jumbled in; 5 hatched and inside escaping; 7 rotting, 6 of these addled and with no embryos sign, 1 with early 3rd cycle embryo dead; deepest part of nest 28 cm; 3 layers of eggs. Rotten eggs - all 7 in bottom 2 layers of the nest; dead embryo in egg in next to bottom-most layer; 5 hatched in upper layer.
On return to Caseta -
In large pond (rocky), full of water, just below Zone 5 - #140 painted ♂ and a large ♀ (all smooth) – copulating in water.
Another mating seen underway at 1735 hrs at El Chato – a large ♂ and large ♀, both all smooth - ♂ about 140 cm CL, ♀ about 90 cm CL.
Nesting area at Cerrito full of herb cover as in Zone 3 NA; rocky ponds here dry but with wallowing signs and some mud still . . .

(Pg. 34)

. . . present. Abundant growth and small to medium-sized tortoises everywhere grazing on herbs and grasses.
Zone 5 much like Region 4 on Caseta – La Fe Trail – herbs abundant and ponds full – many tortoises there and very actively grazing on herbs and grasses.
Zone 5 to and including El Chato – all ponds and tiny ponds full, pampas full of lush green grass – tortoises grazing everywhere in open areas; very few tortoises in forested parts. Tortoises eating manzanillo apples with great gust even though plenty of other food is available.
16 April – to CDRS for Alcedo trip.
Was at Caseta from 23-18 June 1971 but hurt my foot badly and did not get much done at all-
24 June – around Caseta Pond #1 and Caseta:
#157 painted – just below Caseta.
#1293 – CL 60.4; CW 62.5. No algae, lichens or flaking disease. W.g.i.'s thin but clear.

(Pg. 35)
Unmarked ♀ - CL 82.4; CW 89.9; w.g.i.'s thin and incomplete; no algae, lichens, or flaking disease. Half way between pond and Caseta.
Around pond : ½ sample more or less –
#92 painted – CL 81.4; CW 88.0; w.g.i.'s thin but clear; no algae, lichens; few spots of flaking disease on rear.
#7 painted – CL 128.1; CW 137.6; black-green algae and flaking disease in usual area; no lichens; w.g.i.'s clear but very thin.
#101 – CL 103.0; CW 109.7; flaking disease all over front marginals and scattered on rear; w.g.i.'s clear and moderately thick; no lichens or algae.
#713 – CL 96.9; CW 102.5. No flaking disease, algae or lichens; w.g.i.'s as in #101.
#44 painted – CL 122.9; CW 130.5; w.g.i.'s clear but thin; flaking disease terrible and all over; no lichens; algae (black-green) in flaking disease areas.
#103 painted – CL 99.7; CW 109.8; no flaking disease, algae, or lichens; w.g.i.'s clear but thin.
3390 ♀ - CL 93.3; CW 102.2; no red mud; w.g.i.'s clear and moderately thick; scutes smooth in central 1/8-1/2; no lichens, algae, or flaking disease.
#'s 87, 84, 48 painted all in pond drinking and grazing.
26-27 June, 1971 – at El Chato –
many large ♂♂, a few large ♀♀ and smaller tortoises, but not near concentrations in garua season of 1969 and 1970 plenty of food and abundant green grass but . . .

(Pg. 36)
. . . apparently most tortoises are in higher and lower areas.
28 June – hobbled back to CDRS to rest my bruised foot.
In January and February 1971 Galo Torres walked over much of upper regions (of farms just N of Reserve Border), also included a few other sites below (within the Reserve Border). Distances given apply to distance above the Reserve Border, if a perpendicular was dropped to it (N-S) from where the tortoise was seen.

Tortoise Number and Sex	Location and Date.

450 ♂ on Reserve Border below property of Barrera; 21 Jan. 1971.
137 ♂ 250 m up on property of Barrera; 21 Jan. 1971.
53 ♂ 500 m up on property of Barrera; 21 Jan. 1971.
236 ♂ 600 m up on property of Oñate; 21 Jan. 1971.
372 ♂ 350 m up on property of Moreno; 21 Jan. 1971.
1241 ♂ 250 m up on property of Moreno; 21 Jan. 1971.
208 ♂ 200 m up on property of Moreno; 21 Jan. 1971.
441 ♀ 150 m up on property of Moreno; 21 Jan. 1971.
1102 ♂ 500 m up on property of S. Herrera; 21 Jan. 1971.
1044 ♂ on Reserve Border below Oñate property; 22 Jan. 1971.
331 ♂ on Reserve Border below Oñate property; 22 Jan. 1971.
98 ♂ on Reserve Border below Oñate property; 22 Jan. 1971.
103 ♂ on Reserve Border below Oñate property; 22 Jan. 1971.
785 ♀ on Reserve Border below Barrera property; 22 Jan. 1971.
254 ♂ on Reserve Border below Barrera property; 22 Jan. 1971.
783 ♂ on Reserve Border below Devine property; 22 Jan. 1971.
3 ♀ on Reserve Border below Devine property; 22 Jan. 1971.

(Pg. 37)
73 ♂ on Reserve Border below Barrera property; 22 Jan. 1971.
122 ♂ way up on property of S. Herrera – 2000 m; 22 Jan. 1971.
142 ♂ 500 m up on property of S. Herrera; 22 Jan. 1971.
728 ♀ on Reserve Border below Mantalvo property; 23 Jan. 1971.
Unmarked small one on Reserve Border below Mantalvo property; 23 Jan. 1971.
Unmarked larger ♀ Zona 6 pampas; 23 Jan. 1971.
726 ♀ Zona 6 pampas; 23 Jan. 1971.
707 ♂ Zona 6 pampas; 23 Jan. 1971.
1039 ♂ on Reserve Border below Maxcostillo property; 24 Jan. 1971.
Unmarked ♂ on Reserve Border below Maxcostillo property; 24 Jan. 1971.
636 ♂ Zona 6; 24 Jan. 1971.
Unmarked ♂ on Reserve Border below property of Carrion; 24 Jan. 1971.
1297 ♂ 100 m up on property of Moreno; 21 Jan. 1971.
321 ♂ 50 m up on property of Chappy; 21 Jan. 1971.
957 ♂ on Reserve Border below Barrera property; 21 Jan. 1971.
976 Reserve Border below property of Moreno; 21 Jan. 1971.
Unmarked ♂ Reserve Border below property of Moreno; 21 Jan. 1971.
210 ♂ Reserve Border below property of S. Herrera; 21 Jan. 1971.
124 ♀ Reserve Border below property of S. Herrera; 21 Jan. 1971.
103 ♂ Reserve Border below property of S. Herrera; 21 Jan. 1971.
Unmarked ♂ 100 m up on property of Divine; 26 Jan. 1971.
93 ♂ 500 m up on property of Divine; 26 Jan. 1971.
794 ♂ 600 m up on property of Marco; 26 Jan. 1971.
233 ♂ 600 m up on property of Marco; 26 Jan. 1971.
475 ♀ 800 m up on property of Marco; 26 Jan. 1971.
810 ♀ 800 m up on property of Marco; 26 Jan. 1971.
250 ♀ 800 m up on property of Marco; 26 Jan. 1971.

1067 ♀ 1500 m up on property of Divine; 26 Jan. 1971.
Unmarked ♀ pond at Salasaca; 27 Jan. 1971.
Unmarked ♂ foot of Cerro Lechoso; 27 Jan. 1971.
Unmarked ♀ foot of Cerro Lechoso: 27 Jan. 1971.

(Pg. 38)
Unmarked ♀ foot of Cerro Lechoso; 27 Jan. 1971.
Unmarked ♂ foot of Cerro Lechoso; 27 Jan. 1971.
890 ♂ Region 4; 28 Jan. 1971.
95 ♀ Region 4; 28 Jan. 1971.
415 ♀ Region 4; 28 Jan. 1971.
1103 ♂ Region 4; 28 Jan. 1971.
1087 ♀ Reserve Border area below Montalvo property; 29 Jan. 1971.
1000 ♂ 80 m up on property of Humberto Aldas; 29 Jan. 1971.
466 ♂ Zona 6; 29 Jan. 1971.
Unmarked ♂ 50 m up on property of Humberto Aldas; 29 Jan. 1971.
Unmarked ♂ 20 m up on property of Vicente de la Cruz; 29 Jan. 1971.
Unmarked ♀ Zona 6; 29 Jan. 1971.
423 ♀ 500 m up on property of Juan Guerrero; 30 Jan. 1971.
4 ♀ 800 m up on property of Juan Guerrero; 30 Jan. 1971.
223 ♂ 1000 m up on property of Juan Guerrero; 30 Jan. 1971.
Unmarked ♂ 1000 m up on property of Juan Guerrero; 30 Jan. 1971.
13 ♀ 2100 m up on property of Segundo Herrera; 2 Feb. 1971.
1102 ♀ 350 m up on property of Segundo Herrera; 2 Feb. 1971.
1297 ♂ Caseta area; 2 Feb. 1971.
1006 ♂ on Reserve Border below Oñate property; 2 Feb. 1971.
1171 ♂ Caseta area; 3 Feb. 1971.
245 ♂ Caseta area; 3 Feb. 1971.
New #1334 ♀ Reserve Border near Caseta; CL 67.0; CW 70.0; 3 Feb. 1971.
963 ♂ Poza de Manzanillos; 4 Feb. 1971.
New 1335 ♀ Zone 6; CL 95.0; CW 106.0; 4 Feb. 1971.
New 1336 ♂ Reserve Border nr property of Maxcastillo; CL 81.2: CW 84.3; 4 Feb. 1971.
266 ♂ Reserve Border near property of Maxcastillo; 4 Feb. 1971.
35 ♂ 600 m up on property of Marco; 5 Feb. 1971.
307 ♂ 1000 m up on property of Juan Guerrero; 5 Feb. 1971.

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136 ♂ 1000 m up on property of Juan Guerrero, 5 Feb. 1971.
810 ♂ 1500 m up on property of Remegio Barrera; 5 Feb. 1971.
304 ♂ 600 m up on property of Divine; 5 Feb. 1971.
1072 ♂ 600 m up on property of Divine; 5 Feb. 1971.
668 ♂ 800 m up on property of Cirilo Barrera; 5 Feb. 1971.
New 1337 ♂ 600 m up on property of Oñate; CL99.0; CW 104.0; 5 Feb. 1971.
233 ♂ 600 m up on property of Oñate; 5 Feb. 1971.
82 ♂ Reserve Border below property of Carrion; 5 Feb. 1971.

831 ♂ 400 m up on property of Marco; 8 Feb. 1971.
824 ♂ 600 m up on property of Esfien; 8 Feb. 1971.
284 ♂ 500 m up on property of Hernan Guerrero; 8 Feb. 1971.
727 ♀ 450 m up on property of Hernan Guerrero; 8 Feb. 1971.
748 ♂ 450 m up on property of Hernan Guerrero; 8 Feb. 1971.
841 ♂ 450 m up on property of Hernan Guerrero; 9 Feb. 1971.
667 ♂ 450 m up on property of Hernan Guerrero; 8 Feb. 1971.
725 ♂ 2000 m up on property of Maxcostillo; 8 Feb. 1971.
New 1338 600 m up on property of Esfien; CL86.0; CW 95.0; 9 Feb. 1971.
976 ♂ 500 m up on property of Moreno; 10 Feb. 1971.
377 ♂ 500 m up on property of Ramos; 10 Feb. 1971.
707 ♀ 400 m up on property of Chappy; 10 Feb. 1971.
710 ♂ 400 m up on property of Chappy; 10 Feb. 1971.
1253 ♂ 400 m up on property of Chappy; 10 Feb. 1971.
900 ♂ 400 m up on property of Chappy; 10 Feb. 1971.
223 ♂ 2000 m up on property of Ramos; 10 Feb. 1971.
1024 ♂ on Reserve Border below Cirilo Barrera property; 15 Feb. 1971.
1006 ♂ on Reserve Border below Cirilo Barrera property; 15 Feb. 1971.
450 ♂ on Reserve Border below Cirilo Barrera property; 15 Feb. 1971.
785 ♂ on Reserve Border below Cirilo Barrera property; 15 Feb. 1971.
45 ♀ 500 m up on property of Moreno; 15 Feb. 1971.
New 1339 ♂ Cerro Lechoso area; CL 60.0; CW 61.0; 16 Feb. 1971.
955 ♂ between Cerro Lechoso and Cerro Caballo; 16 Feb. 1971.
1202 ♂ 1000 m up on property of S. Herrera; 16 Feb. 1971.
98 ♂ on Reserve Border below land of Oñate; 16 Feb. 1971.

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1044 ♂ on Reserve Border below property of Oñate; 16 Feb. 1971.
668 ♂ on Reserve Border below property of Oñate; 16 Feb. 1971.
572 ♂ La Torta Nesting Area; 17 Feb. 1971.
1303 small La Torta Nesting Area; 17 Feb. 1971.
New 1341 ♂ La Torta Nesting Area; 18 Feb. 1971.
New 1340 ♂ La Torta Nesting Area; CL 65.0; CW 70.0; 16 Feb. 1971.

22 August 1971.
Notes from Julio San Miguel for month of July in G. e. porteri tortoise reserve – Note: will get some details of this month from Luis Albuja, student from Universidad Catolica, who is studying growth and deformities of porteri population now (July-September, 1971).
First Weather Data –
El Chato –

Date	Hour	Rain (inches)
1 July 1971	0900	1.50
8 July 1971	1030	1.80
15 July 1971	1300	0.60
29 July 1971	1200	1.25

(Pg. 41)
Region 4 of Canton-La Fe Trail

Date	Hour	Max	Min	Evap.	Rain (mm)
6 July 1971	1000	77	64	6.0	22.0
16 July 1971	1000	77	62	26.8	11.1
30 July 1971	0939	78	62	17.3	19.3

He changed paper and refilled evaporimeter on each date, reset thermometer and emptied rain gauge.
Zone 3 Nesting Area – Caseta – La Fe Trail

Date	Hour	Max	Min	Evap.	Rain (mm)
6 July 1971	1300	80	64	11.3	16.0
16 July 1971	1100	81	60	dry	7.9
30 July 1971	1100	80	60	29.8	14.9

Trips to various nesting zones and areas –
1 July 1971 – To El Chato, Zone 5 and Cerrito Nesting Area.
In Cerrito Nesting Area found following ♀♀: #1357, 1023, 1250, 1318, 862, 248, 161 painted.
#472 ♀ and #440 ♂ copulating in nesting area; no nests found. See Volume 14, Pg.20.
6 July 1971 – Zone 3 Nesting Area and below; no nests found; #127 ♀ in Region 4 ; in same area, #128 ♂ and #112 ♀ copulating. Luis along.
7 July 1971 – Naranjo, Zone 4 and El Chato – measuring tortoises.
8 July 1971 – El Chato - measuring tortoises.

(Pg. 42)
9 July 1971. = measuring tortoises near Caseta area.
13-15 July 1971 – to Cerrito Nesting Area, camped in Zone 5, measuring and checking tortoises.
13 July 1971 – #1128 ♀ and #1181 ♂ and #1182 ♀ and #505 ♂ - copulating in Zone 5.
14 July 1971 - #61 painted ♀ and #63 painted ♂ copulating in Cerrito Nesting Area. #1378 (new) and #52 ♂ copulating there also. Also found ♀♀ # 1064, 1000, and 65 painted there. Two nests, #2 and #3 for the year, both protected - #2 very fresh, perhaps last night. #2378 ♀ with fresh red soil on legs and rear areas, probably laid nest – very near it when found with ♂ copulating.
16 July 1971 – Zone 3 Nesting Area and below – no nests found.
20-23 July 1971 – trip to La Torta Nesting Area.
New #1388 ♀ - marked – just above barranco, rather on its S side . . .

(Pg. 43)
. . . above nesting area.
♀♀ in upper part of nesting area - #190 painted, #590, #591. (all 20 July 1971).
21 July 1971 - ♀♀ found in upper area – 3's 171, 524, 577, 579, 861, 1308, 1396, 1401, 1414, (last 3 new). Also found 4 nests here, #'s 4-7 for the year.
22 July 1971 – examining lower zone – found ♀ #851; nests #8 and 9 for the year.
On same date opened remaining nests in La Torta from 1970-71:

Nest #	Results

37 wall knocked down (by goats?) and pigs destroyed it.
47 all young escaped - shells indicate 9 eggs.
62 all young escaped – shells indicate 14 eggs.
67 all young escaped – shells indicate 10 eggs.
58 all young escaped – shells indicate 16 eggs.
49 8 young escaped; 10 eggs in all because in bottom (25 cm) 1 rotten, addled egg, and at 20 cm one live young one trapped under soil and a large plate rock. Nest 20 x 20 cm opening more or less. Young one to CDRS looks poor but perhaps will survive (see notes on page 45).

(Pg. 44)
** Found one more nest from this year[1970-71] (not marked or discovered before). With exit hole on one side – opened – all young escaped and sign of 9 eggs. This makes a total of 17 nests at Cerrito, 12 in Zone 3 Nesting Area, and 16 examined at La Torta – or 45 nests completely followed from laying till hatching; #37 above excluded due to pigs – good data on this since pig visited area after walls built around other nests and destroyed only this one - this wall very low also – regular corrals thus a real preventative to pig destruction.
27 July 1971 – Zone 1, measuring tortoises.
28 July 1971 – Chato, Zone4, Naranjo – measuring tortoises.
29 July 1971 – from Caseta to El Chato via guayavillo forest and Scalesia below Mora – measuring tortoises.
30 July 1971 – Zone 3 Nesting Area – found Nest #10 for the year; 100 m distance above main nesting area found ♀♀ #133 and #127.

(Pg. 45)
Small tortoise from La Torta – placed in G. e. porteri pen in tortoise house on arrival at CDRS, 23 July 1971. probably 4-4.5 months old when found trapped in nest.
22 August 1971 – weighed and measured this little fellow, painted #21 for 1970-71 group. SL 68.9; SW 58.9; H 37.6 ; CL 86.0; CW 88.0; Weight 69 g.
clearly deformed by long entrapment -= laterally compressed a few mm on right side and a notable concavity of 4-7 marginals and 2nd and 3rd costals on left side; also a bit compressed forward in rear of carapace but not much. See Roll 352, #'s 25-30 for photos of this hatchling.
23 August 1971 – checking through all reports from wardens to national Park officials for past 2 years – below will write down all things I have omitted from Santa Cruz note books.
4-7 August 1970 – Juan Black and Julio San Miguel covered a lot of ground around Tres Negritos, Cascajo and intervening areas – only saw 2 tortoises, both about 1 hour before Cascajo when heading to it from Tres Negritos – one large ♂ with a hole . . .

(Pg. 46)
. . . in #20 scute and 1 small animal of about 30 lbs – virtually no other sign - thus definitely human predation has done great damage to this area.
Trips by Julio San Miguel and Galo Torres in January – February 1971.
Galo Torres – 408 Jan. 1971.

4 January 1971 - #843 ♂ near where trail braches of Reserve Border to La Torta.
5 January 1971 – Manga of Segundo Herrera - #695 ♂ and 1 unmarked ♂ - up on land near house of S. Herrera - #67 ♂.
6-8 January 1971 – He walked all over by Cerro Salasaca, Cerro Santa Rosa, Cerro Corralon, Cerro Camote, Cerro Los Negritos – through pampa zone too – no tortoises seen at all.
Galo Torres – 15-18 January 1971.
15 January 1971 - #414 ♂ (painted #122) – on Reserve Border below land of Maxcastillo.
16 January 1971 - #516 ♂ - on land of Chappy Zone 4 - #984 ♂ and a large ♀ (unmarked) copulating.

(Pg. 47)
18 January 1971 - #898 ♂ on Reserve Border below land of Maxcastillo.
#798 ♂ on Reserve Border below land of Carrion.
12-15 January 1971 – Julio and Galo building wall around nests in La Torta.
♀♀ there - #'s 677, 587, 196 painted, 194 painted, 2 unmarked ones.
Also – found carapace of #609, slaughtered – above La Torta near barranco.
1-11 February 1971 – Julio San Miguel [Marginal note: see Volume 13, p 142 forward]
3 February 1971 – along La Torta trail to barranco – Tortoises #12 ♂, #266 ♂, #194 ♀ (female with missing leg); 2 small unmarked ones.
5 February 1971 – Zones 1 and 6 - #'s 406, 446, 410, and 1 unmarked – all ♂♂.
8 February 1971 – Naranjo - #'s 494, 759, 210, 675, 680, 677 – all ♂♂
Zone 4 - #'s 982, 660, 532, 97 – all ♂♂.
9 February 1971 – El Chato – Rain 0.30 inches; Tortoises #'s 1240; 1361, 192, 511, 204, 375, 284, 208, 130, 198, 485, 151, 168, 281 – all ♂♂. #'s 856 and 855 ♀♀.
Zone 5 – #'s of ♀♀ 402 (painted 65), 77. #'s of ♂♂ 681, 205, 291, 35, 139, 1188, 225, 68. Also #'s 708, 979, 507 and unmarked small one.

(Pg. 48)
10 February 1971 – Region 4 - #'s 890 ♂ (painted 77); 1103 ♂ (painted 82); 754 ♂ (painted 9). 0800 hrs – Weather – Rain 1.8; Evap dry, refilled ; Max 86; Min 67.

Zone 3 Nesting Area - #'s 1076 ♂, #918 ♂, #1144 ♂#131 ♀ (painted 39).
0830 hrs – Weather – Rain 3.0; Evap dry; Max 89; Min 66.
Galo Torres – late February – 6 march 1971.
26-28 February 1971 – To El Enlace (Tres Piedras??) where saw #1111 ♂ near Cerrito there and 1 ♂ Conolophus to NW of the Cerrito a ways – He also heard dogs in this area at 0530-0630 a.m. and is rather certain that they are wild. On return to Caseta on 28 February checked many tortoises:
New #1247 (♀?) – Zone 4 – CL 55.5; CW 56.5.
New #1348 (♀?) – Zone 4 – CL 67.0; CW 71.5.

(Pg. 49)
New # 1349 ♂ - between Zone 4 and Naranjo CL 153.0; CW 164.5.
New #1350 ♂ - between Zone 4 and Naranjo CL 78; CW 82.5.

New #1351 ♂ - between Zone 4 and Naranjo CL 58.0; CW 59.5.
New #1352 ♂ - between Zone 4 and Naranjo CL 70.5; CW 76.3.
#494 ♂ - between Zone 4 and Naranjo.
#899 ♂ - between Zone 4 and Naranjo.
#497 ♂ - between Zone 4 and Naranjo.
Also Galo Torres – 24-25 February 1971.
24 February 1971 - #767 ♂ - Zone 4; #680 ♂ - Zone 4; New #1346 ♂ Zone 4; CL 65.0; CW 64.5.
25 February 1971 - #535 ♀; #490 ♂; #858 ♂; #207 ♂; #227 ♂ - all below Zone 4 in ponds.
Galo Torres – 3-5 march 1971 –
#898 ♂ - Property of S. Herrera – 800 m above Reserve Border – 3 March.
#206 ♂ - Property of S. Herrera – 800 m above Reserve Border – 3 March.
#54 ♀ - Property of Moreno – 300 m above Reserve Border – 3 March.
#757 ♂ - side of Cerro Lechoso – 3 March.
#707 ♀ - Property of Ramos at 800 m above Reserve Border – 3 March.
#1264 ♀ - Trail to Juan Guerrero's – 800 m above Reserve Border – 4 March.
727 ♀ - Trail to Juan Guerrero's – 1000 m above Reserve Border – 4 March.
#643 ♀ -Property of Espinosa – 1500 m above Reserve Border – 4 March.
#40 ♂ - Property of Espinosa – 1500 m above Reserve Border – 4 March.
#140 ♂ - Property of Espinosa – 1500 m above Reserve Border – 4 March.
#1060 ♂ - Property of Espinosa – 2000 m above Reserve Border – 4 March.
#794 ♂ - Property of Icasa – 1500 m above Reserve Border – 4 March.
#708 or 308 ♂ - Property of Icasa – 1300 m above Reserve Border – 4 March.
#721 ♂ - Property of J. Guerrero 1000 m above Reserve Border – 4 March.
#838 ♀ - Property of J. Guerrero 1000 m above Reserve Border – 4 March.

(Pg. 50)
#1188 ♂ - between Zone 4 and Naranjo – 5 March.
#816 ♂ - between Zone 4 and Naranjo – 5 March.
#533 ♂ - between Zone 4 and Naranjo – 5 March.
#766 ♀ - between Zone 4 and Naranjo – 5 March.
#321 ♂ - Reserve Border – below Ramos. 5 March.

Notes from wardens, Julio San Miguel for August and September 1971.
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(Pg. 51)
[Page stapled in place of Pg. 51.]
Also for July 1971 – more information on trips to Zone 3 Nesting Area – encountered following 1971 hatchlings (notes for Basilio Toro).
6 July 1971 – 3 in area just beside weather instruments - #5 painted and 2 unpainted ones. All appeared healthy; cloudy afternoon – between 1300-1400; all actively walking along.
16 July 1971 – 3 more in same area (beside weather instruments); #3 painted and 2 unpainted ones; appearance as on 6 July. Cloudy – 1100-1200 in morning. All actively moving about.

30 July 1971 – 8 small ones; 2 without marks and #'s 2, 3, 4, 5 painted all in weather instruments area. Also 1 unpainted one, dead . . .
[Back side of stapled page (Pg. 51) -]
. . . here – decomposed but all parts present; no sign that was in any way killed or damaged by a predator. In part of nesting area just over rock pile found #17 painted, i.e. about 40-50 m from release site by straight line distance. Live ones all appeared healthy and all were active – found between 1100-1200, cloudy day.
Also Julio San Miguel tells me he has found during (July- October recorrido = surveys) 5 small painted ones in La Torta Nesting Area and "some" painted small ones in El Cerrito Nesting Area also.

(Pg. 52)
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(Pg. 53)
[Page stapled in place of Pg. 53.]
12 November 1971.
Fausto and I to Zone 3 Nesting Area – looking for small ones – found and weighed and measured following ones - 2, 3, 4, 17 by me; 5, 16, 12, 9, 20, 21 (last 2 remarked and painted today) by Fausto.
Measurements in mm; weight in grams.

#	SL	CL	CW	Weight	Location
2	123	141	156	288	20 m S of release point.
3	131	149	168	415	10 m N of release point.
4	129	147	164	385	5 m W of release point.
5	125	145	165	350	near weather instruments.
9	106	123	132	200	50 m SE of weather instruments.
12	112	135	147	260	40 m S of weather instruments.
16	123	141	155	300	3 m from weather instrument – nest.
17	122	139	158	305	30 m W of release point.
20	105	122	136	220	near weather instruments - only a few feet.
21	121	140	148	260	near weather instruments – only a few feet.

All these little fellows are at and healthy and have very clear w.g.i.'s – white and medium thick. Clear growth rings from past few months – very considerable growth!
Though much drier than April – May period and much less greenery still a lot of low herbs everywhere – abundant enough food to clearly keep them going. Garua only very occasional so water must mainly be coming now from plants; however garua was heavy in June – September period. Also saw #1020 – CL 59.3; CW 65.0.

End of notebook.

Isla Santiago (San Salvador) Notebook #1.
Field Notebook of Craig MacFarland

(Pg. 1)
5 August 1971 - To James Bay on "San Carlos". Arrived late and met Galo Torres who will stay here with myself and Mike Easton to show us much of tortoise area on James. Will go up tomorrow morning via their "campamento central" and highland pampas to camp at Poza Tragica.
6 August 1971. Started out from James Bay at 0930, loaded heavily (Mike and I each with about 50 lbs., Galo with 35-40 because most of his equipment is at P. Tragica). Passed near tortoise nesting zone A but did not enter it as have too far to walk today with heavy loads.
We are moving too fast to check much about altitudes or vegetation but will write some about this later when have more time. **First tortoise we saw was a med.- lg. Blind ♂ on top of Cerro Paraiso. CL 105.4; CW 117.5 alt here 400 m. (Thommens); #13,030. He was first found here in mid -August 1970 by Galo, Chappy, and P. Villa and was blind then. His eyes are somewhat swollen and completely shut and weeping, but only slightly. He is definitely completely blind as can be easily (Pg. 2) . . . determined by watching him move about in search of food and by approaching him - clearly he can not see at all. Watched him feed a bit - using smell a great deal, frequently dropping head to ground and sniffing as moves slowly along, and occasionally eating a small herb. He is clearly eating many Hippomane manzanilla fruits (droppings full). Galo says he is always here and seems to wander about in same small open area, covering a total distance of 80-100 m. diameter. Clearly he is finding enough to eat because has clear medium white growth increments. But is nearly all smooth and small for a large all smooth ♂. Also he clearly can find shade and sleeping burrows as is indicated by their presence and his droppings scattered in the area. Are a few small mud-holes with H20 in his wandering area also. (Pg. 3). . . Took some photos of him also - Roll 339 - #19 to end. Roll 338 - #13 to #17 (#12 nothing).**
[Editor's note: see subsequent observations on this animal - this notebook Pg. 29]
From C. Paraiso passed up through beautiful pampa zone seeing another 12 large ♂♂ scattered out over this area, most grazing, a few in ponds; thence passed down through forest and dense cafetillo bus to P. Tragica where again found 3 tortoises sleeping in brush near pond. Arrived 1830 very tired, ate little, and went to bed. Bloody wearing trip.
7 Aug. 1971. Heading from Poza Tragica toward Cerro Descanso along trail and its environs, checking tortoises en route -
#13177 ♂ (painted #42) Nearly completely smooth carapace scutes, about ¾'s smooth and outer borders very worn; CL 120.0 ; CW 134.0. Black - green algae all over rear of carapace in low spots and especially along scute junctures. A large patch of f.d. on supracaudal and b-g algae growing over this (collected some). Pale bright yellow-green algae scattered on shell I n low spots but light and rest well developed. Lichens - almost nothing - 3 small patches of crustose pale gray =green type on last rear marginals; small patch of green -gray foliose type on supracaudal. Collected some of (Pg. 4) . . .each. Ticks- none; but heavy infestation of mites [collected some] (same type as on Alcedo) all along plastral midline, all along hidden areas in rear, all along carapace skin border

anteriorly and in other such places as interior leg pockets, and holes and depressions along plastral scute junctures.
#13127 ♂ - scutes smooth over ½-2/3s of their area; CL 125.0; CW 133.0. No f.d., b-g and pale yellow - green algae as in previous animal; no f.d. lichens - same 3 types as previous one but restricted to first 3 marginals on each side in front. No ticks; mites as in previous animal. Painted #14.
#13194 ♂ CL 113.0; CW 123.3 Painted #59; Scutes smooth only in very central 1/8 or less but growth rings all well worn. No algae, f.d., lichens; no ticks and mites as in previous 2 animals. All 3 grazing in pampa - guayavillo parkland just SW of P. Tragica.
#13349 ♀ CL 84.5; CW 89.1. No lichens, algae, f.d. Very worn carapaces, but not entirely smooth - (Pg. 5) . . . smooth in central 2/3 - 9/10s. Strange shape - drops off gradually from middle of 3rd vert. All way back = like a ski slope. Took some habitat photos. Roll 340 , photos 4-10. (1-3 of hawks). Alt. Bit lower than P. Tragica and some 300 m toward C. Descanso from it - still Guayavillo parkland. She had only 1 tick of common type, near tail; no mites.
#13289 ♂ (#143 painted) CL 103.6; CW 109.0 Just beyond above ♀ - grazing in a similar area Habitat photos, Roll 340, #11-14. No lichens, algae, f.d. Very worn carapace, ant only central parts completely smooth. Mites as in #13127 - took some photos of these - Roll 338, #s 18-23 - shows rotting of skin they cause. W.g.i's clear and thin as in all above tortoises checked today.
#13104 ♂, CL 102.3; CW 105.2 No lichens, algae, f.d; worn but scutes smooth only in very centers. W.g.i's as above. Ticks: 5 of common type in fold of skin at carapace - skin juncture in rear; otherwise none. A small red tick or mite (probably latter, not seemingly attached) all over front and rear skin in little cracks between scales - both collected.
In guayavillo parkland - 300 m beyond above 2 - toward C. Descanso. (Pg. 6) . . . 8 more in same area- near rocky pondlet [Roll 340, #15-25+ - habitat photos of this area].
#13109 ♂ (painted 140) CL 125.4; CW 133.7. No lichens, f.d. - one old patch on supracaudal; both algae but drying and sparse; Ticks - none; mites all over as in #13177; no tiny red mites. Almost completely smooth. W.gi.i's clear but thin.
#13085 ♂ (painted #18) w.g.i.'s clear and thickish; quite smooth for size; about ½ - 2/3's of scutes completely smooth, rest very worn. No lichens, b.g. algae as in above one; no f.d.; Ticks and mites: as in previous animal.
#13355 ♂ (painted #28); no lichens; b.g. algae as in above 2; old f.d. patches in centers of 4th and 5th vert and supracaudal; very worn and mostly smooth scutes - central 1/3 - ½ smooth; w.g.i.'s clear and thin. Ticks - one of common type near tail in rear along skin /carapace border. Mites abundant in usual areas; no red ones. CL 115.0; CW 121.0.
#13105 ♂ CL 105.6; CW 109.1; No lichens; no algae; f.d. - one old patch on supracaudal and one on a rear marginal; w.g.i's clear and medium; scutes smooth in central 2/3's more or less; worn all over.
Ticks none; mites abundant in usual areas; some of scattered colonies of red mites in rear skin areas. (Pg 7).
#13118 ♂ (painted #147) Smooth in central 2/3 -3/4 and worn all over; w.g.i.'s clear and medium; no lichens; b.g. algae as in most lg. Males on front marg. And scattered in rear but mostly dry or drying. One large patch f.d. on supracaudal. Ticks: none; mites abundant as in others. CL 122.0; CW 125.5

#13103 ♂; CL 114.0; CW 125.0; w.g.i.'s clear and medium; nearly smooth - only outer ½ -1 ½ inches with growth ring remnants and these very worn. Only 1 patch f.d. on supracaudal and 1 patch on a first marginal in front. Algae - b.g. in rear end and on front marginals; yellow green abundant in a depression of 4th vertebral. Lichens - same 2 types in tiny patches on last marginal on each side and supracaudal. (Painted #41). Ticks: 2 of common type - 1 in rear, 1 in front at juncture of carapace / skin; no others or red ones; mites abundant.
#13233 ♂ CL 110.5; CW 118.4. w.g.i.'s clear and thin; scutes smooth save for outer 1.2 - 1 ½ inches; no lichens, f.d. algae. Ticks - none seen; mites abundant. (painted #37)
#13121 ♂; CL 123.3; CW 128.5; (painted #134) Abundant y--g algae in low points all over carapace - especially on front edges of 1st vet. Where joins 1st marginals. Lichens of 4 types - pale gray -green foliage, yellow crustose (word unclear) but greener similar foliose, and pale gray green crustose on front and rear (Pg 8) . . . marginals in protected areas- but all very small colonies. Collected these and took photos; pale gray -green crustose not collected. Front marginals - Roll 338 ; #26-28.; rear marginals - Roll 338 ; #'s 24-25. Almost completely smooth ♂. Ticks: none; mites very abundant, especially in inner leg pockets - much flaking and dead skin.
Around Poza Tragica
#13208 ♂ (painted 56) - smooth save for outer 1-2" of growth rings; w.g.i.;s clear and medium; no lichens, algae, f.d. Ticks- none; mites abundant as in others, but fewer concentrations. CL 118.0; CW 127.0.
#13060 ♂ (painted 44) - scutes as in previous tortoise; w.g.i.s same also; b.g. algae dense in rear 1/5 and front marginals; front marg. Quite upturned and small spots of both type of foliose lichens seen till now present on first 3 marg of each side. No f.d. ; ticks - same as in previous animals plus a few tiny groups of red mites. CL 120.5; CW 129.0.
#13242 ♂ CL 110.1; CW 115.9; scutes and carapaces conditions as in #13208 but large patches of f.d. on rear marginals (1st 2) on each side, supracaudal and last costals Nothing else - as in #208, front . . .(Pg. 9) . . .marginals not well protected from abrasion and therefore not any lichens probably. No ticks seen - abundant mites about as in #13060. w.g.i's clear and medium.
#13135 ♂ CL 124.5; CW about same - cant measure because scutes deformed and mixed up on right side. Almost smooth - outer 1-2 inches very worn growth rings; no lichens; both types algae scattered on front marg, in rear, and along scute junctures; f.d. - a few old scattered patches; Ticks none seen - mite infestation heavy in usual areas.
This entire area around P. Tragica and for some km to south, west and east is heavily guayavillo parkland with an abundant cover of grasses and or herbs below (1-2 dm. Only) and with many scattered water collection sites consisting of large blocks of surface plate lava with shallow areas in them where small pondlets form - these now all contain bits of standing H20 due to garua. Clearly could support many more tortoises than the scattered ones we encountered today - we certainly saw most because made count from 1100 -1530 when manly are active and saw some few on forest - cafetillo boarder but most in open spots in parkland, grazing. Saw only some 17 animals in about 6-8 hectares that we covered well.
Ticks and mites: have very few ticks here and most of the 17 sampled had none, but probably not to do finch tortoise mutualism because are plenty of tree finches in the area but (Pg. 10) . . . .few only of Geospiza fuliginoza / difficilus type and saw no tortoise /

finch interactions. - finches are all back in cafetillo bush anyway and saw only a few in open areas all day long! Mite infestation heavy on nearly every tortoise and a few had small red mites or ticks seen commonly on Tropidurus.
8 Aug. 1971. To camp about 1 hour above nesting zone C; will describe this trip below. Vegetation and terrain change was very great so am going to sample tortoises in open areas near campsite. [Roll 340; #26-28 hawk at P. Tragica; 29-end Cerro Lava and environs]. Terrain here is very open, with scattered guayavillos and Bursera, dense thickets of Clerodendron (word unclear). Altitude about 850 feet according to Thommens, whereas is 1140 at P. Tragica. Much soil and scattered rock pile and small barancos. Very much like Region 4 of Zone 3 Caseta trail on S. Cruz but much more of an open parkland, for kilometers. Camp is about 3 km. Directly north of nesting Zone B and along trail. (Pg. 11)
Tortoises examined:
#13320 ♂; about 1.5 km before camp on trail (to west) just after left rocky areas and entered open parkland. CL 112.5; CW 125.9; Completely smooth carapace; w.g.i;'s clear but thin; f.d. only in some old spots on underside of marginals and along scute junctures of marginals. Lichens - pale gray green crustose form on very back borders of first marginal on each side only; not well protected here and small patches only; yellow -green algae faintly recognizable in some places. Ticks - several of common type in hidden skin fold in rear (plastron / skin border); also common and translucent forms in small #'s in upper interior most parts of rear leg pockets; mites here also and mites in a few other spots along carapace/skin border in rear and along plastral scute junctions but not common. No others-= no red mites; ticks few; collected ticks.
#unmarked ♀ - CL 80.6; CW 86.9 - near campsite - grazing ; no lichens, algae, f.d.; almost smooth save for very outer edges of scutes; w.g.i.'s clear and medium. Later marked #13376. Ticks: no ticks or mites at all.
#13303 ♀ CL 82.1; CW 90.3 - all smooth; no lichens, algae, f.d.; w.g.i's clear but thin. Ticks: collected - only 9 common ones - all partly engorged and all save one (that on tail) in rear hidden area; mites - patches where rear marg. Join skin - 1st one on each side. (Pg. 12)
#13182 ♂ (painted 99) CL 93.6; CW 102.4; No lichens, algae, f.d.; w.g.i's very thick and clear; correction - f.d. on undersides of marginals; scutes smooth in central ¼ or less but very worn all over. Ticks: mites in typical places and rather heavily infested; no red mites; a few of common ticks, engorged ones in rear hidden fold and a few non-engorged ones on skin / carapace border above front left by pocket.
Of these 4, only 3 with ticks and only engorged ticks on more inaccessible areas such as rear hidden fold and interior leg pockets; other ticks not engorged and few and scattered; not any really large engorged ticks on any of them.
Plenty of Geospiza fuliginosa here - large flocks of ♀, ♂♂ and many juveniles - perhaps mutualism occurs given distribution of few ticks on these tortoises.
New Cerro Lava along trail at 950 ft. caught a ♂ Tropidurus and collected red mites from him. Also caught a Dromicus and examined but no ectoparasites. (Pg 13).
9 August 1971. Leaving camp at 0800- Alt reads 930 ft. (should be correct) - to C. Pared and nesting zone C.
#13143 ♀ CL 95.1; CW 105.2; All smooth; w.g.i's clear and medium; no lichens, algae, f.d., very old and large - about 350 m below camp toward El Pared. Altitude here reads

850 ft. Ticks: Some engorged common ones in hidden folds; unengorged smaller ones along carapace / skin border near tail; no red mites; small black ticks (collected a few, in interior rear leg pockets; mites in usual spots on plastron and around borders of skin and marginals in rear. [Marginal note: In grassy pampa- grass to .5 m high and dry]. Mites forward also. Ticks collected.
#13305 ♀; CL 89.8; CW 95.7; Almost all smooth but for very outside border of scutes, which are well worn. No lichens, algae; f.d. only in one old patch in center of supracaudal. W.g.i.'s clear and thickish. Ticks - no mites; small common one around tail and hidden area in rear; small black ones in interior leg pockets in rear and above neck in front - but very few collected ticks from this one and previous ♀ and combined.
[Marginal note: In grassy pampa full of high (up to .75 m) dry grass].
No real evidence either has laid yet. This one at 835 ft - not far from C. Pared. (Pg. 14).
At El Pared - found only one nest in large open area of soil just to east side of it - very disturbed area - much erosion due to goats and very poor soil - yellow brown powdery type; many disturbed area of diggings caused by pigs (recent!).
Nest - a rock in right side of center almost. Deepest 21.5 cm at base of undercut - undercut 6.5 cm deepest in center and extend 2/5s of way around only. Rock - 18.5 cm deep. Hole about 18 cm wide - 10 cm. long at surface opening. Full of eggs - 9 in all - 6 +, - all in bottom of nest in one layer - some 2 in under undercut, other 4 in central part of nest; 3 other eggs lying on tope of these - one at 9.5 cm. below soil surface, 2 others 10.5 cm down. No real hard cap - just moist soil mixed with about 3 large droppings; still moist just below surface. (Pg. 15) . . . . but drying; can see fresh yolk in all the eggs.

Measured eggs:	mm	mm
1	61.3	56.4
2	60.6	57.8
3	62.3	56.4
4	60.4	56.4
5	60.9	56.4
6	61.0	57.2
7	61.2	57.9
8	62.0	55.3
9	65.0	57.3

Photos of nest and area - Roll 341, #'s 1-23. Closed nest and remade cap a bit. (nest #6 for this nesting zone)
Alt. 840 ft.
In a grassy pampa just 50 m distance below nest- #13307 ♂ (painted #106) CL 121.8; CW 127.4. Almost completely smooth carapace scutes; w.g.i.s clear and thick; no clear algae; covered with lichens = see below; f.d. in a few old spots scattered on shell.
Lichens: see Roll 341, #24 - end and roll 341, #'s 1-10 for photos; first 3 marginals on each side in front covered with a great variety of crustose forms of lichens; also (Pg 16) . . . .a few spots on first vertebral and first costal on each side at front borders. All this area well protected because front marginals and flared up very much - approaching sort of saddle-backed form. Also a few spots of pale - gray - green crustose form in rear - i.e. - 1st and 2nd marginals beside supracaudal on each side, rear border of nest to last rgt. Costal, last left costal; also a few spots of same on lower edges of 1st and 2nd rgt costals.

Collected pieces of as many different types as I could detect visually - at least 3 species I think. Roll 342 photos 11-20 of his shape.
Ticks - mites dense all over rear, in usual area; common ticks, (engorged a few) and unengorged along skin carapace border above tail around tail and in leg pockets. But few in total. Nothing else. Collected some. (Pg. 17).
Roll 342 - photos 21 - end and Roll 343 photos 1-10 of nesting areas C and surrounding hills taken from Cerro Corona.
Nest #4 and 8 found only some 4 m apart just north of Cerro Cumpleaños. Whole nesting area here is covered with recent pig sign and much digging by pigs; lots of old destroyed nest all over the place. Am very impressed by lack of small tortoises. Found only 1 - near Cerro Cumpleaños, #13366 (painted #107), CL: ; CW ; probably some 4-8 years old. Galo says he has found only one more of this size in NA C. - one near Cero Pared, 2 of this size in nesting area D and 1 of about ½ or 1/3 this size in NA Zone A this year - last year they found almost none at all of these smaller sizes. Area C is basically an old lava flow like that of Sullivan Bay but with much yellow-brown sandy or pebbly soil filled into the low places, with (Pg 18) . . . rolling lava in between these little soil- filled pampas. ;the pampas or nesting sites are now full of dry grasses (mostly Cenchrus) and herbs from March 1971 rains. Total potential # of nesting sites here is huge but obviously few nest (as would be expected from depleted tortoises population). Pigs have certainly ensured low reproductive rates here and this diggings plus lack of small tortoises attests to what they have caused.
Roll 343 #'s 11-16 of nest #7 and part of nesting zone C.
Opened nest #7 from tiny hole in one side - a beautiful round hole with a shallow ½ circular undercut of depth of 6-7 cm. Max. depth fairly even as were no rocks at all in bottom - 28.5 cm. Nest cavity roughly 23 x 23 cm. [Marginal note: Add 1 cm to all measures due to loose dry soil on top.] 7 eggs; 5 all on bottom, rather fully occupying space but clearly space for 1 egg to fit in if squeezed or parts of 2 more. Top of these eggs really at about 231 cm. because some 9.5 cm of tortoise droppings covering floor of the nest. Two top eggs are resting in interstices of bottom 5 in center of cavity - at about 16.5 cm to their tops. Very fresh nest but soil makes a terrible hard cap - loose though still moist. Room for more eggs (at least 3) in upper layer - otherwise nest rather full. Hard cap full of tortoise droppings - probably use to aid in making it more durable since soil is so pebbly and loose. Eggs all about 63 x 63 cm. roughly, large, and round. Galo says these 2 nests not here when he checked all on July 28, 1971.
Nest #1 - only some 30 m away - same type of soil - not opened - hard cap full of tortoise droppings.
Nest #8 - opened also - did not take many measurements- no rocks in bottom at all - uniform depth - greatest depth 29.5 cm., but 1 cm of compact tortoise droppings in bottom. 4 eggs in bottom at 28.5 cm (bottoms) but easily space for 2 more eggs if placed properly. (Pg 20)
One egg above these, top at 18.5 cm. and space for several more in this layer. Very thick hard cap right down on top of eggs - consists of wet pebbly soil and much tortoise fecal material mixed together. Nest very fresh and still moist. 5 eggs total, all well formed and yolk clear, large and fresh still.
We checked around rest of nesting area C briefly, as far as Cerro Cumpleaños to SW and Cerro Pared to NW Area basically all the same - bits of pampa scattered everywhere

amongst rolling blocks of piles of lava. Am impressed by fact that there is a clear tortoise trail (1.5 - 2 m wide) leading directly from near where we are camped into N.A. near El Pared and from there on down into area near Cerro Corona where a number of tortoise trails branch out all over like (Pg. 21) . .. . a network into small open areas which make-p this nesting zone. There is tortoise fecal material in great abundance and of varying ages all along these trails. Galo says these trails were here when they came last year and the used them to find the nesting areas; they are clearly tortoise from the width and extent to which the lava is worn. Galo says tortoise are frequently seen going up or down on these trails. The trail follows the easiest rout - i.e. mainly follows low earth filled areas and avoids lava as much as possible.
He says there are other trails like this one leading from general direction of Cerro Descanso into nesting area C.
Other nesting zones: (According to Galo)
Zone B - yellow - brown soil like zone C, but even more sandy and pebbly; structure of zone same.
Zone D - yellow- brown soil also but less sandy / pebbly and of a structure such that nest hard caps are more durable; structure of zone same as other 2.
Small tortoise #13366 - CL 39.6; CW 41.4. No lichens, algae, f.d.; scutes not smooth at all and v.g.i.'s clear and medium - looks exactly like a S. Cruz specimen of same (Pg 22) size. Ticks - a few of tiny black type in interior of rear leg pockets but none others.
10 Aug 1971. Took some photos of #13182 young ♂ to show shape - Roll 343, #'s 17-28.
Photos similarly of #13303 ♀ - Roll 343, #'s 29-32.
#13279 ♂ CL 85.1; ;CW 85.0; Near camp; took photo of shape because is very sloped and depressed in rear - Roll 343, #'s 33-36. w.g.i.'s clear but thin; scutes smooth in central ½ - 2/3's. No lichens, algae, f.d. Ticks: a few of translucent type in rear interior leg pockets; no others; mites dense in usual areas.
Photos of #13376 ♀ for shape - Roll 344, #'s 1-5
#13248 ♂ CL 97.2; CW 104. 6. No lichens or algae, w.gi.i's clear and medium; scutes very worn but smooth only in central 1/3 or less; Old patches of f.d. in centers of rear 3 vertebrals.
Ticks: none seen; abundant mites front and rear in usual sites. (Pg 23).
#13074 ♀ CL 88.4; CW 102.5; Almost all smooth ♀; w.g.i.'s clear and medium; no lichens, f.d. or algae; Ticks: only small black type in interior rear leg pockets; none others. Mites dense on skin /carapace front border and same in rear above tail along 1st marg. Reach side of supracaudal. Photos of shape - Roll 344 - #'s 6-14. Above 2 100m along trail west of camp.
#13202 ♂ CL 96.4; CW 103.5. Another 75 m along trail from previous 2. Smooth in central ½ or less of scutes; w.g.i's clear and thick; no algae or lichens; f.d. - old spots of it on last 2 vertebrals, supracaudal and scattered elsewhere.
Ticks: few of tiny black ones in rear leg pockets; common one full of blood just above tail at skin/carapace border;; mite infestation heavy in usual area.
Photos - roll 344, #15-22.
#13081 ♀ (painted #105); w.g.i.'s clear and thin; all smooth; very flattened oval carapace shape. See Roll 344, photos 23-30. No lichens, algae; only old f.d. along some scutes junctures in rear. Just beyond above tortoise. CL 88.0; CW 96.0.

Ticks: a few translucent and many of tiny black ones [marginal note: collected (tiny black ones only)] in interior rear leg pockets; very minor mite infestation along 1st marg. Each side of supracaudal where meet skin. (Pg. 24).
#13244 (or 144) ♀; CL 87.9; CW 101.4; (Painted #72); all smooth, very worn and old shell. Scratches indicating recent copulation attempt. W.g.i.s clear but thinish 1 km. On trail to west from last 2 animals. No lichens, algae, or f.d. Very dented, and scute junctures beginning to widen in rear. Ticks: (common one along plastron) skin border in front below neck; tiny black ones and a few translucent ones in near leg pockets; mites - none seen on front; a few patches along marginal / skin border just to either side of supracaudal.
Very similar shape to tortoise (lg. ♀♀) on S. Cruz of this size and sex. See Roll 344, #'s 33-36. This area has less of pampitas and more trees and rocky ground - is about 100 ft alt. Above campsite used for past 2 days.
#13034 ♂; CL 123.1; CW 130.8; Huge ♂; scutes smooth only in central ½ or less; no lichens; some dry of both types of algae on front marg. And rear of (Pg 25) . . . . shell; f.d. restricted to a few tiny scattered spots; w.g.i.'s clear and thick. Took many photos - some to show shape - Roll 345- 15-end. (1-14 of Geospiza magnirostris) (Could be #134)
Ticks: a few mites in front and rear along scute/skin border (carapace) and some few common ticks in total some 2 near tail, one below neck in front none engorged.
Near where trail starts across lava of Cerro Lava going to west. Altitude here is about 950 ft.
As compared to campsite which was about 900-920 feet and base of Cerro El Pared which was at about 840 feet.
Roll 346 - #'s 1-+,-29 of lichens on trees; 30 - end of #13242 ♂ at Poza Tragica
Roll 347 - #1-25 - #13242 ♂ at P. Tragica; #'s 26-29 - young hawk at P. Tragica;; 30 - end - #13224 ♂ at P. Tragica.
Roll 349 - #'s 4-11 - #13224 ♂ at P. Tragica; #'s 1-3 - #13242 ♂ (Pg 26)
#13224 ♂ (painted #57) - carapace very worn but smooth only in very central 1/10 - 1/8 or less; no lichens; no algae; f.d. in old spots in centers of 2nd and 3rd vertebrals; w.g.i.'s clear and medium; Ticks - a few of common type in hidden area; no others seen; mites dense along skin/carapace border above neck and along first 2 marginals on either side in rear next to supracaudal; CL 97.8; CW 103.2
#13129 ♂ CL 128.2; CW 133.3; (painted #55); almost entirely smooth save for outer few cm around dorsal scute borders; w.g.i.'s present but incomplete and very thin. Algae - both types - yellow - green type very bright and much on first marginal in front on each side and front border of first vertebral; also distributed all over rear ¼ of carapace; b-g. in same places especially thick in rear along scute borders; both types also (Pg. 27) . . . scattered along scute borders all over carapace. Collected bright yellow-green type. Lichens - 1 patch of a rather bright green foliose form on last vertebral; bits of pale gray - green crustose form on last right costal; bits of pale gray - green foliose form on last vertebrals and on border of first marginals with first vertebral. Collected first and last types listed. To dark to photograph anything. [Marginal note: Also collected some flaking apparently diseased scute (front marg.) material from this one.
Ticks: none seen; common mites dense in usual area; red mites dense in scale cracks on all 4 legs, but esp. in rear.

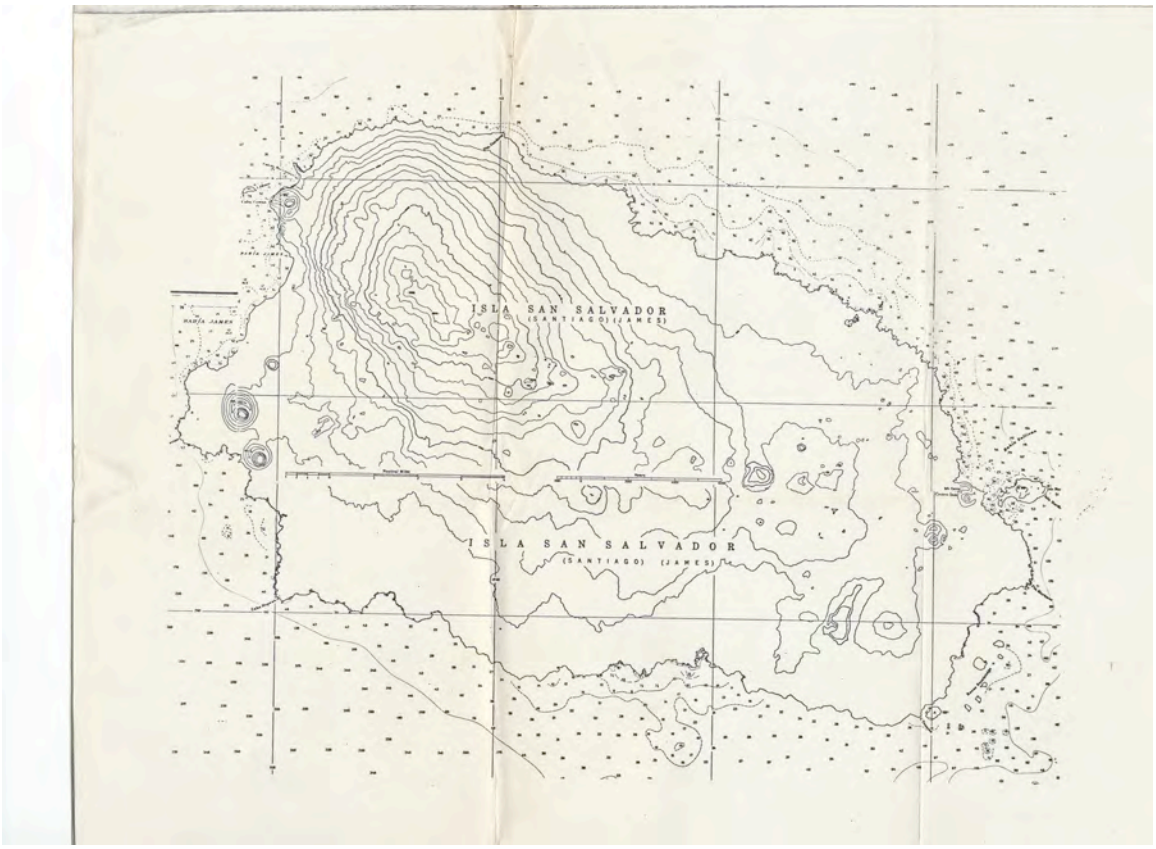
#13193 ♂ CL 115.6; CW 120.1; (painted #132) all smooth. Only one lichen patch - p. gray - green crustose from on 2nd right front marginal; f.d. - a few spots on front marginals and scattered on rear 1/5 especially along borders of last vert and where it joins supracaudal and last marginal on each side. B. g. algae dense on rear area along scute junctures - see Roll 349; # 33-36.
Ticks: none seen; mites same as in above animal, both types; red ones not as dense and only on rear legs and outer tail surface. (Pg 28).#13017 ♂ (painted #16); CL 110.1; CW 117.3; very worn carapace, but only central 1/3 - ½ of scutes really smooth ; no lichens or algae; f.d. in one large patch on supracaudal; w.g.i's clear but thin.
Ticks: a few common one around tail and in leg pockets = none engorged; mites - only along marg. ; skin border on either side of supracaudal and not dense at all. Roll 349, #13-32 of pampas near P. Tragica with tortoises - (word unclear) environment.
#13290 ♂; CL 125.5; CW 135.2; all smooth; found dead - fell off a small rise and onto back on top of a plate rock sitting up at a 60 degree angle and with rear leg pocket against a guayavillo trunk - could not turn over and apparently starved - see Roll 350, photos #1-12. Near P. Tragica - not dead long - all scutes still on but bones clean; only some of leg (Pg. 29) bones and pelvis scattered; in an area with much pig sign right around - therefore pigs did not destroy as claimed by Black and Villa. Lichens similar to that on #13129 on first vert front border and 1st right front marginal - collected these.
To camp in pampas.
12 April 1971.
#13032 ♂; CL 136.2; CW 140.3; Near a small pond just southwest of campamento central- Galo says he is always in high pampas near this camp. All smooth scutes, no lichens, no f.d.; b-g algae scattered lightly in usual areas. Extremely low, flat and wide - very much like a few El Chato tortoises on Santa Cruz. No ticks at all; a few mites on rear marginal / skin borders near tail underneath, but very few. See photos Roll 351 - #'s 1-10
#13030 ♂ - blind one has moved some 200 m to large open pond / pampa near C. Paraiso. Eyes now open and can see clearly and well today and both eyes are open. No ticks or mites, or lichens; both type algae common in usual areas. See photos - roll 351, #20-22; others are of pampa/pond at C. Paraiso.
[Editor's note: see notes originally made on this animal Pg. 1-2, Santiago notebook] (Pg. 30)
#13154 ♀ probably; scutes mostly worn and smooth but still growth rings throughout. F.d. - old patches on 2nd, 3rd, and 4th vertebrals; no lichens or algae; at pampa on side of Cerro Paraiso. W.g.i's clear and medium thick- clearly growing well.
Ticks: none; no mites either- looked well - not even any dry skin indicating previous mite infestations. Photos - Roll 251 l- #'s 23-28 for shape - just like S. Cruz tortoises of same size; CL 78.5; CW 84.7.
All the following ♂♂ were checked in the pampas this morning and recorded then in temporary notebook (raining):
#13161 ♂ (painted #73) CL 126.0; CW 125.5. In Pampa Larga at about 560 m. No lichens. Both types algae prevalent in usual places. Old patches f.d. on last 2 vertebrals and supracaudal. A few of common (Pg. 31) . . . ticks in rear around tail, non-engorged; mite infestation moderate at carapace / skin juncture along last marginals in rear.

#13158 ♂ (painted #76) CL 129.0; CW 131.5. In Pampa Larga also, 560 m. No lichens, both algae types light in usual areas. NO ticks; mites in mild patches in usual areas in rear and carapace / skin border above neck in front. Also light mite infestation in rear leg pocket interiors.
#13006 ♂; CL 141.6; CW 146.3; (painted #74) In Pampa Larga also, 560 m. NO lichens or algae; a few common ticks around tail in rear and in rear leg pockets; no f.d.; mites very light only on borders of last marginals either side of tail.
#13051 ♂ (painted #80) - CL 131.7; CW 146.5. In central pampa at 650 m. No f.d. light covering of bright green algae (Pg. 32) . . . .
in usual places. Small patches pale gray -green crustose lichen on fist marginal on each side. No ticks, mites as in previous tortoises.
#13361 ♂ (82 painted) - CL 114.9; CW 123.3 - in central pampa at 660 m. NO lichens, algae; old spots f.d. on rear 3 vertebrals and supracaudal. No ticks; mites in some abundance front and rear in usual areas.
#13241 ♂; (painted 81) - CL 91.8; CW 97.0; In central pampa at 660 m. also. No ticks or mites; no lichens, algae, or f.d.
#13157 ♂; (painted 79); CL 127.7; CW 141.0; In central pampa at 635 m. Lichens - a few small patches of gray -green crustose form on first front marginals in front, fore edge of first vertebral and in rear on last costal each side; pale (Pg. 33). . . . gray - green foliose form in last areas also, but very tiny colonies. Ticks: a few common ones on tail; mites - heavy infestations, front and rear in usual areas.
#13009 ♂ CL 122.6; CW 126.5. Pampa - 610 m. No ticks or mites; not lichens, algae, f.d.
#13160 ♂ CL 119.0; CW 135.0; Pampa - 610 m. No ticks; mites as in #13006 ♂; f.d. on old patches on last 2 vertebrals; no lichens; both algae species light on usual areas front and rear.
Some other notable observations- Pepe Villa told me recently of a large ♂ G. e. darwini with they found in July 1971 on James which had obviously fallen onto its back and badly injured itself, or at least something such as a block of lava fell onto it, causing a deep smashed in wound on the last right costal scute. The wound was about 12 x 10 cm. in size and 4 cm. deep with the laminae and bone of the carapace completely broken through and traumatized. However, there was no bleeding going on when the tortoise was discovered and the wound was healing well and apparently not infected. (Pg. 34)
I showed Daniel Weber Pepe Villa's map of James from last years National Park work there - he thinks it to be basically correct in most details but that the pampa Region is overextended on the north side (see correction made on my map according to Weber). Weber's opinion is that the huge central highland pampa is largely an artificial one, crated mainly by action of the pigs, i.e. they keep the ground nearly continually disturbed thus favoring annuals and herbs and strongly selecting against reproduction of trees especially, and most shrubby species. The exception to this is Psychotria which occurs in great density in patches through the pampa zone, this being a species which pigs, goats, and donkeys do not apparently eat.
Weber does not seem to think so, but the same argument could be applied to the guayavillo - parkland pampas of the Poza Tragica altitude zone.
Weber has indicated that to the North West of the pampa areas, in the (Pg. 35) . . . highest areas, the vegetation is moderately dense, consisting mainly of forests of

Xanthoxylum and Croton with an understory of Psychotria, also with dens thickets of Psychotria (no trees) and small open spots covered with grasses and herbs. He is certain in these highest areas that the pigs have created these tiny "pampitas" because he has seen areas when they have killed from a few to a few dozen Xanthoxylum trees by cleaning around their roots and causing them to topple over.
Tortoises probably created and maintained pampas on Santiago as on S. Cruz but only small ones that were scattered about - also probably more parklands than completely open pampas.
Weber has not been down below the summit of Cerro Pelado but de Vries has and he indicates that just below the summit the vegetation begins to be that characteristic of dry, arid zones and that this continues on to the coast - i.e. much Pal Santo, dry bushes, and rather open (de Vries went from Buccaneer Bay to Cerro Pelado's top in 2 hours at a steady moderate pace. (Pg. 36).
The dry conditions also prevail not far below the highest peaks on the north side, NNE side, NE side and east sides also (this can be seen from Villa's map of extent of pampa and guayavillo park land zones on due east side.
Weber has never seen tortoises in the Cerro Espino through Cerro Pelado highlands area at all. However, he found a slaughtered one in 1967 [marginal note: medium - sized; scutes already gone; sex not determinable; pigs had not eaten it] not far above the water formation on the west side (see location on my map) so tortoise must have or might still occur in this area infrequently. They certainly must at one time have occurred all over lower and middle slopes on north, NW, and west sides and perhaps on NNE and NE sides also. Weber never saw any pile of bone indicating previous oil hunter's activities but that is not surprising considering the (Pg 37) . . . intervening time periods.
Villa's elevations, taken with a pocket sized Thommens seem a bit high- (but consistently so) but the various locations are correct on the map so that the proper altitudes can be extracted from the map.
The large area on the Southwest through East -Southeast sides between the guayavillo parklands and the upper large pampas consists mainly of forest of Xanthoxylum with a thick understory of Psychtria. The vegetation here is very dense, with other shrubs, lianas, vines, herbs etc. Extensive large areas of nearly pure Psychotria shrubs are also present. The workings of pigs are prevalent though out all this area, but especially more prevalent in pampas above and guayavillo parkland below.
Hippomane mancinella trees are scattered everywhere thoughout the guayavillo parkland, they are dense also in the Cerro Paraiso area and the upper lava areas leading to tits base and there are some also in the highland pampas. (Pg. 38) Tortoises were still eating these and had been eating them in great quantities before as indicated by droppings. Most of the eaten fruits were well digested.
Psidium areas most common in the guayavillo parkland belt but there were also trees of it (small windswept ones) in the upper pampas (reaching heights of only 10-15 feet mostly). The tortoises were eating their fruits in abundance also and digesting them well mostly but some droppings continued unscathed, passed apples. Psidium trees were also common down to about 250 m. on trail to nesting zone C - i.e. just above Cerro Pared. Pigs were eating the fruits in huge numbers also.
Opuntia was very scarce everywhere. On ascent to base of Cerro Paraiso from James bay we saw very few adult trees, scattered young ones up to 2 - 2.5 m. (Pg 39) . . . tall and

scattered very young seedlings. The seedlings and younger one are covered with very dense, stiff spines. Conditions were about same through areas from above Cerro Lava along trail to nesting zone C, but very, very scattered and few Opuntias, all sizes included.
After passing out of guayavillo parkland on trail, not far from P. Tragica crossed lava for a long time before reached Cerro Lava fresh flow and for another 30 minutes on other side of the fresh flow - these area covered with very little in the way of herbs or shrubs, scattered only, Bursera trees, Guayavillo trees, Pisonia trees, Cordia trees, and few Erythrina trees - not good tortoise habitat and saw only one in entire old lava flow areas. Then passed into open soil filled areas which occur north of nesting zone B all along trail and continue thusly to nesting Zone C. These areas very open with lots of small dry herbs and grasses, scattered guayavillo trees, scattered Bursera trees, and dense thickets of (Pg 40) . . . Clerodendron molle. There are lava piles all around these area - i.e. it is an old lava flow with the lowest areas filled in with soil.
Nesting area itself is made up of hug soil filled areas with hills and barrancos, and lava scattered around. These areas are now covered with dry or semi-dry Cenchrus grass, Cassia, and other grasses and herbs. But all of this clearly a result of last heavy rains (March 1971) and Galo Torres says area was very barren soil last year.
Tortoise pathways indicated by P. Villa on map both in green, lush zones and into tortoise nesting areas seem to be correct. I saw only those leading into nesting area C but they were wide, clear, well formed tortoise paths with abundant droppings all along them. Very clear paths. From questioning Gal Torres seems that these others (Pg. 41) are also very clear in similar fashion. Also certainly are other pathways which Galo knows of and the terrain makes it likely that these are mostly pathways into nesting area from higher zones. END OF PAGE 41

-Rest of notebook blank except for included loose map of Santiago (appended below) showing bathymetric features and general topography of island (no notes made on map) and a loose sheet with following notes on it:
Interview Pepe Villa about James - see list on Santiago 1970-71 sheets.
Also ask about total dist. (distribution) of tortoise; Chappy's knowledge of vegetation before; lichens on tortoises in highest areas; large injured ♂; veg dist. (distribution) on N to NE sides. Soil and conditions in other nesting area.
Get complete 1971-72 data from Galo Torres in October or before. End of Notebook.


ISLA SAN SALVADOR
(SANTIAGO) (JAMES)
ISLA SAN SALVADOR
(SANTIAGO) (JAMES)

Isla San Cristobal Notebook #1
Field notebook of C. G. MacFarland

(Pg. 1) On leaving coast set Loftt altimeter at 0 m, at seaside at 1500 hr. See notes of 22 Sep for details of this instrument.
21 Sep 1970 – Arrived at small bay on NE side of San Cristobal from which terrapin Road commences at 1400 hr. We arranged things for transport a bit and struck out for inland area along easy burro trails toward eastern edge of Pan de Azucar mountain. This pathway was running more or less SE. At Pan de Azucar's NE edge we circled it a short way and turned more or less due S. We immediately left nice completely soil covered areas and began crossing slowly rocky, but worn, rope and similar types of lava; this had a fairly dense cover of Xanthoxylum, Bursera, Piscidia, and Croton with some scattered Scutia, Acacia, other spiny species and Waltheria and Scalesia and Jasminocereus. No Opuntia through these areas at all. The lava all through this area was very interesting because it appears as if tortoises at times in the past may have crossed it in great numbers in a generally N-S running direction (as well as pathways in other directions). It has been noticeably worn and smooth by action of something along many pathways. However, these are not as clearly highways as I have encountered on Santa Cruz; in the latter case the highway is always a clear, smoothed pathway usually on a meter to a few meters wide and the surrounding rocks (Pg. 2) are all well jumbled and not smoothed at all. Thus it is clear on Santa Cruz that animals have made them, and I, of course, have seen the extensive use of them by tortoises and abundant tortoise droppings along them and not in the rough areas surrounding them.
Here on San Cristobal in this area such previous use is only a guess. We saw no tortoises and no sign all through these areas. Also, the lava in an overall sense is not nearly as jumbled and broken; it is all rather gently rolling and extensively smooth by weathering and with much gently rolling rope and similar types of lava. Anyway it looks to one as if tortoises have aided in smoothing this lava extensively, so will have to make further observations later.
Continued on to a campsite on flat lava rocks inside a small, collapsed, tiny rater where we were forced to stop at 1800 hr because of approaching darkness. (Pg. 3)
Altitude here was 125 m (taken at 0700 next morning, 22 Sep 1970). Not to bad a surface to sleep on but much harder than soil; about the same as a floor made out of Piscidia logs.
22 Sep 1970 – Next morning we set off in search of large pond which J. Black and company used as campsite area on last trip of 24-26 Jan 1970. This is rather centrally located in rocky pampa, upland area at this end of San Cristobal, which is the main area for the still feeble but extant population. We headed more or less directly SE and after about 1 hr of crossing lava and vegetation very similar to that described for yesterday's hike from Pan de Azucar to campsite, we came into the border of the tortoise population area. I will describe this more fully after I have seen more of the area. For now I only note that as we entered it the amount of soil patches, mixed into the generally rolling and somewhat broken but worn lava, increased from virtually nothing (*over our entire hike till now) after leaving Pan de Azucar) to about 10-20 of surface area of ground, varying

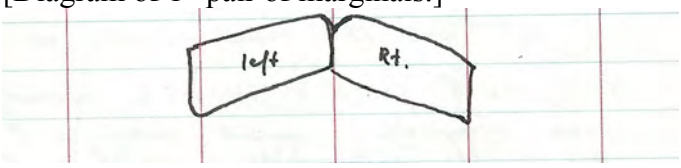
from place to place. (Pg. 4) Very quickly we began to note dozens of tortoise turds, mostly months old, but some from past 1-3 weeks, scattered about all over. Burro sign and freshness also sharply increased but we have seen burrow sign all way from coast, i.e. everywhere we have been till and including now.
J. Black soon recognized this first area beyond the rocky area we had crossed as being on the edge of the rocky upland pampas and as being a portion of the tortoises and burro's main highway toward Cerro Setenta, to the SW, there the one tortoise nest was found last Jan. It was then only a 15 min walk to the large ponds and we established our camp.
In this first tortoise area just before turning SE once again to head for camp we found one tortoise:
New #15,115 ♂, CL 94.0; CW 92.5 (Pg. 5)
Under a Castela tree resting; not sunny yet today (now 0900) but looks as if will soon be so; now relatively cool and cloudy, but weak radiation that is sensible is coming through and clouds are breaking up. Has no flaking disease, no lichens, and nothing clearly distinguishable as algae; does have a fine coating of a dark dried up material on rear portion of carapace (last costal on reach side, supracaudal, 5th vertebral, and rear marginals) which could be dried black-green algae. Scutes smooth only in central 1/3-1/2 of their area and very, very worn even where growth rings are present. White growth increments clear but very, very thin. Not much of anything to eat here; no shrubs, almost no herbs, no Opuntia, not any fallen Jasminocereus parts, even though are some of the latter trees in the area.
Only 30 m away from this animal is a large flat rock area where H20 collects when there is substantial garúa. It and paths leading to it from all around are covered with fresh, but dry, read mud. Obviously has been much tortoise activity here and some burros also very recently; within past week I would guess when garúa was strong. Tortoises obviously were clambering about here, drinking, wallowing to the extent possible, and generally walking around in the thin layer of mud available on the ground (Pg. 6)
Personnel – from here on for 22nd, only J. Black and me. After setting up camp, we decided to establish our location as exactly as possible, since we are camped on a rocky pampa at the edge of a large pond and in what seems to be the center of the "concentration" of tortoises as the extant population now exists. This large pond is only one of many ponds near here but it is the largest in this area, measuring about 100 x 50 m, being more or less a large ellipse in shape. It is full of large black boulders; here and there are patches of brownish (pale)-grey soil. [Plants re mostly in soil patches in pond; occasionally in rocky crevices also.] Most plants in it are now dead and dried up and blown or trampled down – principally these are grasses and a composite species I do not know, plus a few other species of herbs. One plant occurs in some abundance in dry by green, living form. All are small herbs. Will collect some of these later.
First we went up to top of low hill, with a small rock outcrop which crowns it, just to E of camp. The big pond, other ponds and rocky pampas (Pg. 7) the latter are also occasionally pond for short periods after heavy rains) circle the base and surround this low hill entirely. It is a very large hill but so low that most of its surface (circa 95-99%) is really very slightly sloping planadas consisting of same basic structure as rocky pampas around bases; i.e. most of its surface area is just a large rocky pampa also, with scattered clumps of trees offering shade and large boulders with small caves in and under and around them also offering cool, shaded places.

Directions for top of the outcrop on top of this hill. (see my map for names of hills):
To most NE, highest point of Pan de Azucar - 317˚
To very center of Cerro de los Galápagos 258˚
From here we went more or less to N to a very old large crater which lies about NNE of camp about 0.5-1 km. This crater we will call Cerro de los Liquenes because the walls all along its rim and inside of it are covered by beautiful pale yellow, cream, green, orange, and white lichens. It as well as all other unnamed hills and craters will be found on my map from this trip. Direction from it to other hills: (Pg. 8)

1) To highest point of most inland Media Luna crater to ENE 67˚
2) To highest point on southern end of Cerro del los Galápagos 255˚
3) To northwestern and highest point on Pan de Azucar 302˚

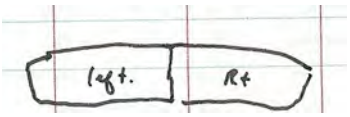
At 1310 hr took altitude here with Luftt altimeter, temperature compensated type. Reads 150 m at rim of the crater on its N side.
This and all other altitudes on this trip will be taken with this Luftt instrument and time of day (and temperature of the altimeter inside) taken when possible. From here returned to SW base of Cerro de los Liguenes and sampled around to camp in rocky pampas around base of the small low hill just E of camp. Will complete this circular sample another day.
Tortoises found and data:
#15,109 ♀ maybe – tail a bit intermediate in length. White growth increments not complete and extremely thin. Scutes smooth only in central 1/15 or less; rest of carapace has growth rings but they are (Pg. 9) well worn ones. No lichens or clear algae. Could have had black green algae recently during rains but now is only a dry thin darkish-black scum on scutes, especially and mostly confined to rear 1/6 of carapace more or less below border of 4^{th} – 5^{th} vertebrals and on front marginals area. No flaking disease. On N side of hill in deep shade in rocky pampa area.
#15,039 ♂ - Same area and behavior as previous animal. All scute conditions on carapace as in previous one except: smooth in central 1/10 or less; no algae at all for certain; no lichens or flaking disease. White growth increments clear and moderately thick and well-developed. Took photos 23-24, Roll 183 of this animal resting/sleeping in shade. Very hot now at times – sun out off/on.
New #15,116 ♂ - CL 81.8; CW 86.2. Notably flared rear marginals; almost certainly a ♂ but tail a bit intermediate in length and short/fat in shape. Marginal scutes in rear quite flared; rear of carapace drops off a bit more forward than in most, from middle of 4^{th} vertebral; then sharp rapid drop from 4th-5th vertebrals border. Scutes quite worn and smooth in centers; 1/8-1/5 or less. No lichens, algae, or flaking disease. White growth increments very, very thin. 1 extra tiny marginal on right side next to supracaudal - thus 12 right ones. Same general area and behavior as previous 2 animals.
#15,006 – CL 77.0; CW 75.6. north side rocky pampa area also. Sleeping under a tree in the shade. We marked (Pg. 10) 15,000 now; only #6 was there from a previous trip by M. Castro. Fairly normal, typical shape, unlike #15,116. ♂ almost certainly; tail rather intermediate in length. Marginals rather flared in rear, 11 on each side, but #700 one is only a tiny wedge-shaped thing. Most strange carapace characteristic – front marginals (first of each side) not curved in normally to form a regular looking nuchal notch; instead they are notably long and flat and almost rectangular in shape and the notch is just a very small indentation:

[Diagram of 1st pair of marginals.]



On Jan 1970 trip J. Back says he saw one, with no injuries or cut off parts which was almost a flat surface in front – i.e.: front marginals

[Diagram of 1st pair of marginals with no nuchal notch.]



had virtually no nuchal notch. He does not have its number, size or sex recorded.
New #15,117 ♂ - Very near previous animal. Under a Bursera in shade resting. CL 85.5; CW 86.5. Fairly normal shape, sharp drop in rear (Pg. 11) elongate oval form from above, but flared rear marginals and very raised up in front. Really a saddle-backed shape of nearly extreme of Española (hoodensis) or Pinzón (ephippium). Extremely different from those seen till now in this respect. White growth increments present but rather thin. Scutes smooth in central 1/10-1/15 or less but all quite worn. No flaking disease, lichens, or algae. Took photos of shape – Roll 183, #27-28.
New #15,118 ♂ - Also on N side at pond's edge in an area of flat rocks where H20 collects in pockets and basins; resting under a tree. 12 marginal scutes on left side, a small extra one next to supracaudal. White growth increments clear and well-developed and rather thick. Normal shape ± raised a bit in front but not saddle-backed. No flaking disease, lichens, or algae. Scutes smooth in central 1/10 or less, but well worn. CL 87.0; CW 86.7.
#15,099 ♀ - CL 76.5; CW 71.3. near last 2,, same behavior. Normal shape; but raised some in front so that nuchal notch is only a bit lower than the top of the carapace at highest point. White growth increments clear but very thin. No lichens, algae or flaking disease; scutes smooth in central 1/5-4/5 and very worn elsewhere. Fresh dry red mud on rear feet, tail, rear of carapace at supracaudal lip – thus could have nested? But unsure because H20 collection sites and red mud all over this area. No clear sign of recent copulations at all. (Pg. 12)
Near camp saw 4 more along border of large pond just 25 m from tent – all in shade, resting or sleeping:
#15,035 ♂ - CL 82.1; CW 82.8. White growth increments clear but rather thin. Scutes smooth in central ¼-1/3 or less; no lichens, algae, or flaking disease; very worn elsewhere on carapace. Normal shape – i.e. curves down to nuchal notch in front in gradual manner from area of middle of 2nd vertebral to 1st -2nd vertebras border. Marginal scutes in rear only slightly flared – more or less a bit more flared only than "normal" G. e. porteri In rear drop off from region of mid 4th to 4th-5th vertebral border in a gradual (but considerably steeper than G. e. porteri) curve to supracaudal lip i.e. normal a definite intermediate race shape.

New # 15,119 ♂ - Normal shape except almost flat out on top of carapace from center of 2nd vertebral to nuchal notch. White growth increments very clear but very thin. Scutes smooth in central ¼ of less, but very worn. No lichens, algae, or flaking disease; CL 83.5; CW 79.3.
#15,090 ♂ - CL 86.1; CW 83.5. White growth increments clear and moderately thick normal shape except very little down slope in front to nuchal notch. No lichens, algae, or flaking disease. Scutes smooth only in central 1/15-1/20 or less but well worn. One extra tiny marginal scutes just behind rear leg pocket on right side. (Pg. 13)
22 Sep continued – New #15,130 ♀ - (mis-marked at first so changed to this) – no lichens, algae, or flaking disease; white growth increments thin; scutes smooth in central 1/10 or less only. CL 71.5; CW 75.1
23 Sep 1970 – Leaving camp for Cerro Setenta and nesting area; on leaving Luftt altimeter reads 108 m at camp on edge of large pond; time 0845 hr. J. Black, H. Garcia, and I. Along sides of pond enroute to Cerro Setenta – near camp #15,104 ♂ - CL 89.2; CW 85.5. Sitting on open soil spot; active but nothing to eat here. No flaking disease, lichens, or algae. Scutes smooth in central 1/8 or less but all very worn. White growth increments present but extremely thin. Form normal ±, no sharp drop in rear, gradual rounded curve from center of 4th vertebral; lowered a bit in front, sloping to nuchal notch; 12 marginals on each side.
New # 15,120 ♀ - very near last one, a bit more up on rocks; active, just moving out of nice burrow in soil between large rocks; well protected site from last night's strong cold wind. CL 76.0; CW 78.0. Carapace shape exactly like previous animal. White growth increments present but extremely thin no flaking disease, lichens or algae. Scutes ± mostly smooth, central 1/3-1/2 or less, very worn elsewhere and almost smooth. Can not see any clear sign of definite recent nesting.
New # 15,121 ♀ - CL 69.7; CW 71.3. Same general area as last two. Shape of carapace exactly similar to previous two. No flaking disease, lichens, or algae; white growth increments extremely thin and incomplete. Scutes smooth in central ¼-1/3 and very worn all over. Sitting quietly in soil up against lava block beyond edge of pond. No definite recent sign of nesting. Male has mated with (Pg. 14) very recently because had fresh red mud from this area all over top of carapace; from previous week sometime when was more garúa.
New # 15,122 ♂ ? – CL 80.3; CW 81.0. Same area as last one – in similar site, resting; shape same as last 3 - ± "normal". No lichens, algae, flaking disease. Scutes smooth in central 1/8-1/10 or less; not as worn beyond these areas as 2 above ♀♀. White growth increments clear but rather thin. ♂ almost certainly but tail rather intermediate.
New #15,123 ♂ - CL 110.5; CW 103.7. Very large and very old; almost completely smooth scutes; only very outer edges, 1.25-1.75" not completely smooth, but these areas extremely worn also. Very odd shape, injuries etc. prevent adequate description of carapace. Rises very high to a point at highest on carapace in center forward part of 1st vertebral then used to slope to marginals and nuchal notch downward. But almost all of first 2 marginals completely broken off and worn away well back onto 1st vertebral. Apparently from many falls and injuries and re-healings. (Pg. 15)
Jan took some photos of him, Roll 184, # 1-8. These should show some of these deformities. White growth increments not complete and very thin. No flaking disease or clear sign of algae; lichens in a number of places (2 types) on front marginal area and on

upper rear of 3rd and 4th vertebrals and last 2 costals of each side. Will return to photograph these and collect them. In same area in general as previous 4 animals, sitting in shade. Will examine him more closely later.
Circled a bit more around to E, not far, passing through same red soil patches / lava boulder mixture to another pond:
#15,050 ♂ - CL 96.2; CW 95.3; white growth increments clear and moderately thick; no flaking disease, lichens, or algae; scutes smooth in central 1/10 or less but well worn even on all growth rings. ± normal carapace shape like first 4 encountered this morning. Sitting, inactive under a Cordia lutea. Nothing to eat near here; just on edge of the dark pond full of black lava boulders.
New # 15,124 ♂ - CL 96.2; CW 92.1. Same pond area just up slight and very rocky rise from it; resting under a Xanthoxylum, inactive. Shape ± normal as in first 4 today; 1 extra small marginal scute on each side next to supracaudal; the latter smaller than usual. White growth increments present but extremely thin. No flaking disease, lichens, or algae. Scutes smooth in central 1/10 or less but well (Pg. 16) worn all over.
#15,018 ♀ - CL 65.7; CW 65.2 – Out on flat rocky area just to S ± of last pond, 40 m distance; flat rocks, a lot of trees, but not much food – dry grass, Alternathera, some low growing shrubs with leaves within tortoise's reach – Scutia, Croton. Xanthoxylum, Vallesia glabra. White growth increments clear and well-developed but rather thin. Scutes smooth only in central 1/10 or less, but worn somewhat elsewhere. No lichens, algae, or flaking disease. No clear sign of recent nesting or copulations at all. Form ± normal, like first 4 today.
Still all tortoises resting in shade, but not any real sun yet; light breeze and cool till now (1030 hr).
#15,079 ♂ - CL 90.0; CW 90.0. Same area and behavior as previous one; also "normal" shape of carapace as in first 4 today. No flaking disease, lichens, or algae. Scutes smooth in central ¼-1/5 or less, but well worn elsewhere. White growth increments incomplete and extremely, (Pg. 17) extremely thin. #7000 and 700 scutes of marginals just tiny wedges, but number (of marginals) 11 is normal.
Starting up trail (road made by tortoises; smoothed lava; used now by tortoises and burros). Goes toward Cerro Setenta ±. Runs about SSW to S from camp and ponds area up toward Cerro Setenta, but via some small rock outcrops.
Enroute – 2 tortoises under a tree in shade; about 200-300 m up road from last pond; both resting; area and food availability as in last 2 animals. [Marginal note – altitude 110 m; 1115 hr; 28.7˚C]
#15,107 ♂ CL 88.0; CW 87.4. ± normal shape as first 4 today, but slopes a bit more gradually in rear from center of 4th vertebral scute, and not quite as much of a downward curve in front; i.e. a bit more raised in front than most. 12 right marginals because supracaudal smaller on that side, and not symmetrical and extra tiny marginal next to it. No lichens algae, flaking disease; scutes smooth in central 1/6-1/8 or less but all very worn. ♂ but tail a bit intermediate. White growth increments clear but rather thin.
New # 15,125 ♂ - CL 111.3; CW 110.9. Almost completely smooth shell; only outside ¼-1" of growth rings remain and these are very worn and almost gone. No flaking disease or algae which is clear. White growth increments well developed and of medium thickness. Perhaps 1 algae (or lichen?) on rear border of each first marginal and fore border of 1st vertebral on each side. Probably a lichen. Collected some and put (Pg. 18)

in FAA (Type 1); other portion of same in box to dry with other lichens; will call type #1. See photos; type #1 along beside and at same sites with 3 definite lichens (perhaps same as type #2 but I doubt it?)
Lichens – Type #1 – see above.
Type #2 – pale blue-grey-green – in liverwort growth form – very tiny, tiny patches of it only 1 mm or less in width. Same area as all others plus on 2nd and 3rd front marginals of each side.
Type #3 – yellow patches, dry, 1 x 0.5 cm ± on each of first marginals on each side; very dry and like old worn paint.
Type #4 – Pale, pale, greenish white; large patches of ± 1.5 x 1 cm up to 1.5 x 2 x 3 cm on both first marginals and first vertebral as described. [Marginal note – also patches like dried paint – old worn and cracking!] Also on upper edges of last costal of each side, on border of 3rd (rear) and 4th (fore and sides) vertebrals. This same as on ♂ #15,123 from this A.M.
Photographed all these types in place; Roll #184, photos 9-20 (end). (Pg. 19)
Has 12 marginals on each side and a very small, almost square supracaudal; 1st marginal and 5th one on each side as go forward all small.
On up trail to area with 2 rock outcrops – near outcrop closer to Cerro Setenta and well up on its side near top:
#15,114 ♂ - CL 117.0; CW 113.3 – Also has a mark in #7 notch. Probably because was #7 of M. Castro; will have to check. #7 notch is notably older than all others which seem to be of same age and much more recent. Up on side of this hill which rises up to this outcrop. Inactive and in shade; now a bit sunny off and on and strong radiation coming through clouds all the time; thus quite warm and only a light breeze all morning for cooling. White growth increments clear and distinct and medium thick. Almost all smooth carapace, save for outer 1-2" border of scutes where they are very worn and almost smooth. No clear algae and no flaking disease Has a nice set of lichens like #15,125 ♂. Same apparently different 4 types in same general area of front 2 marginals, of each side, and 1st vertebral. Type #4 also scattered along scutes borders all over top of carapace – i.e. all vertebrals, upper borders of almost all costals near where they join vertebrals. In addition apparently a 5th type – pale grey in center, white borders, square to round to rhomboid patches, only 6 of them and all on 2nd, from last (Pg. 20)
[Marginal note - Took photos but in collection discovered 5th type was tree sap.]
Marginal on right rear of carapace.
Collected some of first 4 to keep separate from those of #15,125 and collected some of 5th type also. [Marginal note – see previous page – tree sap – therefore no #5 type exists up till now.]
Took some photos of these and body form Roll #185, #1-9.
Rather of normal shape like first 4 today, but a bit more raised in front. Appearance of front nearly like #15,123 ♂. About 1/3 of each first marginal broken away badly and re-healed. Nuchal notch cut into a bit also and a bit posterior of where it would be if first marginals were whole. Perhaps injuries from falling? Or dogs attacked when was smaller? Are a few holes like teeth in one of first marginals (left) near border where is broken off. [Note – only 4 lichen types apparent – exactly same ones as on #15,125 ♂; collected what of these I could. Type #5 was really dry tree sap]

#15,006 ♀ - CL 77.2; CW 75.0. Just down hill from ♂ a short ways; coming up hill toward same area along tortoise highway. [Marginal note – 1330 hr and hot but moving along.] Normal shape, but with fairly large extra marginals on each side of the supracaudal in the rear. The (Pg. 21) supracaudal is correspondingly smaller than normal. Smooth scutes only in central 1/8 – 1/10 or less but worn growth rings beyond those areas; no flaking disease, lichens, or algae; white growth increments clear but rather thin. No sign of recent nesting or copulation. We marked 15,000; #6 was from M. Castro.

Just to clarify positions of these tortoises I took some readings from top of this rock outcrop:

Altitude: with Luftt altimeter: 1345 hrs; 31.5˚C inside instrument; 162 m.

Directions with compass:

To highest peak of Cerro Pitt 63˚; to highest peak of inland Media Luna 49.5˚; To center of Cerro de los Liquenes 27.5˚; To campsite in ponds area 355˚; To highest point on E side of Pan de Azucar 330.5˚.

Enroute to this area around these outcrops we have found continuous and scattered old to fairly recent, (past month or 2) dry tortoise turds; no single clear well worn road was encountered running up from pond area, but there are long stretches of smoothed lava rocks and many of these pathways scattered about between the 2 areas. #15,006 ♀ was clearly coming up hillock from direction of ponds. Thus it is clear that these pathways are ancient and well worn and are still being used by tortoises and burrows heavily Area is all otherwise rather jumbled and tumbled rock with fierily dense cover of shrubs and small trees. Not much food available now. (Pg. 22)

Just at bases of this last rock outcrop in flat rocky plain enroute to Cerro Setenta – First Opuntia I have seen – a huge thing. Flat, smoothed rocks and ancient tortoise trails all around this Opuntia and running out from it in all directions over this plain. Vegetation here is rather dense with trees and shrubs. Not much soil, just little patches here and there. Will have to return to adequately cover this area.

Two tortoises under the Opuntia, and others nearby, can see one and hear 1or 2 others. Two below the Opuntia:

#15,112 ♂ - large and absolutely covered with lichens; will return to examine him.

#15,113 ♂ - also probably; tail a bit intermediate; no lichens, flaking disease or algae.

New #15,126 ♀ - nearby in shade of a tree l- CL 73.5; CW 72.5. No flaking disease, lichens, or algae; white growth increment clear and moderately thick; scutes nearly smooth – central 1/3-1/2 completely so and rest well worn. No sign at all of any recent nesting or copulations. (Pg. 23) Much worn lava all over this area indicates abundant tortoise activity around the base of this rock hillock and especially around the Opuntia; not one pad or even a tiny piece of one is visible anywhere on the ground around its base. I am sure that the tortoises (and goats and burros) devour the few pads that fall, and very quickly since Opuntia seem so few and very far between here over most of this end of San Cristobal.

Still all rock terrain since leaving pond areas near camp and no soil yet adequate for nesting.

This large Opuntia is on the S side at the base of this rock hillock, and ± due ENE of Cerro Setenta. Continued on up to Cerro Setenta, now moving ± directly WSW from

rock hillock/outcrops. Tortoises clearly move up to and around base of this old crater because old scattered dry turds are all around it and enroute up it. But after looking in "nesting areas" around it and beyond it and over some of its side for about 1 hr it is clear that not many have been using this area recently at all. Saw only 1 animal and no fresh sign (turds, trails, burrows, etc.) save for this one animal.
Just before returning to camp took some measurements and directions on top of Cerro Setenta to assure proper localization (Pg. 24) on maps.
Altitude – 188 m; 1630 hr; 28˚C, inside altimeter casing.
Directions: To highest point of Cerro Pitt 63˚; to highest point on inland Media Luna 52˚; to highest point on S peak of Cerro de los Galápagos 271˚; to far point at SW border of Bahia Rosa Blanca 180˚.
There are scattered patches of soil all around sides of immediate base of rocky outcrop and crater at top of Cerro Sesenta. But very, very poor as nesting sites. Seem to be much better locations around ponds and "pampas" near our camping area. We walked over a considerable portion of these areas around Cerro Sesenta, including two areas seen by J. Black on Jan trip when he found the one nest with eggs. Soil much of the area is a light yellowish-reddish brown, with rocks right under it at the surface. Few goats which exist here and burros scratch in these soil patches extensively and thus keep them churned up and subject to easy erosion. Only a (Pg. 25) very rare site in these areas would provide digging opportunity or a completed nest. Two small nesting spots of Jan 1970 trip and several others I discovered in same general area are of very pale beige-grey soil; very dry, powdery, and fine. Same feral animals keep this stuff well churned up too and in terrible condition for nesting. Most of the area have rocks in abundance at surface or near it. To lay successfully here, as in reddish soil areas near here, ♀♀ would most often have to attempt several to many pits before succeeding. None of soil here is deeply cracked from frequent wetting/drying cycles as near ponds. We found no adult ♀♀ of laying size, no sign from recent weeks of any of such size, no attempted holes or even surface rasping and no nests for 1970/71 season.
In addition, even though we know some ♀♀ lay here, the total available area is so small, that if the population still contains even a few dozen laying ♀♀ they could not all be coming here - there was a total amount of activity here for last year that could be accounted for by 1-2 ♀♀ and no more.
The one area where the nest were found is only a few hundred square feet in surface area and upon re-examination of it and J. black's notes(from Jan 1970 trip) we decided that (Pg. 26) it had contained 2 definite nest; i.e. one from which the young had escaped; 1 from which he brought back eggs. A third site he thinks had been a nest which dogs dug up and destroyed (young or eggs?); if young before or after 1 or some had left nest and thus opened hard cap up? – no one knows). Can't tell about this 3rd one now and he did not have time to take adequate notes before. In addition appear to be 4-5 holes dug by ♀♀, but unsuccessful attempts. Therefore, all this could reasonably be from 1-2 ♀♀.
In other larger areas, but exactly like and near this one, we found no clear signs of past years' nests. Only a few holes, again probably uncompleted attempts. But hard to separate these from burro rasping and churning-up of the area. Part of problem may be that burros and goats churn this duty soil up so much that one can not see previous nests and unfortunately it may be found to be difficult to even detect recently laid ones. (Pg.

27) Altitude of these areas – 173 m; 31.5˚C inside altimeter case at 1515 hr; Luftt altimeter.
One smaller tortoise in open layer soil-covered area like one where nest found and just below it a short distance.
New # 15,127 ♂? = probably ♂, but tail of intermediate size; carapace condition i.e. not very worn, indicates is probably a ♂. CL 61.4; CW 60.5. No flaking disease, algae, or lichens. Scutes somewhat worn but smooth only in a very tiny central part. White growth increments clear, moderately thick. Sitting inactive under a Piscidia. His tracks evident all over this are so has been poking about here a bit.
At this time we returned to camp via a route just to W a few hundred meters of our ascent route. Saw no more tortoises from Cerro Sesenta and rock outcrops till we reached large pond near camp but saw essentially similar terrain and sign as on ascent; i.e. a lot of smoothed lava trails leading up toward 2 rocky outcrops and around their bases just below Cerro Sesenta. There were old tortoise droppings scattered frequently all along these smoothed pathways indicating a lot of ascending and descending and general activity throughout these areas in recent months. Between ponds area and "pampas" around hillock (Pg. 28) near camp we saw all way to nearby base of rock outcrop themselves of 2 small hillock and Cerro Sesenta we saw no soil at all; all is rocky and with a fairly dense cover of shrubs, sapling, and small trees. [Editorial note: this sentence was edited and left in incomplete form by CGM – a rarity, thf].
From all we have covered to this time I would say that this is a very dry period with no water in the ponds and very little to eat anywhere.
As regards H20 it is clear that the only way in which tortoises now obtain it and probably the only way they have gotten it for all of garúa season (and even months before in the hot season) is by drinking from the small holes, pockets, and worn basins which are scattered all over. Around all of the ponds and rocky pampas areas below in the general vicinity of our camp and Cerro de los Liguenes there are abundant sites where garúa water collects in shallow basins with large lava plates and blocks. All of these areas show abundant recent tortoise activity in the form of recent to (Pg. 29) 1-2 months and older turds and all are covered with a fine coating of dry red mud where the tortoise have been clambering over them with the past few weeks after garua periods. The ponds are all completely dry now an d probably have been so since some time in the hot season (probably Feb – Mar 1970) J. Black says that during Jan 1970 trip (24-26) was H20 only in pockets in deepest ponds full of black lava boulders near our camp and around rocky hillock near it. Most of all ponds and all of H20 sites in pampa like areas were devoid of H20.
Regarding food, one can say that in ponds and pampa areas there is virtually nothing. Some scattered small green herbs, but mostly completely dry grasses and herbs and not much of any leafy trees or shrubs available. Was not much in Jan 1970 but considerably more herbs than now. On rocky areas leading from ponds to rocky hill and Cerro Sesenta amount of tree and shrub leaves with in tortoises' reach and herb over increases slightly as go toward Cerro Sesenta. But still almost nothing. I even discovered a few sprigs here and there of young shoots of Commelina nudiflora on lower lopes of Cerro Sesenta as we were ascending it. Later found bits of same in pond beds near camp. But very scattered. Suffice it to say that there is a real lack of almost anything to eat for the (Pg. 30) tortoises now. This leads naturally into another discussion – climatic factors and the activity of the

animals now. I will elaborate on all these aspects- food and H20 availability, climate and activity – at the end of the trip. For now I want to note that for the past day and half of observations since we established camp I have seen not one animal moving or eating at all. Every one encountered has been resting or sleeping, usually in small patches of loose dry soil, sometimes on rocks. Most have been in shaded spots, but some largely in the open. What is noticeable is that this period has been cloudy and cool and such that they certainly could have been active throughout it. But they are not doing much of anything. I suspect strongly that in this long period of drought and lack of food they are simply conserving their energy because they have nearly no food and only occasional small amounts of water. An analogy to the G. e. porteri population on Santa Cruz in the late Feb to mid Jun 1970 period is probably a correct interpretation. [Note that fore example # 15,035 and 15,119 both very near our camp have literally not moved at all from right where we found them on 22 Sep at 1000 hr. (Pg. 31)

24 Sep 1970 – Finishing area around large pond near camp and will complete inside of ponds around base of small rocky hill just E of campsite. Personnel just J. Black and me. Along pond's edge of W side.

New #15,128 ♀ - CL 69.6; CW 71.0. No lichens, algae or flaking disease; scutes smooth only in very small central parts but all well worn. White growth increments non-existent. No sign of recent nestings. Lots of red mud on carapace in fine layer so probably recently copulated with in this area. Resting in shade; inactive up on flat lava blocks at pond's edge. About "normal" shape as I am using the term – just like first 4 yesterday. One extra small marginal on right side next to supracaudal the latter shortened a bit due to this.

New #15,129 ♀ - CL 71.1; CW 75.4. Same general location and behavior as last animal; resting in similar spots 20 m to S with next animal; both under a tree in shade. ± "normal shape" = but 2 things exaggerate measures – 1) 5th vertebral is very raised and pointed in center – very strange; 2) junction of marginals and plastron over curve measurement on left side is well below (2 cm ±) normal position. No lichens, algae, flaking disease that is clear; scutes smooth in central 1/8-1/10 or less but well worn. White growth increments extremely thin and incomplete. (Pg. 32) Deeply scarred areas in centers of 2nd and 3rd left costals and 3rd vertebral scute – can't see if is anything like flaking disease of Santa Cruz (G. e. porteri) – not clear because all simply old worn out areas now. First animal have seen with this sort of scute condition.

New #15,131 ♀ - CL 82.6; CW 83.6. No lichens, algae, or flaking disease; scutes smooth in central ¼-1/5 or less but extremely worn all over. White growth increments clear and moderately thick. Supracaudal very small and square with 1 extra marginal next to it on each side "normal" shape. Has nice normal classic San Cristobal appearance. In same location and same behavior as #15,129 ♀. Both have abundant dry but recently fresh red mud of this area on carapace tops all over; thus certainly copulated with recently.

New # 15,132 ♂ - climbing up over rocks from pond along a stretch of rocks intermixed with red soil. A lot of recent tortoise activity here after recent garúa. Rocks (Pg. 33) here have many pockets where H20 collects and mud all over testifies to tortoises clambering about. This area just 30 m more to S along pond edge from last 2 ♀♀. CL 112.8; CW 111.3. No clear algae or flaking disease. He has some small patches of Type #4 lichen from yesterday in this same common location where saw on # 15,123, 15,114,

15,125, and 15,112 ♂, i.e. lichens are in small protected areas on first marginal on each side of nuchal notch and just where front-sides of first vertebral joins first marginals (i.e. on 1st vertebral). Very smooth shell save for faint remnants of growth rings on outer 1-3" border of some scutes; white growth increments well-developed but rather thin.
Roll 185, photos 21-23 of whole animal. Shape ± normal except well raised up in front around nuchal notch area could be one from Volcan Wolf if just saw in a cage and was of unknown origin.
New # 15,133 ♀ - CL 72.3; CW 71.5. No lichens, algae, or flaking disease; scutes smooth in central 1/12-1/15 or less and worn but not as much as larger ♀♀. White growth increments present but very thin and not complete. No extra scutes. Rather nice shape; could even be an odd small ♀ or ♂ from Santa Cruz on this basis; almost no flaring of marginals in rear – only (Pg. 34) very slight; and a bit more depressed and curved down to nuchal notch in front than normal G. e. chathamensis shape; but more low and flat, unlike most G. e. porteri. No sign of recent nesting or copulation. In similar mixture of flat H20 collection rocks, lava boulders, and red soil patches as previous animal but on up (50 m) well used (burros and tortoises) trail up side of low hill to SW of pond below (from its border). She was sitting in shade inactive.
Continued sample on around to pond where we quite yesterday and climbed toward Cerro Sesenta. No new animals. Photos Roll 185, #24-27 - #15,120 ♀ resting in small cave out of sun; midmorning, 1030 hr. #28 – rock ledge where tortoises drink collected garúa water.
Continued on around base of hill to complete circle to point where we began sampling on 22 Sep between Cerro de los Liquenes and hill near camp. In one small rocky area at edge (Pg. 35) of pond on E side of rocky hill:
New # 15,134 ♀ - CL 77.0; CW 77.3. Sleeping and resting up under a little rock ledge, 2/3 out of sun, soon to be completely shaded. Took some photos – Roll 185, #29-32. No lichens, algae, or flaking disease. White growth increments non-existent; scutes smooth in central 1/8-1/6 or less, but well worn elsewhere. No sign of recent copulations or nesting. ±"normal" shape; 700 and 7000 scutes just tiny wedges; but 11 marginals on each side.
New #15,135 ♂ - CL 85.5; CW 82.8. near last animal; also in shade (of Bursera and small Crotons). White growth increments clear and moderately thick; no lichens, algae or flaking disease. Scutes smooth in central tiny portions only but becoming well worn. ± "normal shape ; scutes normal on carapace.
#15,063 ♂ - CL 90.4; CW 94.2. Near last 2 in shade of Bursera, inactive. White growth increments clear and well-developed, and medium thick. Scutes smooth only in central 1/10 or less but worn rather well. No lichens, algae, or flaking disease. Normal shape; carapace scutes normal.
Continued on around to the area where we began sampling ponds toward camp. Will have to return to area just crossed briefly this afternoon because I did not get all of the area covered adequately. (Pg. 36)
Then worked on up and over sides and flat planadas of the rocky hillock and outcrop which the ponds surround. This area is very large (many hectares) and consists of mostly Open areas of soil patches and small rocks and boulders intermixed. There are scattered trees and groves and dense patches of shrubbery and large rocks with underhangs where tortoises can get shade. The soil is mostly of red type and is now of a consistency of hard

crumbly clumps. It is deeply cracked here and there and lots of fissures run into it. The soil in the pampas below is largely the same as on these flat and slightly concave plains around the sides of the hillock, but in the pond at the lower elevation there is less soil, in fact none over large areas of large black lava boulders. This soil in the elevated plains and in the ponds show a lot of previous action of water standing in these very shallow areas over short periods and then (Pg. 37) drying out rapidly and severely for longer periods. Most of these areas are clearly not suitable for nesting; definitely not in the ponds; and only along the sides and slightly sloping area of the upper, shallow, slightly concave, "pond-like" plains would successful nesting be possible. [Marginal note – i.e. where run-off presents standing H20 as in ponds and some pampas at base of hillock.] But after 1 hour of 2 of us searching over these plains rather carefully we could find no clear sign of any nesting or nesting attempts from this or any past nesting seasons.
Tortoises found on these upper elevated plains above the ponds:
#15,118 – from other day; took a few photos, Roll 185, #33 and of it resting in shade under a tree. Has come up a well used tortoise path about 35 m and 10 m altitude from where was on 22 Sep.
#15,136 ♀ - CL 70.5; CW 69.9. Scutes smooth in central 1/15-1/10 or less only. White growth increments clear and well-developed but very thin; resting in deep shade under an Acacia. No lichens, algae, or flaking disease; ± normal shape but a bit more raised in front than most tortoises here of normal condition of carapaces.
Finished checking around in circle of ponds around hillock near camp – no more animals. (Pg. 38) Then we moved through a series of small ponds running almost due ESE to E of E side of hill and its circle of ponds. A string of these, continuous in reality with "pampas" and pond –like areas around hillock. These are much small but much like the big pond full of black lava boulders near camp –
Encountered 2 of naturally dead tortoises found on Jan 1970 trip by J. Black and group:
1st was a ♂ - circa 115- 125 cm CL (can't check exactly because top of carapace breaking up). In Jan did not have most of scutes still on and was just beginning to open up at top. Now is with only one marginal scute and is badly opened up all along costal and most vertebral have fallen through. Was without lichens of obvious type in Jan. Now is covered with several kinds, especially the orange "bushy" kind so common on Croton and other plant stems on this island. Took some photos – Roll 186, #1-6. (Pg. 39)
Is out in open, but no sign of any injuries obvious; not feral animals unless they did not eat into carapace, plastron or bones; leg bones present. In pond. Hard to imagine what caused death. J. Black though 4 months dead when found.
2nd one – much smaller; sex – probably ♂ because scutes not smooth in centers much at all; photos #7-11. In Jan 1970 was under a small tree at edge of pond. Dead maybe 1 month; scutes all on it, bones whole and no breaking up; no lichens; a little meat still on head and fat inside in oily form on plastron. Now dry; just starting to open up at top, most scutes fallen off; some lichens especially orange one just getting started. Also no obvious injuries to this one at all. Measures from Jan 1970 – CL 89.4; CW 89.2.
[Marginal note – In photos note that has a few smeared areas of red mud showing hat another tortoise tried mounting it recently – mud on carapace top and front areas.]
Tortoises along sides of these ponds and through this general area of pampas on border:
New # 15,137 ♀ probably but tail rather dumpy and intermediate in length. CL 78.2; CW 78.2. Scutes worn but smooth only in central 1/15 or less; white growth increments very

well-developed but rather thin; no lichens, algae, or flaking disease "normal" shape. No extra scutes. In shade near last pond on its edge. (ponds really all one series of wider areas connected by narrower joints. (Pg. 40)
15,078 ♂ - CL 73.4; CW 74.3. Very near last animal (25 m) also inactive in shade. ♂ probably but tail is dumpy and somewhat intermediate in length. Scutes smooth only in tiny central portions, but well worn elsewhere; white growth increments clear but rather thin; no lichens, algae or flaking disease. Normal shape. No extra scutes.
Continued to SE a ways to a small rocky hill with outcrop on top. Pampas and pond-like areas quickly stop and turns into well worn lava as first begin ascending the hill and continues similarly to top. Can not judge for sure, but hill is about 1 km from camp.
At top took some directions –
To highest pint of inland Media Luna 45˚; to center of Cerro de los Liquenes 358˚; to highest point at eastern end of Pan de Azucar 314˚; to southern most point on Cerro Sesenta 244˚.
We looked carefully for sign on ascending this hillock. At its bottom where lava pathways begin and for first 50 m or so up it found abundant old tortoise turds (nothing from recent weeks- 1.5 months ago ±) Then petered out rapidly to nothing. Then we failed to encounter (Pg. 41) any more till just at base of small outcrop where I found 2 more old droppings in patches of loose dry soil which donkeys have churned up for wallowing and marking. There are far fewer tortoise turds above pampas and ponds as one ascends this know as compared to the amount of sign along pathways leading to 2 knolls we ascended yesterday in route to Cerro Sesenta. Plenty of tortoise sign at very base of this whole long rise, i.e. in ponds and rocky pampas which extend out toward Media Luna (inland one) from ponds and pampas around hillock near camp. Seems that tortoises do not or have in recent months not ascended this know in large numbers.
One aspect of this are worthy of note- out to SE and ESE of this knoll we could see only rocky lava covered areas with fairly dense vegetation all the way to the base of the furthest visible group of large hills. No soil visible at all and doubt there is any or at least almost none. But around western and southern side of know and out at least a short ways beyond it (could not see any clearer further on) there are flat, smoothed areas of lava with dense to thin varying vegetation cover and abundant (Pg. 42) burro trails and sign. Did not have time to check this area for tortoise sign and trails, but they obviously could easily pass to S of this hillock and on out into this low lying area via this route. In addition, these smoothed lava areas lead directly out from the rocky pampas and ponds to N, NW and WNW blow this hillock, where we know there are a large number of animals now and where they seem to have been concentrated on previous visits to this area. This all remains to be examined.
Inside the little crater found a rather young (relatively) Opuntia and took a number of photos of it, both whole plant and close-ups showing fierce huge spines on trunk and hair-like soft spines of youngest pad on top of trunk; it was about 2.5-2.75 m tall. Will be making more extensive notes on Opuntia later so will leave this as is now. Roll 186, #12-22 (2 or 3 of some Jasminocereus mixed in here). (Pg. 43)
Then returned to camp. Enroute checked one more portion of ponds/pampas areas we excluded this morning – just between camp hillock and Cerro de los Liquenes. Found 2 more animals:

New # 15,138 ♂ - CL 71.6; CW 75.0. White growth increments clear but very thin; scutes smooth in very tiny central portions only – but worn considerably all over. No lichens, algae, or flaking disease. Normal shape ±; but rear marginals not flared upwards virtually at all, very similar to those of G. e. porteri on Santa Cruz. Sleeping in shade on rocky pampa border; now 1645 hours.
#15,059 ♀ - CL 77.2; CW 76.0. Same general area and behavior. White growth increment clear but rather thin. Scutes smooth in central 1/5 or less but quite worn all over. No lichens, algae, or flaking disease. Normal shape, but rear marginals even less flared upwards than previous animals – very similar to those of G. e. vicina from Cerro Azul on Isabela.
I examined 3 burros (2 adult ♀♀, 1 colt ♀) today which I shot – could not find any ticks or any other obvious parasites anywhere on them. (Pg. 44)
25 Sep 1970 – To Media Luna (inland) via large planadas and rocky pampa to look for tortoises, their sign and nesting areas. J. Black, H Garcia and me.
First – 2 more along small part of pond near camp which we failed to examine the other day. Jan searched here yesterday and found them.
New # 15,139 ♂ - CL 72.1; CW 74.5. No lichens, algae or flaking disease. Scutes smooth only in tiny central parts. White growth increments clear but rather thin. Shape normal; no extra scutes but 700 and 7000 ones just small wedges. No ticks I could find anywhere.
New # 15,140 ♂ - CL 92.1; CW 92.4. normal shape but raised more than most in front – very similar to some G. e. becki. In between true saddleback and intermediate form. Scutes almost entirely smooth except for well worn almost smooth outer ¼-1" border on some scutes. No lichens, algae, or flaking disease; white growth increments well-developed and medium thick. Scute number normal. No ticks could be found anywhere on him. Borders (Pg. 45) of marginals front and rear banged up and chipped from much use. One hole in first left marginal and some chipping of first marginals around nuchal notch indicates perhaps attacked by wild dogs.

On trip: Just 75 m beyond where we stopped yesterday to go up small hillock.
#14,1015 ♂ - CL 80.5; CW 80.2. Heading toward Cerro de los Liquenes; in pond like pampa area at border with rocky uplift. ♂ probably, but tail a bit intermediate – carapace indicates male considering size. No lichen, algae, flaking disease. White growth increments clear but very thin. Scutes smooth only in central 1/8-1/10 or less, but well worn. Normal shape; rear marginals not flared much p- like most of G. e. porteri in form. No ticks could be found on him anywhere. Area near him well used after recent garúa period; H20 collection sites on flat rocks and much red mud and trails all over for hundreds of square meters.
We continued on across very open red soil, rocky pampa to some rock outcrops which rise directly out of pampa (crater floors so full of soil and on level of pampa and side collapsed out about 2/3 way round). Scattered old, very dry tortoise turds from months past (probably from early past hot season of Dec-Jan 1970 or even much earlier). Very (Pg. 46) few and far between. Around these rocky collapsed crater their density increases but of same age. Full of grasses and Castela (checked 4 of them; 2 full of grass; 2, Castela). This crater lies about E or slightly S of E from Cerro de los Liquenes. Altitude on planadas here at foot of collapsed crater 0945 hr; 27˚C in altimeter casing;

reads 82 m. Directions: To S point of Cerro Sesenta 236.5˚; to center of Cerro de los Liquenes 287.5˚; to highest point of inland Media Luna 37.5˚.
Plenty of sits enroute to this hill and inside open soil filled area of collapsed craters where tortoises could seemingly lay. Most areas where soil is not cracked and crumbly, clumpy and dry is (are?) extremely churned up by Burros. But still many sites which could be good enough and could never be really ponds of standing H20 because planadas slopes gently off to ESE. But no nesting sign at all of this or past years. Soil is mostly deeply (Pg. 47) cracked as in red soil areas around camp so perhaps this is the best explanation of why they do not lay here. They certainly reach here, but only in relatively small numbers judging from numbers of droppings here versus areas near campsite ponds and Cerro Sesenta. Certainly lower altitude, more open. Les vegetation here, not ever much standing H20 (only temporary little puddles in flat rocks basins), and drier than former areas. Will continue to inland Media Luna area. Drier conditions all across this area since leaving pond – pampa area near hillock visited yesterday afternoon certainly means that they probably are out in this area only when it is green – i.e. after heavy rains in hot season (Jan-May).
Took a few photos of collapsed crater here before setting off again – shows abundant soil but also burro damage to soil by churning and to vegetation by eating it. Roll 187, # 3-4.
Just 200 m further toward Media Luna (inland) form last area – a large pond with black lava blocks. Completely dry; no herbs or eatable vegetation anywhere. Surrounded by same red soil pampas full of rocks as we have been crossing all morning. Scattered tortoise turds between last site and pond. Also full of Castela and/or (Pg. 48) grasses and all very dried out. At pond – under a very gnarled Cordia lutea in shade inactive. Took photos Roll 187, #5-9 of pond, pampa around it and this tortoise with J. Black and Hug Garcia.
#15,141 ♂ - CL 79.6; CW 80.6. Normal shape; no extra scutes. Scutes smooth only in central 1/15-1/20 or less and not too extremely worn elsewhere; no lichens, algae or flaking disease. White growth increments clear but very, very thin. Certainly hardly a damned thing for him to eat here. Very inactive. But some fresh mud on carapace so must have been garúa here in past 1-2 weeks sometime. Lots (8) of dry turds at his resting spot but all old – 1 month + - nothing fresh – seems incredible but must be defecating very seldom now.
#15,142 ♂ probably – CL 85.2; CW 84.5. Tail very short and fat but not of ♀ type, although of ♀ length – probably an injured ♂. White growth increments clear but very, very thin. No lichens, algae, or flaking disease; about normal shape but big pointed hump in center of 5th vertebral and not quite as much curved down to nuchal (Pg. 49) notch as most. 700 and 7000 scutes only small wedges, but normal number of scutes. Scutes smooth only in central 1/15 or less and well worn.
Quite a number of very old dry turds under tree in pond area where he is resting also – all a month or more old also. Scattered turds all through pond bed and surrounding pampa. Indicates more activity here than anywhere since we left base of hill we ascended yesterday and ponds/rocky pampas there. Logical since this is lowest area we have encountered and only one which could hold considerable standing H20 after heavy rains. All the turds seen in this area till now are quite old and dry. Most recent must be at least 1-2 months old – most older and extremely dried out and bleached.

This area is surrounded by a huge semi-open area of rocky pampa with red soil and scattered shrubs, saplings, and small trees. Quickly enters into a huge pond full of black rocks – at least as big as that near camp – about 100 x 60 m – a large black oval. In heavy rainy season must contain a lot of H20.
Tortoise turds all around and in it – all very dry as in previous small pond and pampa area. Turds more frequent around large pond as might be expected. (Pg. 50)
Completely dry now and surrounding pampa (to NW) and rocky hill (to E and SE) also very dry. Some small decumbent green herbs in pond bed in soil patches as at camp pond but very dry. Otherwise nearly a complete lack of food all over this area.
Tortoises and sign around the pond – more information:
Found a tortoise skeleton on side under a Waltheria bush in semi-shade – not too old – perhaps 1.5-3 months. Still has skin and a bit of dry meat on one leg. All scutes but one off of carapace and it is just beginning to break up along vertebrals. All 4 legs present and no sign of dogs having hauled them off or bitten into legs or carapace. Dogs could have killed it but more likely died of a disease or thirst/hunger in past hot season (or end of hot season- beginning of garúa). Normal shape – perhaps a ♂ because scutes only slightly smooth in a small area in center and not (Pg. 51) extremely worn. Hard t determine sex accurately. CL 73.0; CW 77.0. Collected nearly complete skull.
3 out in center of pond in shade; 2 together under a gnarled dried up Cordia lutea. The other under a Scutia; all inactive in shad or semi-shade.
#15,143 ♂ - CL 85.1; CW 84.4. normal shape; no extra scutes. White growth increments clear but extremely thin and occasionally incomplete. No lichens, algae, or flaking disease. No ticks.
#15,144 ♂ - CL 85.6; CW 91.2. normal shape; no extra scutes but 700 and 7000 ones rather small. No lichens, algae or flaking disease. Scutes smooth in central 1/6-1/10 or less; but well worn. White growth increments clear but very thin. No ticks.
#15,145 ♀ - CL 66.4; CW 69.0. Normal shape; no extra scutes but 700 and 7000 are very small wedges only. No lichens, algae or flaking disease. Scutes smooth in central small parts only but very worn. White growth increments incomplete and extremely thin. No sign of recent nesting or copulations. No ticks.
Old dry turds all around all 3 of these beasts- but as with #15,141 and 15,142 as regards freshness and condition. Very hot in open here. Strong breeze makes it relatively cool in shade. They have certainly not been active here for awhile nor could they be on days like today. Must move and eat very little; and no water except after strong garúa – very poor existence and conditions here throughout (Pg. 52) at least most of garúa season I am sure except for early part of it when have heavy rains in Apr-May period of hot season.
Took some photos in this large pond area – Roll 187, #10-16 of pond, only small amounts of live vegetation, burro skeletons etc. # 17-21 of ♂♂ #15,143 and 15,144 they had a brief aggression (see notes at end of day).
No other tortoises seen around pond. But a lot of turds from very old bleached ones (many months old) to some of 1-2 months age. Sign scattered all over pond floor and around it. Many pathways of smooth lava worn all around pond edge and leading into it from many directions; (especially so on SE and ESE sides where lava uplift occurs).
[Marginal note – Dogs (feral) and tortoise nests!]
Found one extremely interesting thing in pampa between small ponds just before this one and this large one – a very fresh dropping (Pg 53) from a dog. Only slightly dry and

covered with flies; from late yesterday or early today. And inside it all small pieces of a hard only slightly curved white egg shell (circa 1 mm diameter pieces and a large 1 x 1 cm piece of an egg membrane. [Marginal note – am almost certain is tortoise egg.]

On toward Media Luna (inland one): Continued to near base of this mountain, crossing an area of mostly rocky pampa with red soil patches all the way; to both sides of us was pampa, but not as extensive in parts as that crossed earlier today – more rocks and dense vegetation on either side of pampa now and the pampa itself narrower. Finally found 1 more small lava block-filled pond only ½ km from base of Media Luna. Just past this we ran out of pampa and ponds and entered a zone of pure soil which is the alluvial plain surrounding Media Luna and the smaller hill beside it on all sides. This area consists of the pale yellowish-brown, very fine, dusty and powdery soil as found in nesting site and potential nesting sites around Cerro Sesenta.

After climbing both the smaller nearby hill and Media Luna we discovered that this fan or plain of soil completely surrounds the bases of these hills, covers the floor of Media Luna inside (collapsed at one end and easy to enter for tortoises and burros) and even appears to run all the (Pg. 54) way or almost all the way to a small baylet on the coast below (this remains to be examined on my map for the trip is indicated the area to which we could definitely see this soil covered plain and areas where it may be are indicated by question marks. Anyway, it is and certainly has been for along time an easy access route to this end of the tortoise population from the sea, being the natural drainage pattern to the sea from Media Luna and thus filled with weathered soil from that cone. This soil is in effect the exact same type s occurs in a narrow band along the drainage from the Pan de Azucar directly to the small bay where we disembarked for this trip in Bahia Terrapin. The soil is deep and virtually without rocks for quite some depth; it is not cracked and does not form ponds anywhere because of a slight seaward slope everywhere. It would be extremely easy for tortoises to nest here although the hard caps of nest made in (Pg. 55) it would not be of great durability. Both for digging quality and net structure I think this soil would be much the same as nesting Zones D and E on Isla Pinzón where the tortoise ♀♀ lay in great abundance without difficulty. The total area of this openish type of soil just around the outer base of Media Luna and its adjacent small crater must be many score of hectares. Of course the drainage to the sea and the same soil type around the smaller Media Luna closer to the sea (but another inland one and to the N would greatly increase this size estimate.

All of the way to the beginning of the yellowish soil from the big pond area (noted previously) we noted scattered but frequent dry tortoise droppings from recent months up to very old dry, bleached ones. – no really fresh ones. Most (examined circa 15) full of Castela, grasses, and/or small herbs. Nor tortoises seen though out this trek. We then examined (3 of us slit up) virtually all of the yellowish soil area around the entire southern half of the base of Media Luna and its adjacent crater. There were scattered but months old tortoise droppings, all dry and bleached all over this alluvial plain. They were not as frequent as in ponds and red soil pampas around last large pond and after it enroute her, but their quantity indicated that animals still frequent this area, probably (Pg. 56) during and especially after heavy rains. We found some small depressions of a few to 5-8 cm depth just into this area a few meters after we left the last pond/red rocky pampa area. Beyond this there were no definite signs of tortoise nesting activity now or in recent years at all. In addition these small depressions, although of the proper size to

be old nesting attempts by tortoises could easily have been caused by burros scratching and pawing about. We saw many donkeys in the area and their sign and trails are every where leading to Media Luna, all around it and on to the sea via the soil-covered pathway described above. As at Cerro Sesenta the problem of finding old or new nest sites is certainly complicated by donkey activity in the open soil areas.
Most of these yellowish soil area is openish with scattered groves of trees (Bursera, Acacia) offering good and abundant shade and with ± dense Croton in other areas offering some shade. There is plenty of just plain open (Pg. 57) unshaded soil everywhere in it however. The area lies (alluvial plain on S side of Media Luna) at about 80 m altitude (Luftt, 1430 hrs). It is now extremely dry and dusty with no green herbs virtually at all for food, and little on shrubs and trees within tortoises' reach. In fact all way today from ponds/pampas near campsite and Cerro de los Liquenes has become gradually and very slowly drier conditions and lower altitude.
It is very probably that tortoises used to visit this area in even greater numbers and that nests were made here. It remains to be examined but I am fairly certain they went all the way to the sea coast via the yellowish soil pathway on the N side of Media Luna and perhaps go to sea even now.
Their elimination or decrease rather in this area is certainly due to previous exploitation for probably 2-3 centuries and at least in the 19th (century) up till some time in the 20th, perhaps occasionally now (doubt now – no human sign of very recent age). The pathway to this area described above would be easy from a ships longboat or any small yacht or fishing boat anchored in the small baylet and the soil would create easy traverse; all this would be especially true in tortoises had been scattered (Pg. 58) all along this pathway from Media Luna to the coast. We gathered some evidence of previous human activity here - 1) a piece of a clay pipe or vessel found in the largest pond where marked # 15,143- 15,145; 2) some pieces of green, thick well-made, hand-made and blown bottles on S side of Media Luna only 100 m from its base in the yellow soil plain (parts of 2 different bottles – necks, and bottoms); 3) same bottle type – the bottom of another with inscription "JWG" on bottom; this was on our return and was about ¼ of distance from large pond on back toward camp area – in a rocky red pampa near another pond (a small one). All these were collected and some of bottles returned to station; same done for clay piece; placed their sites on map.
From and around top of Media Luna took rest of roll #187 of photos. Also surveyed surrounding areas for 360˚ with binoculars and will make certain changes on map from this. More on this later and information on map also.. Also saw first goats 4 ♂♂, large (Pg. 59) adults on top of Media Luna; shot and killed all of them.
On return toward camp we decided to pass about 100=150 m further to SE from this mornings route because rocky pampa slopes to this area. Here we found that there is a long series of rocky red pampas/small black pond all way from area of 3 small collapsed craters where were this a.m. on to where saw #15,015 this a.m. – i.e. joins system from camp area. Much sign of tortoises enroute = many droppings and very old to reasonably recent (± 1-3 weeks). Several H20 collection sites and mud all over them. Clearly this is route used most and not higher up on plain where crossed in a.m. 5 tortoises seen enroute along this pathway – we were hurrying so certainly missed others:
New #15,146 ♂ - CL 89.0; CW 93.9. ± normal shape but raised more in front; like some becki. White growth increments clear and moderately thick; no lichens, algae, or flaking

disease. No extra scutes; slightly NE of collapsed crater visited this a.m. – near another small crater.
New #15,147 ♀ -
CL 73.0; CW 74.5. White growth increments as in previous animal; no lichens, algae, flaking disease; scutes smooth in central 1/10 or less only. Normal shape, no extra scutes. Just 100 m SE of rock (collapsed crater) visited this a.m. [Marginal note – no sign of recent copulation or nesting.
Three under one tree – further toward camp – 150 m ± (all resting) (no aggression seen).
#15,014 ♂ -
#15,064 ♂ - with lichens – all 4 types seen so far – all over front are of 1st 2 marginals on each side plus 1st vertebrals.
New #15,148 ♂ - CL 94.0; CW 91.2. All 3 with well-developed moderately thick white growth increments. Also all have much red mud all over carapaces, even on top – thus perhaps a lot of mounting – shallow basin in lava blocks near them – red mud thinly spread all over lava here. See trip summary for aggression notes. (Pg. 60)
26 Sep 1970 – J. Black and Hugo Garcia are off to check around base of Cerro de los Liquenes and then to look for the pass we thing may exist to the E and SE from rocky pampa ponds area running from our camp area all the way to the inland Media Luna. This pass is not mentioned in yesterdays notes as a possible rout toward the hills to the E quite a ways off, but will say more in this evening notations. I am going up to Cerro Sesenta on roughly same route as we 3 took on 23 Sep 1970. Looking for ectoparasites of tortoises (ticks mainly), lichens and algae on tortoises certain plant species to collect herbarium specimens and root hairs for karyotypes (for Heslop-Harrison), and tortoise nesting sign.
#15,139 ♀ - at tent, moving. #15,119 2o m S of tent sleeping.
Enroute to Cerro Sesenta - still in big pond near camp I encountered #15,140 ♂ crossing pond in the open and took photos 1-5, Roll 188 of him crossing pond – shows lack of vegetation and dryness. He is obviously sniffing (Pg. 61) about and looking for small herbs to eat.
#15,122 – moving along passageway of red soil and rocky boulders which leads from big ponds to smaller ones on S side of hillock near camp.
Then I am moving up another well used Tortoise-burro route ± directly toward Cerro Sesenta – over red soil patches/boulders; lots of drinking sites which have been well used recently after garúa. Dry turds all along this route.
#15,123 ♂ - resting under a tree. He is abut 100 m from where we marked him the other day – seems to have moved up this well used path directly from ponds area. More notes on his lichens. He has types 1 and 2 all over 2nd and 34d marginals in front on each side. Has also a few spots of type 4 in same areas; not type 3 First 2 types are in very fine patches of too scattered a condition to collect them. Also has large (1x 1, 1x2-3 cm patches _ of type 4 in shallow depressed areas (where are slightly protected) around borders of 4th vertebral scutes, along borders of 3rd – 4th (last) costals on each side; i.e. borders both with each other and with 4th vertebral. All these patches are growing on areas which are almost completely worn smooth like most of scute surfaces, but still not quite (Pg. 62) smooth – roughened just a bit from vague remnants of growth rings there along scute borders. I suspect this lichen grows here and in areas note on front marginals and first vertebral for both reasons- slightly roughened surface still here even on large old

males and also more protected then open, completely smooth areas where abrasion is greatest. Other 3 lichen types have only been seen on front marginals /1st vertebral areas noted before but other areas also are slightly roughened and even more protected than rear areas of these old smooth scuted males. Again probably same reason for these 3 other lichen species. One exception to this is #15,064 ♂ seen yesterday, who had one tiny patch of type 2 lichen on protected rear, but smooth surface of a last costal. Can't all be a case of protection or even roughness because all ample area on 5th vertebral and lower portions and more new portions of last costals, supracaudal, and even (Pg. 63) places on rear marginals where I have not yet seen any of these 4 lichen types growing. These area and scutes are both protected (in most cases better protected than surfaces of last 2 costals on each side and 3rd and 4th vertebrals where type 4 does grow) and are roughened along their borders just as much as places where lichen type 4 grows and nearly or just as roughened and protected as front marginals – 1st vertebral area where types 1-3 grow!

These areas however are generally a bit more shaded in an overall sense than the main areas where I have seen the 4 lichens growing as perhaps light is the additional important factor accounting for the differences.

So far I have seen no lichens on any small to medium-large sized ♂♂ or any ♀♀. All have been on largest and oldest, and most smooth-shelled males – why? Perhaps then scutes all still very roughened in sense of having wide bands of growth rings the lichens will not grow. Also, these smaller ♂♂ and of course the ♀♀ are probably (definitely I would say) mounted much more often by large males. This might aid in prevent lichens from obtaining a foot hold in both areas – (Pg. 64) in front marginal area because of abrasion by feet and in rear area by plastron of the mounted large ♂♂. I should mention that the roughened surfaces along the scute borders where the lichens are found on the old, larger males are rough only slightly and are made up of many fine lines running in parallel to the scute edge and the lines are only fractions of a mm to 1 mm apart (see photos). This forms a finely roughened surface which is not like the wide more grossly rough surface formed by slightly or even greatly worn growth rings of younger ♂♂ and most ♀♀ except for the very oldest ones. Also have not yet seen a ♀ of great enough age to be as worn as these males with lichens. Should be interesting to see if such very old, large, worn ♀♀ have lichens – must question up till now. (Pg. 65)

Since it is becoming obvious that this pathway leads on off to the W and WSW I decided to change direction and not head up to the Cerro Sesenta area immediately; but am moving instead to WSW, skirting Cerro Sesenta and about 1 km from it.

Tortoise turds of many ages from very dry to some recent mist ones are continuing all along this route. The area is mostly rocky with lots of smoothed lava pathways from ancient tortoise use; there are patches of red and brownish-red soils scattered all through the rocks in formation such that pockets and basins are present for H20 collection. There is mud all over these and all along rocky trails from recent garúa and tortoise and burro activity then. This is the general area where saw #15,115 ♂ on 22 Sep.

Found #15,115 ♂ only 30 m from where was marked on 22 Sep. Now he is resting in shade (but still cloudy and cool). Moving on past him and gradually climbing. Soil enroute decreasing from like that around pampas near camp – becoming more rocky.

Then in an area just below and about 100 m from base of a rock outcrop which is about WSW of Cerro Sesenta found a number of tortoises, all resting under vegetation – small trees and some very large Pisonia. (Pg. 66)
New # 15,149 ♂ - CL 79.8; CW 77.8. No lichens, algae, or flaking disease. scutes smooth only in central 1/10 or less. White growth increments incomplete and extremely thin. Normal shape but raised more in front than usual – but not approximating a real saddleback as a few have seen here do. Red mud all over carapace as if was mounted recently during garúa. no extra scutes. [Marginal note – Lots of turds all over this area – most recent ones (1-3 weeks) have lots of Castela inside with some twigs and herb leaves and dry grasses.]
New # 15,150 ♀ - CL 67.0; CW 67.5. normal shape; no extra scutes. No lichens, algae or flaking disease. White growth increments incomplete and extremely thin. Scutes smooth in central 1/12-1/10 or less. No sign of recent nesting; red mud all over carapace so perhaps copulated with or at least mounted recently.
New # 15,151 ♀ - CL 74.9; CW 74.5. normal shape; no extra scutes. No lichens, algae, or flaking disease. Scutes smooth in central ¼-1/5 or less but well worn. White growth increments incomplete and extremely thin. No sign of recent nesting or copulations.
New # 15,152 ♂ - CL 86.8; CW 84.7; normal shape; no extra scutes, but 700 and 7000 ones rather small and wedge (Pg. 67) shaped. Scutes smooth in central 1/5-1/3 or less but well worn; no lichens, algae, or flaking disease; white growth increments clear and moderately thick in some places, rather thin mostly however, Covered with red mud from recent garúa.

New # 15,153 ♂ - CL 85.5; CW 87.7. normal shape except does not curve down much in front at all; approaching a saddleback shape but not quite; 700 and 7000 scutes as in last animal. No lichens, algae, or flaking disease. White growth increments incomplete and very thin; scutes worn but smooth only in central 1/8-1/6 or less. Fresh brown mud on front and top of carapace – clearly has been mounted recently by a larger ♂.
#15,132 ♂ very near previous one both in shade, inactive. Has moved about 300=400 m from where last saw him. Around the base of the rocky outcrop mentioned above and when I found these 2 animals I discovered that the smooth rock/soil patch areas stop rather quickly. In fact at point where I found these 2 am now in another low lying pathway leading up to Cerro Sesenta and the group of small hills it lies within. Climbed rock hillock and found that all around the base of it is smooth lava and tortoise inhabited area. As I look out to NW and N however there is a big rise upwards to what appears to be just pure lava and denser vegetation – no soil at all is visible. This area is in part what we crossed the other day (21st and early 22nd, of (Pg. 68) Sep in coming to pampas area via Pan de Azucar. As I look to W to Cerro de los Galapagos in other words, it is obvious that form here in this immediate area of the pampas and ponds there is not much but rocks on to the W. Am only about 0.5-0.75 km W of our camp area and it looks as if area with tortoises only extends to about 0.75-1 km to W NW and WSW of camp. Can't tell from here of course what lies on to SW, S, etc. of Cerro Sesenta group of hills and tortoises are there and could go further W and S of there. Probably went on to W in general from where I am now at one time but doubt they do now – or at least we saw no evidence of it on ascent of 21-22 Sep.

Will not take coordinates or altitude here since I am still so close to pampa/ponds and campsite area and above description will allow me to fill in map accurately as regards present and past supposed tortoise habitat. (Pg. 69)
Just before climbing to here I noted tortoise #15,153 began moving along a smoother tortoise lava pathway or highway – took photos – Roll 188 - #6-10. Climbed up by route from rock hillock to Cerro Sesenta area. Lots of tortoise turds first 1/3 of way then nothing, then just around bases of outcrops at top a few dry ones again. Perhaps move up more via route we used other day. Rocks more smoothed there.
New #15,154 ♀ - CL 76.0; CW 76.5 – just beside rock outcrop to N a short way from Cerro Sesenta itself. In shade of a tree beside an open area where burros kick up dust. Area is of yellow-brown soil and like small area where J. Black found nests. No lichens, algae, or flaking disease. White growth increments extremely thin and incomplete. Scutes smooth in central 1/5-1/3 and very worn. Normal shape and no extra scutes; but 700 and 7000 one small and just wedges really.. No sign of recent nesting involving cloacal fluid dropping or of copulations. Perhaps here to lay? She has mud and soil from this area on feet and legs and tail but could be just from garúa. Checked over soil patches near here – there are places she could dig her but no nest and no sign of attempts. Very disturbed and churned up by donkeys; even so, if she had dug within last few days one might expect sign – but none. She has no ticks or other ectoparasites I could locate. There are several old dry turds – circa 1 month plus around her rest spot and 2 more recent – 1-2 weeks – ones – recent ones full of sticks and twigs and dry (Pg. 70) grasses and leaves – poor food I would guess energy –wise. Older turds contain same things.
From last area I worked down hill to W of Cerro Sesenta toward potential nesting are where marked #15,127 on 23 Sep 1970. Passed several other small patches of soil like those typical of this area in route but no sign of nesting activity of recent years or this year and no tortoises. Scattered dry turds everywhere.
#15,127 was in same general area but ambulating today – still cool and cloudy (now 1430) as has been all day – seems to be foraging.
Then on to W to rim of largest highest crater of Cerro Sesenta group of small craters – about 200-300 m W of Cerro Sesenta peak itself. Found scattered dry tortoise turds all way from Cerro Sesenta to rim of this larger crater (very gradual slope to its rim). There is a lot of flat, plate like rock and red soil all over slopes of this crater, but (Pg. 71) nothing suitable for nesting. Tortoises clearly use this area however, and are some scattered green herbs to eat even now. So no animals and most turds all dry and several months old but some few are from past month or 2.
At the rim of this highest crater altitude was approximately 220 m at 1500 hr on Luftt altimeter. From here could see all over t W, S and N toward Bahia Rosa Blanca, El Chin, highest mountain on island, Cerro de los Galapagos, Cerro Brujo etc. Could easily note that was much soil along and all over lower slopes of this crater and all around its base. Also, though beyond this soil toward Cerro de los Galapagos and to the SW I could not see clearly enough to determine the nature of the substrate (due to dense Bursera, Croton, and other vegetation covering all these areas), it looked as if tortoises could pass in both directions via the lowest lying areas running out from the soil covered areas at the base of this crater. There appeared to be 2 possible paths to Cerro de los Galapagos, and 1 or more to the SW (toward (Pg. 72) Cerro Chino ±). These pathways are probably rolling, ropy lava covered by fairly dense vegetation but the actual substrate is unknown

as of now. There is certainly no problem regarding shade for the tortoises passage. They would not have to now or probably in past, cross any fresh open, un-vegetated and un-shaded lava of either black or red type to reach Cerro de los Galapagos or the whole SW portion of the island.
If there are rocky pampas leading to one or both of these areas then they most likely will exist along these low-lying "valleys: or pathways. Of course, it could be lava all the way beyond the immediate base of my present location, but even so, with shade they could have crossed the lava in the past in great numbers and maybe even some occasional ones would do so (Pg.73) still. Smoothed pathways on the lava would at lest give evidence of previous population distribution and movements. This all remains to be investigated.
We at least know from Sr. "Coca-Cola" Morales that there is much soil all over Cerro de los Galapagos and around its base and running form it to a large bay on the coast. He says that up till 1955-1958 period fishermen (including himself) used to go to this area of hills via this bay to search for adult tortoises for eating and for oil. Also, to that time Ecuadorian Navy officers and sailors went to same area to obtain very small tortoises (hatchlings and those of a few years age) for selling in Guayaquil. The thinks these young were found somewhere along the pathway from the coastal bay up to Cerro de los Galapagos. This indicates there must have been a nesting area (and maybe still is) on the outer and NNW flanks of Cerro de los Galapagos or on the alluvial plain below it. He says that in 1955-58 period sailors and fishermen stopped going here because tortoise young and adults became so scarce and hard to encounter. (Pg. 74)
Since I doubt this was (or is) an isolated population in this area it must have been (and perhaps still is) connected to the extant population to the E.
We do not actually know what exists over toward the huge area to the SW out toward El Chino as regards tortoises but Julio San Miguel says people used to go to NE to hunt for tortoises from El Chin area and that there was a trail from the settlement in that area to Bahia Rosa Blanca (for lobster fishing).
All of these areas are indicated on my map for the trip.
Then I proceeded to base of this crater (to W side) and poked about some in soil there. Lots of scattered dry tortoise droppings and some fresh tracks of them in soil. Looks as if could serve as nesting sites. Since it was nearly 1600 and I had much left to do had to move on and this area will simply have to be searched more thoroughly on another voyage here.
Before leaving here I collected some specimens (3 sheets) – (Pg. 75) (5 individual plants) of a small low growing Alternanthera which was growing right in small cracks and openings between rocks in paved lava surface of the crater near its top. Growing much like Tundra plants in open, clear, hot, rocky sites with no other plants nearby – very windswept area. Will give some of these plants to CDRS; is plant #23 of my series of Galapagos plants. Saw many specimens of this same plant on S facing windswept hot surface right near summit of inland Media Luna. Same size and characteristics there. Very open site also; none collected there.
Continued on to large Opuntia tree at base of rocky little hill just NE of Cerro Sesenta. Visited it on 23 Sep 1970. Now are 4 tortoises around its base: #15,112 ♂, 15,113 ♂, 15,126 ♀, and an unmarked ♀. Did not have time to mark the latter one, but can add to count. First 3 actually under the Opuntia tree; other one 20 m away under an Acacia. All inactive and resting. Very poor light, but collected and photographed anyway.

Roll 188, #15-18 of this Opuntia tree as a whole. Along with photos of pads, spines, etc. of younger specimen of 25 Sep 1970 should enable some description. Tortoises in photo, (Pg. 76) especially lichen covered #15,112 ♂ should allow a relative scale size. This Opuntia tree is huge, standing at least 5-6 m high. Has bark of tough red type all over trunk and well out onto limbs. Pads have only soft, hair-like spines. Could see not real hard stiff spines on them. It had no flowers and I could only see 4 fruits; I could reach only 2 of these and collected them in FAA.

Till now, had not taken note of it, but ground all over under this tree is littered with several dozen dry tortoise droppings of ages of several months to not more than 1-2 weeks old ±. Some of thee are full of grasses and herbs, but most are crammed full of Opuntia remnants, including hair-like spines, internal pad structures, and red bark. Not sure if any seeds of Opuntia are present or not. Tortoises are certainly devouring completely (perhaps with burros goats and or cattle's help) all pads which fall, bark also and probably all fruits and flowers which make it to the ground. (Pg. 77)

Collected 3 of the more recent droppings which contain Opuntia material to examine them at the lab for seeds and other parts.

Did not take altitude here but top of nearby rock outcrops on top of hillock read 162 m on 23 Sep 1970 at 1345. Altitude here must be about 145–150 m judging form that.

Did not record it a while ago, but when in 173 m altitude potential nesting area at 1430 (where #15,127 was) I collected some root hairs from a tiny cactus (Opuntia) seedling there. These are for Heslop-Harrison's karyotype studies. Also pressed the seedling itself- Plant #22 of my Galapagos series.

This is an appropriate place to make a few comments on Opuntia and Jasminocereus conditions here. Opuntia are extremely scattered and very few in number. After walking over large areas for 6 days and looking over dozens of square km from various peaks with field glasses have discovered:

1. only 6 very large old trees like one am now at – visited this one only; saw other 5 with binoculars, all in this upland area. All these of 4-6 m high variety; with thick red bark; no spines.
2. only 3 smaller specimens still with spiny trunks and lacking red bark – all these of 2.5-3 m tall size range. Visited 2, one (Pg. 78) on 24 Sep 1970, other yesterday near camp on hillock nearby. All with very fierce spines on trunks and some spines on most basal pads. Most pads and even basal oldest pads mostly with hair-like spines, not stiff ones.
3. 10 small seedlings, consisting of only 1 or 2 pads, only a few to 6-8 cm out of ground. Extremely heavily spined pads; only fierce spines. All ones seen but one living but dryish. One dried up and dead.
4. No other intermediate sized, younger ones seen between types under 3. and 2. above.
5. All Opuntia seen in areas where goats, burros, cattle could get to them to eat trunks (types under 1 and 2) or pads (types under 3).
6. Many, many, circa 25, old dead dried up ones. All were large heavily-barked trunk types. All fallen down, dry and dead for long time. Many with trunks stumps beside them still in ground, rooted into rock. Appears that most (Pg. 79) of these had been killed by goats and or burros eating trunks partly followed by death and collapse of the large trees.

Entire Opuntia population is extremely decimated and appears as if above comments indicate that goats and burros are the cause, in that they eat most young ones once they get a bit beyond seedling stage and also have killed all but oldest, largest ones in most of the area. A few seedling are still getting by as indicated by some younger ones (the 3 under 2. above) but with only few, scattered adult plants reproduction is very low.
All tiny seedling sere found at distances of hundreds of meters or more from nearest reproductive adult Opuntia trees – probably indicates transport of seed by tortoises, feral animals and or birds.
Status of Jasminocereus population is much better. Saw individuals of varying sizes everywhere we went on rocky, lava substrate area. But again in this case huge numbers of large adult ones eaten around base at trunk height of burros and goats; many of these collapsed and dead; others in process of dying and drying out. (Pg. 80)
(Note: some natural death of these adult ones evident also, much as on Santa Cruz; but majority killed by ferals). Also lots of tiny seedlings all over in rocky areas k- only 3-8 cm tall, mostly. Saw some of intermediate sizes between these seedlings and largest adults but few and more scattered – only lots of them in healthy condition in very inaccessible inner steep slopes of a few tiny craters like Cerro Sesenta. Anywhere ferals could reach these intermediate ones were lacking. So also, clearly, this population is suffering from feral damage.
Then I proceeded to photograph and examine and collect lichens from #15,112 ♂. Scutes smooth save for outermost borders of about ½" maximum –s some entirely smooth. White growth increments clear but extremely thin. No extra scutes and normal shape except extreme drop in rear from back of 4th vertebral; also not quite as low in front at nuchal notch as normal. No clear identifiable algae or flaking disease. (Pg. 81)
Absolutely covered with lichens – distributed all over carapace – quite a striking view. Took rest of Roll 188 (HSE), #19-36, of these lichens and various views of the whole animal. Using nomenclature of 23 Sep 1970 and earlier today and for rest of this trip, Noted location of various lichen types. At least 5 types and perhaps 6 – collected as if 6 types; collected all of them in dry form and additionally some of type 1 (perhaps an alga) in FAA.
Types 1-4: as described for #15,125 ♂ (see Pg. 17) all over first 3 front marginals on each side; on front, lower, slightly inwardly depressed edges of 1st vertebral and 1st costal of each side where these join front marginals. All 4 also along upper borders of last 2 costals on reach side and along most all borders of 2nd, 3rd, and 4th vertebrals.
Types 1-3 (not type 4) , also on last 2 marginals in rear area on each side, and all 3 scattered all over 5th vertebral but only lightly. Also all 3 on rear border of last costal on each side where join with 5th vertebral; type 4 on none of these locations. (Pg. 82)
Type 5 – very like Type 2 in growth form and size of patches, but not as pale; more of a green caste to it and less pale grayish. In same sites everywhere as Types 1-3. Could be same species in different stage as Type 1 ? (due to color) Or Type 2 ? (due to form and size).
Collected separately as with first 4.
Type 6 – only on first 2 marginals on each side in front in small patches; and on very inner borders of 1st vertebral where it joints first marginals on each side. Hard to

describe. Seems to be growing on tope of type 4 and thus may be only its "fruiting bodies" or something akin to such structures?
Collected separately as with first 5. No lichens at all on supracaudal it is very scratched and abraded and shows signs of much abrasion. All lichens individually, and as a group are definitely concentrated in less abraded and more depressed areas- these areas are also those where final remnants of (Pg. 83) most recent growth rings often provide a roughened surface. But all 6 types also occur in areas without any roughened surface save for that created by lichens themselves. So perhaps protection is a more important factor than a roughened surface per se, although both factors go hand in hand in hand obviously. Then returned rapidly to camp as dark was approaching and I was about 2-3 km away over rough lava.
Today J. Black and Hugo Garcia took trip I described. Where appropriate I have indicated their route and discoveries on the map from the trip. They found.

1) ponds (rocky pampas area runs to SE even further than where we saw 5 animals on return to camp from Media Luna late yesterday (25th). About another 300 m ± 1 tortoise seen here previously marked – no number recorded? This tortoise in last pond before rocks started.
2) After this there is an area of rocky lava with shady vegetation, but with clear sign of tortoises crossing it – dry tortoise turds here and there along it (few) and smoothed lava pathway. After about 1 km of this they left pure (Pg. 84) lava and entered more rocky, red soil pampa – here in a tiny crater with an entrance on one side saw fresh and old tortoise turds round about in pampa and found 1 unmarked animal(♂; medium) inside crater (easy passage inside). They used knife to put an x on #1 (first left marginal) scute of this one to allow us to recognize it in future. From here they continued on to "red" hills to SE of camp but from last tortoise on, although reddish soil and rocks intermixed all the way, saw no more tortoises or clear sign. But were moving fast here and do not know if missed sign. Anyway, clear that tortoises probably did and could now pass all way to these red hills. They returned directly to camp avoiding this "pass" and crossed all way to new camp on lava – going too fast to say much but did not see sign or tortoises. (Pg. 85) Saw no clearly utilizable areas for nor sign of nesting on entire trip. In early part of trip circled base of Cerro de los Liquenes to its N and out over a low large hill and then to pass. Enroute around Cerro de los Liquenes saw rocky pampa with red soil everywhere, scattered tortoise sign (dry turds) but no tortoises. This was true all way to beginning of pass to SE where found the one animals marked on a previous trip (see Pg. 83)

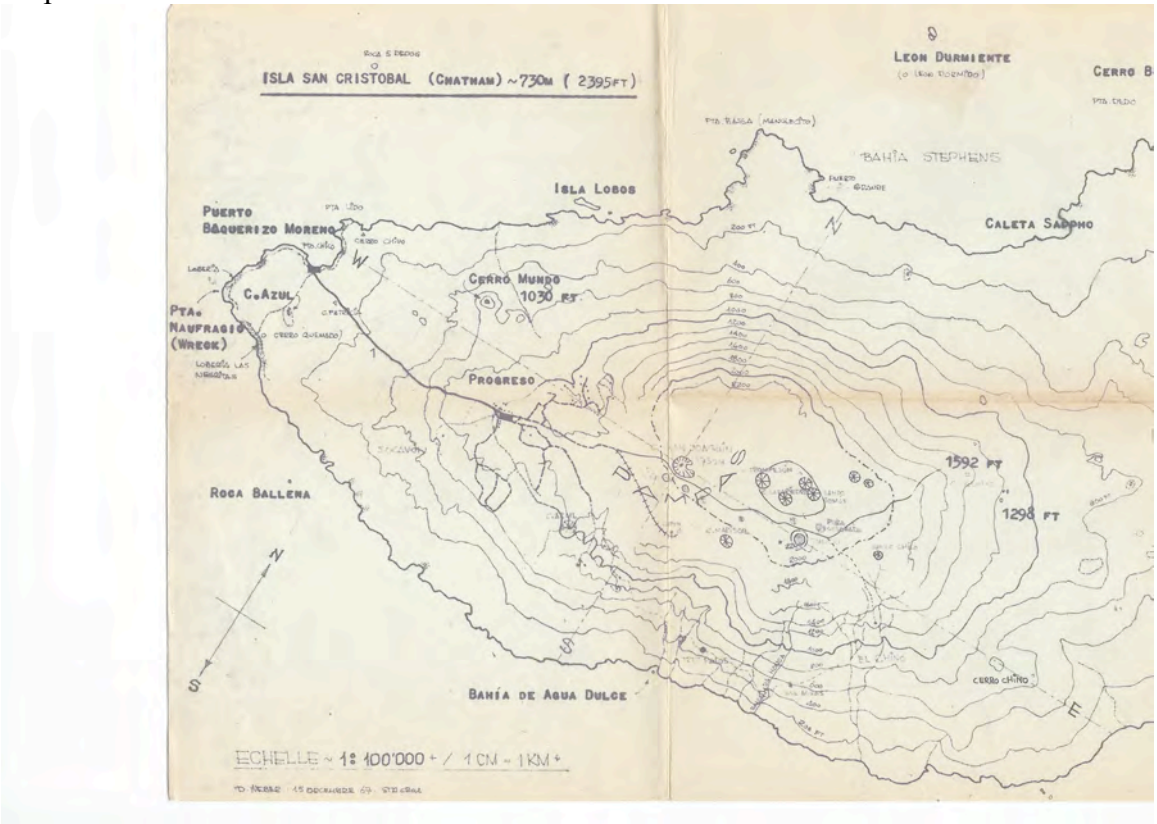
Not far from camp they found 1 completely whole and 1 nearly complete (top of neck missing) bottle of same type as found yesterday near Media Luna. Were in rocky red pampa on NW side at base of Cerro de los Liquenes – all exposed; remains of 2 other bottles but not brought back. So people got this far for Christ's sake! The 2 bottles will be returned to CDRS for their collection and hopefully identification. Also Juan Black found some individual of what appeared to be Scalesia incisa (see map for location) at altitude of about 100 m. He (Pg. 86) brought some back so I pressed it for my collection and put some flowers and leaves (all 1 plant) (all on 1 sheet) in FAA. Plant #24 of may Galapagos series. This location on top of low large hill just NE of Cerro de los Liquenes.

27 Sep 1970 – This morning before breaking camp and heading back to coast about mid-day will collect a few plants and take some photos.
First went up to rocky area just above campsite and ponds toward Cerro Sesenta a short ways to collect what is called, at least, Scalesia divisa. Took photos 1-6, of Roll #189 of 2 plants, first 2 of one whole plant, last 4 close-ups of another one. Pressed some of each – first one is my series #25. Second is my #26. From 26 preserved some powers and leaves in FAA. Also collected 2 vials of root hairs for Heslop-Harrison from #26. Close-up photos were of #26, others of #25. Altitude here was about (Pg. 87) 130 m.
Then returned to ponds area near camp and collected a number of plants altitude for all these 110 m; all growing in soil patches in ponds.
#27, my series – Commelina; probably same species as on Santa Cruz. (C. nudiflora). Only one flower found, pale blue as on Santa Cruz. Pressed one sheet full; sample plant seen around Cerro Sesenta. Tortoises surely eat this but did not see such.
#28, my series – A composite species – most plants now dead and dry but a few not so. Saw #15,144 ♂ eating dry pieces of this in large pond bed just prior to Media Luna (inland) on 25 Sep 1970. 3 stems from same plant – 1 to CDRS; I kept 2.
#29 and #30 – Same plant; #29 more green and much reduced in size and not as healthy. Perhaps a Verbena? Saw tortoises eating this in dry pond beds near camp. Just about only abundant and green even though dry, herb in these ponds. 3 of #29, 1 to CDERS; 7 of #30, 3 to CDRS.
Also collected #31, my series, another and different Alternathera; specimens (2) both to CDRS. (Pg. 88)
Then returned to 1st of larger of two carapaces from a dead tortoise which visited on 24 Sep 1970. Took photos 718 of this carapace (roll 189) and lichens which just covered it; photos also include some of 2 of the most conspicuous lichens (which are on the carapace) growing on trees nearby (Cordia lutea). These 2 more conspicuous ones are both of the "bushy" fructicose form – one is a rather bright orange color; the other is a pale, pale yellowish-green. Besides these 2 there are at least 2-4 others growing on the carapace, all of the "liverwort" ± growth form. One type is very pale grey-blue-green, another almost white (slightly grayish) and a third a dark grey, almost charcoal grey in color. I can not accurately say how many of these "liverwort" growth form types there are because some of them may be only slight variations in form of only one species. There are certainly a (Pg. 89) minimum of 2 types or species. Some of these are very like types 2 and 5 collected from living male G. e. chathamensis carapace this week. But can not be sure so will not label them yet with numbers. There are definitely not examples of types 3 and 4 from the living tortoises on these dead carapaces.
I collected some of the most obvious types from the carapace and placed them all in one small box for drying and preservation. All of the types are growing all over the carapace (not much inside it and none on plastron- probably due to less light).
Also collected 2 fructicose types from a Cordia lutea tree nearby; in a small box. Also collected most of the 2nd and 3rd costal bones from the right side for preservation with lichens intact. Thee have all the lichen growth types which occur on this carapace so should serve as a good example for all of them.
Finally only one scutes was still on the carapace, the 2nd, left, front marginal one. It has what appears to be lichen types 2 and 3[Marginal note – type 2 and 3 from living ones

that is.] (and perhaps others) growing on its upper surface. So collected whole scute without removing any lichens, for preservation.

End of journal.

Map of San Cristobal included in back of notebook.




CABO NORTE
(PTA ESTE)
BAHIA ROSA BLANCA

Volcanoes Cerro Azul and Sierra Negra, [Isla Isabela] Notebook Volume #1.
Field Notebook of Craig MacFarland

(Pg. 1) 24 Aug 1971 – Am going through file of Sr. Jacinto Gordillo, CDRS Representative on Isabela (Puerto Villamil) – these are his personal communication from Jul 1966 to present (when he began his job on Isabela as representative). Will put most pertinent things here, and will copy some lengthier items separately.

1. "Informacion a la Estacion Charles Darwin",
   30 Sep 1966. Covers history of Sierra Negra colonization, introduced animals, etc. Information gathered from colonists and by tradition.
   1895 – first colonization of duration – by Sr. Antonio Gil Using prisoners and vagrants. On arrival (Villamil and S. Tomas) they discovered abundant wild cattle (but very tame), abundant tortoises, and introduced plants like sugar cane, yucca, bananas, watermelon. But [island] uninhabited. Two explanations for introductions:
   1) 1832 or after – General Jose de Villamil- left introduced animals on various islands including Southern Isabela. (Pg. 2)
   2) Plants from workers of Sr. Manuel Cobos of San Cristobal who were forced to escape to Sierra Negra and try to live out their existence (when?).

Settlers of 1895 claimed that tortoises were so thick on Sierra Negra that one had to separate or move them when walking along trails in order to progress normally.
Gil first colonized Villamil and Santo Tomas. By 1914 was to Alemania on Cerro Azul.
1946 – Velasco Ibarra declared prison colony on Isabela and 300 plus prisoners arrived. Tortoise slaughtering for oil quickly became a big business – killed thousands and thousands between then and end of prison colony in March (15) 1959. The prisoners went as far as la Cazuela, Volcan Chico, Cerro Pipon, Cerro Barahona, Alemania, and Cerro Azul in search of tortoises to slaughter. (Pg. 3)
Oct 1966 – work by Antonio Constante, warden on Sierra Negra and Cerro Azul.
Date Observations
Oct 8 – Alemania – nothing; most of day to zone.
9 – Cerro Pata-Gallina and area – no tortoises or sign.
10 – W of Cerro Pata-Gallina – only signs of tortoises
11 – N of Cerro Paloma – 2 tortoises near each other.
12 – S and E of Cerro Paloma – no tortoises.
13 – N of Cerro Paloma again – 1 65 x 42 cm.
14 – Return to Sierra Negra.
17 – To Cerro Cazuela – between Cerro San Juaquin and Cerro Los Chivos – 1 40 x 30 cm.
18 – Around Cazuela – no tortoises.
19 – W and N of Cerro Los Chivos – on N found 1 40 x 30 cm.
20 – to N of Cerro Los Chivos again – near Cerro found 1 30 x 20 cm.
21 – E and S of Cerro Los Chivos; 1 40 x 30 cm; 2) 37 x28 cm – near each other.
22 – 150 m N of Cerro Cazuela – 1 34 x 22 cm. Saw same here on 3 Sep 1966.
23 – E and S of Cerro Cazuela – nothing. (Pg. 4)
24 – Between Cerro Cazuela and Cerro San Juaquin – 1) near latter – 40 x 30 cm.
25 – Left Cazuela area – signs of colonists here – but no slaughtered tortoises.
29 – to Cerro Cazuela N zone.

30 – 1) 90 x 72 cm – Cerro Cazuela area.
31 – Cerro to W of Cerro Los Chivos – 1) 32 x 20 cm.
1 Nov – To Cerro Grande.
3 Nov 1966 – Sr. Constante again.
Date – Observations
7 Nov – Between Cerro Los Chivos and Cazuela 1) 40 x 30 cm.
8 – Between Cerro Los Chivos and Cazuela 1)40 x 30 cm; 2) 30 x 20 cm 3) 30 x 20 cm.
9 – Between same 2 areas 1) 40 x 30 cm.
10 – To Villamil.
16 – Between Cerro Grande and Cerro San Joaguin – 1) 40 x 30 c. 2) 30 x 20 cm.
25-29 – Spent 3 days to SSW of Alemania toward San Pedro area – no tortoises. (Pg. 5) Colonist entering both areas – Cazuela and Alemania to hunt goats and pigs. No slaughtered tortoises found.
Sr. Constante – Dec. 1966.
Date – Observation.
5 – Between Cerro Los Chivos and Cerro San Joaquin – 1) 35 x45 cm; 2) 30 x 40 cm (seen before here)
6 – Cerro Los Chivos and Cazuela – none.
7 – Between Cazuela and Cerro Grande – 1) 30 x 40 cm.
8 – Cerro Grande 1) 30 x 40 cm
16 – To Alemania.
17 – S toward San Pedro – none.
18 – continuing S – none.
19 – almost to coast on S – 1 60 x 70; ;2) 50 x 65 cm.
20 – coast again, 1) 50 x 60 cm.
21-22 – return to Villamil.
Saw 8 pgs in Cazuela area; 3 pigs and 13 dogs in Alemania area.
5 Jan 1967 k- Miguel Castro there – see his notes and card file – 2 marked. Beginning this month all tortoises henceforth marked. M. Castro marked 6 beffore in July 1966, (see his notes and card files). (Pg. 6)
27 Feb report from Sr. Gordillo about explorations from 20-25 Feb. 1967 on Cerro Sierra Negra.
20 Feb 1967 – Exploring Cerro Pipón and surrounding area – slopes on N to SE sides of this hill covered with vegetation and soft soil. Are wild pigs, goats and cattle. From SE of Cerro Pipón to Cerro Pelado is on large “planchonadas”. People he trusts claim this area was a tortoise inhabit3ed one up till 15 years ago. Now – absolutely no tortoise sign at all.
20-22 Feb – along coast but inland a bit via Quinta Playa to Cabo Rosa. From here went inland, probably heading NE for 3 hours, then headed toward Cerro Colorado – very bad lava, no tortoise sign and they doubt are any or have been any.
23 Feb – Continuing same march – Finally came into a decent area of pebble soil and herbs between Cerros Colorado and Barahona, here found and marked a tortoise, #8,016. Then headed directly up to N or NNW toward center of Volcan Sierra Negra. Good country but no more tortoise sign.
24 Feb – Return to Cerro Barahona by same route (Pg. 7) and on next day back to Villamil.

7. 1-15 March 1967 – M. Castro on Sierra Negra – see his notes and card file.
8. 2-9 April 1966 – M. Castro – Cerro Azul – see notes and file.
9. 11-18 May 1967 – Sr. Gordillo and Warden A. Constante – trail from Alemania to large lava flow to West – worked 13-17 May and saw no tortoises while making trail.
10.-- June 1967 – Sr. Gordillo and Sr. Constante 5-8 Jun – explored E of Cerro de los Chivos, NE of same in a big loop and to N of same till reached large lava flow – Marked # 8,017 through 8022. Near lava flow N of Cerro de los Chivos found # 89,020- 8022 – two of them small, thus possibly a nesting area. No nests, new or old, found.
22-26 Jun – Explored area of NW of Cerro Paloma, Cerro Paloma passing through Alemania en route – Marked #89023- 8,026 – no sign of nests. He notes that #8026 is nearly a saddleback in form.
11.—July 1967 – Sr. Gordillo and Sr. Constante
7-10 Jul 1967 – again to possible nesting area north of Cerro de los Chivos – same results; marked # 8027-8038. Mostly quite small ones. Saw one (Pg. 8) land iguan in a vegetated area out in large lava flow more to N of possible nesting area.
12.—Aug 1967 – Sr. Gordillo and Sr. Constante.
18-20 Aug – Constante to N of Cerro Grande found 1 slaughtered tortoise, killed perhaps 5 mo ago.
21-24 Aug – to SE of Cazuelita – no signs of tortoises; then to S and E of Cazuela- [Marginal note - marked #89039] signs of tortoise but found none.
27-31 Aug – To Cerro Azul via Alemania – Marked # 10,002-10,006 in NE area (to W of large lava flow) (10,002 marked by Castro on Apr 1966 trip.)
13.—Nests and tortoises – Cerro Azul – M. Castro NE and E of central crater – see his notes and card file – marked #10,007-10033. 15-21 Sep 1967.
14.—11 Sep, 15 Sep, 21-24 Sep. M. Castro marked # 8041-8045 in diverse sites on Sierra Negra – see notes and card file.
15.—15 - ? Oct 1967 – Sr. Gordillo and an aid to "El Tuno Blanco" a site near edge of lava flow, SE of Cerro Grande, Sierra Negra, directly in direction of Los 4 Hermanos. In this area found 2 ♀♀, 1 huge ♂, 1 of ♀ large and of reproductive size and other nearly so. Huge ♂, marked #8,048, has a hole in last left marginal scutes which according to (Pg. 9) his guide was probably made more or less 20 years before by a certain Sr. Ramos; this latter person used to go to this area specifically to slaughter tortoises. He used a corral to keep small to medium sized ones in between trips. This rock corral still there. Also found 1 nest – nest soil dry – contained 9 eggs; made in area of little soil in low pace in the lava. Nest cap made of soil, roots, tinny sticks, and tiny rocks and pebbles. Top 3 eggs perforated, lower 6 OK. He remade nest leaving 6 good eggs inside. Also noted shells and old nest sites from previous years. No pigs, cattle, dogs, donkeys in this area. [Marginal note – This comment on old nests and following (16) apparently derived from "letter to CDRS of 31 Oct 1967 Informe No. 1"]
16.—Oct 1967 – latter part of month – J. Gordillo and 2 assistants. Cabo Rosa and San Pedro – left from 3 hills 2 km SE of Alemania. After about 8 km walking SE and S of passing over "Cerro Solitario" (probably Cerro Jaboncillos) found a huge ♂, #8,050 and signs of others. 4 km more to S – 2 more tortoises and much sign of other medium to large sized ones. This area more or less 5 km inland from point between Cabo Rosa and San Pedro. Turned back N at this point from Cerro Solitario" and far to S (Pg. 10) much vegetation and lots of cattle, donkeys, and pigs.

17.—Informe No. 002 – J. Gordillo – 30 Nov. 1967. 17 marked tortoises in Nov 1967 trip to E of Cerro Grande, Sierra Negra. Marked 3 large ♀♀, 1 large ♂ near a small hill here. No nests found. Near colonists and wild pigs in the area.
Another trip to "Galapaguera" N of Cabo Rosa – same area visited previous month – end of Nov.
Marked 13 tortoises here; not any signs of present or past human exploitation here – but pigs and cattle in the area. In this "galapaguera" (central area) found no nests, but long sides of soil-vegetation covered area found 2 old nests and 1 new nest in soil pockets on a small "barranco". New nest was found 30o Nov 1967, soil in it dry ; 7 km N of Cabo Rosa, at foot of an Opuntia; 12 eggs of normal size (1 perforated) and 1 small egg of 2 x 2 cm. From ground surface to top of egg was only 5 cm. Soil very (Pg. 11) pebblely and hard. Remade nest with 11 good eggs in it. Extent of the tortoise area – 12 km N to S to coast. Also another extension of E to W. Enclosed by huge barrancos which prevent tortoises moving to W part to San Pedro or to E part to Santa Rosa. They have main movement in N – S.
Found 1 "rare tortoise" - #8,065 68 x 60 cm. Colonists call them "Galapagos de carey" because have yellowish color that dominates whole animal, especially notable on head, and especially on "hocico" and "trompa". Last costals on each side very depressed and last vertebrals thus elevated. Says will send photos? Letter of 14 Dec. 1967 says sent roll with photo via Sr. Salto. [Marginal note – photos no good]. Land iguana – has seen one also near Cerro de los Chivos.
18.—Informe #003 – Sr. Gordillo, 31 Dec 1967 – 4 days to Cerro Azul; 6 to La Cazuela region.
20 Dec – opened nest. Found eggs just beginning to hatch "picas") so recovered nest. Location is "Cerro Azul" – probably Las Crateres area. [Marginal note – Gordillo says this is not Cabo Rosa nest but another one not reported previously.]
30 Dec – Gordillo returned and opened nest – found one just digging out of nest top and leaving area; 1 other already left nest. 5 eggs inside – 2 with tortoises beginning to hatch – these left in place. (Pg. 12)
In area of nest saw land iguana. Sr. Pedro Cartagena claims there is a colony of land iguanas to the N of Cerro Paloma.
19.—15-16 Jan 1968. Miguel Castro – marked # 10,039-10043 on Cerro Azul – see his notes and card file (no trip description).
20.—19-28 Feb. 1968. – J. Gordillo – Informe 004, date 7 Mar 1968 to CDRS.
With T. DeVries, by foot, visited areas inland from Quinta Playa, Santa Rosa, Cabo Rosa, San Pedro, then climbed from San Pedro to Cerro Los Jaboncillos and then to Santo Tomas.
Results: Quinta Playa – (also call "galapaguera de la union") – saw a few signs only ; probably once with many tortoises and connected with Cerro Barahona by an extensive planchonadas. Large recent lava flow would seem to impede passage to Santa Rosa area.
Santa Rosa area – behind a large sand beach, the most extensive one between Cabo Rosa and Quinta Playa. Much visited by fishermen in past till recent time. (Pg. 13)
Saw no fresh tortoise sign; found some tortoise bones under humus. Area enclosed by large lava flows preventing access to Quinta Playa or Cabo Rosa.
Cabo Rosa – not visited much by man – very difficult landing, saw no tortoises but is now very dry here. Saw signs all way from here to San Pedro. Corrects information

from Report #002 – definite connection of passable terrain from Cabo Rosa to San Pedro, but not from former to Santa Rosa. Found 2 old nests, 1 100 m inland just W of Cabo Rosa, another about 3 km before San Pedro and also 100 m inland.
San Pedro – much used by fishermen; probably have slaughtered many ; they found 1 slaughtered one of 3-4 yr age (age since death).
They found that "galapaguera" of San Pedro and Cabo Rosa are really one large uniform area along coast of soil with Pisonia and Bursera trees, interrupted here and there by small areas of lava rocks and recent lava, but easy for tortoises to move all along through the area – saw sings all along. Two zones also connected more inland S of "quemado" between Cerro Azul and Sierra Negra, but not too far N because the terrain is rough and rocky and dominated by Xanthoxylum, Tournefortia, (Pg. 14) and Chinoccoccus (?).
Saw no land iguanas on entire trip.
21.—May 1968 – Informe 006; 31 May 1968 – J. Gordillo.
10-26 May – Not much new = marked 9 new G. e. vicina; found that "galapaguera" of San Pedro extends all way to lava of 1959 (28 June 1959 eruption began) eruption both along coast and inland half way to top of Cerro Azul. To NW of San Pedro there is a "galapaguera" they call "la Planchonada de los Cinco Cerros" – connects to San Pedro – nice, tortoises under manzanillo trees, but full of dogs and pigs – no small or medium sized tortoises here.
6-9 May(?) – Tupiza and Constante to "Cerro Cascajo" (only old signs of tortoises) and Volcan Chico (no signs) on Sierra Negra.
22.—Sep 1968 – Informe 008 from J. Gordillo to CDRS – date 5 Oct 1968. Not much – visited Zone 1 on Sierra Negra checking Cazuela, Cerro de Los Chivos, Los Corralitos and Tuno Blanco – marked 1 tortoise in latter area. (Pg. 15)
23.—Oct 1968 – Nov 1968 – Letter from Sr. Gordillo date 21 Nov 1968 to CDRS. Last days of Oct were in Zone 1 of Sierra Negra – i.e. Cazuela and surroundings. Marked 3 tortoises; found 1 unmarked, large ♂ - slaughtered in past 3-4 months – CL 91.5; CW 104.0 (Between Cerro Grande and Cerro de Los Chivos.
5-13 Nov – to Cerro Azul – investigated from 500 m altitude around E side to Puerto Iguana, marking tortoises en route and on Cerro Azul.
24.—Dec 1968 – Letter from J. Gordillo CDRS dated 17 Jan 1969. Explored to just W side of large lava flow between Sierra Negra and Cerro Azul finding some old nests, and 3 new nests ; see and copy map.
3 new nests, all in same area–

1. 15 eggs – 1 rotten = 16
2. 10 eggs – 2 rotten = 12
3. 10 eggs – 2 rotten = 12

Re-covered nests and left for hatching. Marked tortoises also.
Nesting sites all near lava flow (on its W side) and near and just N of large elbow of lava which extends from long main flow out to SW. no pigs, but are dogs and cattle in these nesting areas.
25.—Jan 1969 – Letter fro J. Gordillo to CDRS date 8 Feb 1969. Trip from 21-26 Jan 1969 to Caleta Iguana and Las Tablas area on Cerro Azul. (Pg. 16)
Went from Iguana Cove inland to altitude of 600 m and then to N maintaining this altitude, heading for above Las Tablas. Found a nesting area at an altitude of 400-500 m and 3-4 km inland from a point on coast about half way between Las Tablas and Caleta

Iguana landing spot. No signs of dogs or pigs in this nesting area, but some signs of cattle. Found 3 nests still closed. –

1. 9 hatchlings and 1 rotten egg
2. 8 hatchlings and 1 rotten egg.
3. 7 hatchlings and 2 rotten eggs.

In same area found 3 more nests "recently abandoned", 4 other "recently abandoned" in nearby areas and in other areas more in same condition. (He must mean young hatched and all left?) [Marginal note – Yes!]

From here went to "Cinco Cerros" area which lies directly inland from Las Tablas, seeing clear tortoise trails and much tortoise signs en route. Also saw small nesting areas all through this area with 3+ nest with young hatched (Pg. 17) out and gone from nest in each little area. All a very dry and hot area. From Cinco Cerros and their surroundings all way to Las Tablas is a large pain covered with soil and vegetation. Lots of soil patches with old nests from which young seen to have escaped; but probably eaten by abundant wild dogs in the area – no sign of small or medium sized ones.

On shore side of half-moon hill at Las Tablas must have been a very fine "galapaguera" – soil and plenty of vegetation in a large plain. Now covered with carapaces of slaughtered tortoises. Fishermen entered here much up till a few years ago and still do so. Also many wild dogs in the area.

On some of dead tortoise (and he claims that medium and large sized ones are also attacked by dogs, found gnawings of dogs -= sometimes to center of carapace chewed, on horseshoe shaped gnawings of plastron to its center. Smaller ones were completely crunched and had tooth holes in them. See and copy map. Did not see land iguanas on this trip at all. Sr. Nelson Gil reported to J. Gordillo, that he recently saw herds of goats (Pg. 18) near coast on W side of Alcedo about half way between Elizabeth Bay and Urvina Bay (copy map).

26.—April 1969 – Letter from J. Gordillo to CDRS dated 30 April, 1969. Went to Las Tablas via Alemania and nesting area discovered in Dec. 1968 (see above) – checked these nests – all eggs rotten! Much rain here and nests extremely wet thoughout. Also found 1 nests in Las Tablas but did not open it. Apparently did not recheck any nests in Las Tablas area other than this one.

27.—7-14 Jul – To Cerro Azul – Letter from J. Gordillo to CDRS dated 26 July 1969. Made a big circle on E and N slopes of Cerro Azul; in a site on N side of central crater at 400 m elevation found a nesting area. Found 3 nests here, (9 July) all moist on top and recently made; also 2 small tortoises (25-30 cm CL) in same area of only a few years age; nests not opened. Copy map – no introduced animals in this area.

28.—Dec 1969 – letter from Sr. Gordillo to CCDRS dated 17 Dec 1969. Found #9047 slaughtered in Zone II of Sierra Negra (wardens found) – dead 1-2 months. (Pg. 19)

29.—Letter from J. Gordillo to CDRS – dated 17 Mar 1970. From Dec 1969 and discovery of slaughtered tortoise all efforts directed toward "galapaguera" of Sierra Negra – marking tortoises and checking on hunters activities.

Cartagena went to "El Tuno Blanco" and found signs of large tortoises and 1 very recently hatched one.

30.—Letter from J. Gordillo to CDRS of 24 April 1970.

17-20 (not clear whether Mar or Apr) – Wardens to El Tuno Blanco – found 1 nest (galapagos had left it) from previous year and 1 hatchling in the same area. 1 Apr – marked 76 tortoises in an area called "La Señal".
31.—Letter from J. Gordillo to CEDRS, 24 Sep 1970. Reports that an old colonist of Villamil, Sr. Alfonso Balladares climbed to top of Cerro Azul twice in 1928 and 1930. On one of these 2 occasions he spotted a huge tortoise down on first platform where had apparently grown well and become fat on sparse vegetation there. (Pg. 20)
32.—Letter from Sr. J. Gordillo of 3 Nov 1970. Mentions "Los Corralitos" an area to extreme N of Cerro Grande, Sierra Negra, where have found many small tortoises but can not seem to locate nests.
33.—11 Jan 1971 – letter to Juan Black at CDRS – from J. Gordillo.
27 Dec till 1 Jan – end of Dec. 1970 – Cartagena and Tupiza to E side of Cerro Azul to sites known as "Pega-pega No. 1, Los Craters, Cerro de los Nidos" to look for tortoise nests – found 4 nests –

1) opening in nest with 4 hatchlings (29 Dec) inside; in Zone 1 on slopes of Cerro de Los Nidos, at 340 m altitude. Sent these 4 to CDRS for raising. Yolk sac scars closed and healed.
2) Eggs nearly to hatching point.
3) & 4) more recent nests. 2, 3, and 4 only opened slightly.

34.—16 Jan 1971 – letter to CDRS – from J. Gordillo. Discusses same as letter of 11 Jan 1971. Also, 11-14 Dec. – Cartagena and Tupiza to El Tuno Blanco – found one old nest, marked 8 tortoises, 2 very young ones. (Pg. 21)
35.—30 Apr 1971 – Letter to J. Black J. Villa (informe #001 to SPNG) from J. Gordillo. Cartegena and Tupiza from 24-28 April checking Cazuela area for nests – found none, new or old, but vegetation very green and abundant and this caused great difficulty in checking for said nests. However, marked many tortoises and saw tortoises copulating. (I also read reports from 2 wardens on this trip): The especially concentrated activities to E of Cazuela. Marked #8,157 to 8,172. Found #8,161 ♀ copulating with #8,162 ♂. Of the 16 checked, 4 ♀♀, and 2 ♂♂ definitely mature adults, others of smaller sizes.
36.—Informe #3, 25 July 1971, from Pedro Cartegena and Arnaldo Tupiza – about 5-22 Jul 1971 work in Cazuela and surrounding area – Visited Cazuela and are directly E of it up to lava flow, Los Corralitos (area just NE and E of lave patch which lies to NW of Cerro Cazuela) and El Tuno Blanco. 7 July – SE of Cerro Cazuela – found 4 nests, 1 from this year, 3 old ones. 2 of old ones only contained egg shells. 1 of old ones contained 6 eggs - 2 tortoises had escaped, 2 embryos had died during (Pg. 22) incubation, 2 eggs were addled or infertile. New nest was dry and had to open a bit from side to make certain it was a nest – contained 4 eggs at least but certainly more. Old nest (6 egg one) was 25 cm more or less deep and more or less 35 cm in diameter. Found 3 small tortoises here, too small to mark - measured CL of them:

1) 11.0 cm
2) 11.5 cm
3) 22 cm

20 Jul – same areas – freshly dug hole from previous night or so, made by ♀ #8,170. Returned 21 Jul buy could not find any nest she had made.
Los Corralitos – found 3 large ♀♀, 1 large ♂, 3 smaller ones which were too small to mark – measured curved lengths –

1) 30 cm
2) 32 cm
3) 32.5 cm.

2 old nests here also – opened but only egg shells – could not determine number of eggs.
El Tuno Blanco – no eggs an found no tortoises, but search not great. (Pg. 23)
In areas of Cazuela to and including Los Corralitos marked 45 tortoises, # 89,173 – 8,217 of these break down by size classes is:

	♂♂	♀♀	? SEX
30-40 cm			2
41-50 cm			10
51-60 cm			8
61-70 cm	1	3	7
71-80 cm		6	
81-90 cm	1	4	
91-100 cm	1	1	
101-110 cm			
111-120 cm			
121 cm plus	1		
Totals	4	14	27

Note predominance of small and mediums sized tortoises.
W a bit of Cerro Cazuela found a slaughtered tortoise of about 70 cm CL, #8,125.
Saw cats throughout area examined, also goats. They say nothing about pigs or wild dogs. (Pg. 24)
37.—Informe #4, 10 Aug 1971 by Arnaldo Tupiza on trip of 28 Jul – 10 Aug 1971 – with 1 assistant. To Las Tablas (Cerro Azul) and Cabo Rosa (Sierra Negra), and W of San Pedro (Cerro Azul).
Las Tablas – could not find nesting zone located previously because vegetation very closed; marked # 10,121 – 10,126 and found #10,011
San Pedro – W of it – on 3 Aug found 5 old nest; however, could not tell number of eggs per nest because all deteriorated and only had pieces of egg shell; 1 nest very near coast, other 4 some 4 hr walk inland and far from the coast. Saw 40 tortoises 15 large ♀♀, 25 large ♂♂, all unmarked.
Cabo Rosa – 7 tortoises checked, # 8218 – 8,224. Found 3 old nests; one in middle of lava – seemed to have contained perhaps only 2 eggs – 1 escaped nest and other egg addled. Two other nest in small bit of soil, also surrounded by lava. One appeared to have had 4 eggs, all tortoises escaping, other 5 eggs, 4 escaping and 1 with (Pg. 25) dead embryo inside; 1 small tortoise of 30 cm CL in same area. All tortoises at Las Tablas medium-large to large; At Cabo Rosa, 2 small, others medium-large to large. See card file for these.
38.—Trip of 25-28 Aug 1971 to Cazuela nesting area on Volcan Sierra Negra. In a letter from Sr. Jacinto Gordillo de 31 Aug 1971 to Pepe Villa.
Went to Cerro Cazuela and checked far to its S and E, including zone where Nest #1 for this year was found. Have found only 3 large mature ♀♀ in this whole area, called "Zona #1". In this zone much sign of human entry – old cans and bottles; must have been a fine "galapaguera" years ago. Lots of small and medium sized tortoises there.

Also visited area to N of Cazuela, called "Zona #2" and found 1 more new nest there about 4 km N of Cerro Cazuela. Have found only 1 large mature ♀ thre with a very small tortoise – both near nest when found. Area is motly lava with soil collected in low areas in it. Apparently no dogs or pigs in this area. Nest not opened. Map – copy this. (Pg. 26)
26 Sep 1971 – Left Santa Cruz at 08090 on "san Carlos" a fishing boat , for Villamill. Arrived there at 1600, met Sr. and Sra. Gordillo and made plans for next 10 days more or less, had a fine meal with them and spent night on shore – bloody rough but beautiful port.
27 Sep 1971 – Left Villamil at 0830 and continued on to W to "galapaguera: just W of Puerto "San Pedro" where wardens are encamped. Circled area at coast (nowhere to land) hoping to see them or vice versa, but no luck as they still must be up; thus returned to San Pedro, disembarked and Sr. Gordillo and I began heading for W of San Pedro at 1515 hr. Around the zone all the way, covered with broken lava and dense coastal vegetation including much Opuntia – apparently all this area once had tortoises but fishermen cleaned it out using San Pedro as a port. They also damaged Cabo Rosa area but not as severely apparently because can only land there during certain periods of hot season and certainly not during this season at all. Throughout whole zone saw many trails and dry droppings of cattle, 1 cat, and scattered droppings of cats and dogs. Stopped for night at 1800 (Pg. 27) having to sleep on stones, just above high tide line. May be a wet night.
28 Sep 1971 – Continued over to W arriving at base camp at coast where "planchonadas" of lava begins and runs directly inland more or less to N. Here mete Oswaldo Chappy, Arnaldo Tupiza, and Pedro Cartagena and learned that they have seen numerous old ♂♂ and ♀♀ (no medium-sized or small ones seen _ and found and protected 12 nest in this general area and above.
Left coast at 0830 heading directly inland toward area of " Cinco Cerro" – will describe this are, altitudes, locate on maps tomorrow – moving too quickly today – for today will mainly check some tortoises and make some notes on other items; will mainly discuss nest tomorrow also. At foot of lowest (altitudinal position in regard to coast) of Cinco Cerro" at 1200 hr – altimeter says 625 ft but is probably 50-75 ft high reading. A huge ♂ Tortoise in a herb pampa. See Roll 370 (KX) photos #6-14 of pampa area here and tortoise. He is extremely wide and flat on dorsum and drops off in rear suddenly – have never seen one of quite this form before – quite raised in front but not a true saddleback form, CL 111.5; CW 117.2. [Marked #10,174] Absolutely covered all over carapace with very severe flaking disease; also lots of black green algae all over; some (Pg. 28) scattered spots of yellow-green algae in certain places, i.e. more protected ones. Also abundant lichens of several types, mainly in protected areas of rear , i.e. last costals and 5th vertebral, low areas along sides and rear of other costals- vertebrals, and all over front area where first marginals, and 1st vertebral join – in all however, has them literally scattered all over upper 1/3 of carapace. Mainly 2 types – a crustose medium yellow one (in rear and on first marginals) and a crustose pale grey one – everywhere else and where yellow one is. Collected these (included flaking disease and yellow-green algae in one jar) and some of flaking disease material dry and some of latter also in 70% alcohol. Photos of lichens – roll 370, #15-21.

White growth increments clear and moderately thick. Scutes basically all smooth where one can see them through the flaking disease. Ticks: very few – only found a few unengorged common ones scattered on neck, upper legs, and near tail (no real hidden areas) and some scattered tiny black ones in rear leg pockets. Had common mite type in leg pockets interior, along skin/scute borders in (Pg. 29) rear and along plastral midline but only light infestation – collected ticks and mites. Also found a few tiny bits of pale grey-green foliose lichen on him and perhaps another pale off-green crustose form.
Just below here in another little pampita another huge ♂ 10,139 – CL 110.0; CW 112.5. White growth increments clear and moderately thick, same size, shape and incredibly old worn shell like in previous animal. Absolutely covered down to junction of costals with marginals with flaking disease, pale grey crustose lichen, scattered large patch of yellow-green algae, scattered bits of pale-grey green crustose lichen, and scattered patches of yellow crustose lichen and pale-grey –green foliose lichen. See Roll 370, photos 15-end of lichens and shape. Ticks: exactly as in previous animal.
Just below this 100 m distance- New #10,175 "young" ♂ CL 103.0; CW 110.5. [Marginal note: See Roll 371, HSE, #1-4] Quite nearly round in form; a young ♂; scutes smooth only in very centers to maximum of 1/6th of scutes; white growth increments clear and thick; only 2 tiny spots of flaking disease on front vertebrals, and an old spot of it in 3rd vertebral; some black-grey and yellow green algae (former thick) on front marginals; former also all along scute junctures in rear; no lichens; ticks: (Pg. 30) No mites; a few tiny black ones in interior of pockets; a few translucent look ones on legs; nothing else.
150 m lower – New # 10,176 ♂ - CL 117.7; CW 121.7. Also huge, worn, old and same form as 2 large ♂♂ above; covered with flaking disease as badly as previous 2 large ones; scattered black-green algae all over; yellow-green algae in spots, especially depressions made by flaking disease; a few spots of yellow lichen an pale grey fructose lichen on last vertebral and latter scattered on 1st vertebral and first 2 marginals in front on each side; white growth increments clear and moderately thick. Ticks: mites along mid –plastral line; otherwise almost none – lest but as in first 2 large ♂♂ above.
Returned to camp at 1600, very thirsty and tired – have had flu lately and am rather (Pg. 31) weak.
Noted a few things in passing 5 of protected nests today as well as many destroyed by pigs but will note these observations tomorrow when examine nest more completely.
29 Sep 1971 – Again up same trail – set altimeter at coast – 0800. Following trail on planchonadas – easy walking – smooth lava and rope lava – scattered tortoise droppings, old and new, full of mostly Opuntia all over. Vegetation is mainly Opuntia, Darwinothereus Lantana, Maytenus, Hippomane, Waltheria, and other shrubs and grasses and herbs (latter 2 mostly dry) scattered all over lava.
New ♂ - 10,178 – CL 108.5; CW 112.0. at 120 ft altitude on planchonadas – vegetation still same; eating Opuntia. Another huge unmarked ♂, all worn smooth and old. Like large ones yesterday has an extensive area of carapace eaten away by flaking disease same form as those of yesterday. Scattered algae of both types all over carapace. [Marginal note – have photo of him from yesterday eating Opuntia pads – Roll 370, #1]. Spots of grey crustose lichen on first – fourth vertebrals and on front marginals (first on each side); same tiny patches of pale grey-green foliose form on last vertebral – otherwise

none. White growth increments clear and well thickened; ticks –same as large ♂♂ yesterday. Just above here 100 m – near trail eating Opuntia.
New ♀ - #10,179 – CL 85.9; CW 99.8. Nearly flat on to- and very depressed and wide – see Roll 371, #5-9. Smooth all over and with extremely bad flaking disease all over rear 1/3 and scattered elsewhere. No lichens; both algal types distributed in flaking disease areas. White growth increments clear and moderately thick. (Pg. 32)
Ticks almost none, a fee common ones; no mites. Curved off toward right toward lava flow with lies just to W a km or 2 , but continuing to climb, passing into a zone of denser vegetation – more or less like Region 3 of Caseta – La Fe trail on Santa Cruz. Large Pisonia, Xanthoxylum, some guayavillo, lots of green shrubs and green herbs all over ground. Altitude is about 18;5 ft (0900 hrs). Soil moistened slightly and of deep rich brown color.
Two tortoises here:
♀ - #10,172 – CL 73.5;; CW 86.5. All smooth female – carapace conditions and ticks just as in ♀ above; small but of same degree of worness of carapace and same form as ♀ #10,179. Sleeping in open – cloudy.
New ♂ - #10,180 – largest yet; more or less same form as other huge ♂♂ but declining a bit to nuchal notch. [Marginal note- CL 136.8; CW 139.5] Completely covered with severe flaking disease; pale grey crustose lichen scattered all over, also with patches of yellow lichen all over rear and a few patches of pale grey-green foliose lichen on 5thf vertebral. White growth increments clear and well thickened. Roll 371, photos #10-13 of him. (Pg. 33)
Right beside him in an open spot of some 15 x 15 m in brown soil are 3 destroyed nests. Wardens were here on 26th and nest not here then so pigs passed by recently – nests obvious very fresh. Roll 371, photos 14-15 of this nesting spot.
Proceeded to nest – Nest #41, found 23 Sep 1971, very fresh then. [Corral built same day.] On top of a barranco covered everywhere with rocks, boulders and dense Polypodium fern except for this one spot of very rocky, pebble, cinder – soil mixture. There is a regular tortoise trail leading up barranco like a long curve at a cloverleaf in a US type highway. [Marginal note – 2 recent nests near here – destroyed by pigs.] Trail leads nowhere else and is space here for only 1 nest, so probably a certain ♀ use the site. Opened nest – Dimensions 25 cm deep in center (base all 1 depth almost); 22 cm front to rear excluding 6 cm undercut, 21-23 cm wide, a bit hard to tell; no sloping down from sides but does slope down and inward in rear. A bit of soil and gravel in floor of nest; floor full of loose small rocks but just like soil at surface so perhaps deepest ♀ could dig. 9 eggs in 2 layers, 5 on bottom at 17.5-19 cm (Pg. 34) from surface to their tops, 4 above these, depth to uppermost ones top being 9.5 cm, to others about 2-2.5 cm more; nest full of eggs at these 3 levels. Muddy hard cap (actually loose because of soil structure) contains 1 ground in tortoise dropping and impacted right down on top of eggs – lower eggs with a bit of air space, upper ones surrounded by wet damp soil and little rocks. Eggs normal and large; uppermost one has top of shell broken, but membrane intact.
Egg measurements –

1	62.0 mm x	58.9 mm
2	61.9	60.2
3	61.6	59.0
4	62.6	60.3

5	62.6	58.3
6	59.2	58.2
7	61.0	58.2
8	61.0	58.5
9	62.8	58.1

Re-covered eggs and reconstructed nest. (Pg. 35)
Were 2 old eggs in this nest at same depth and just to side of the nest cavity- whole shells but empty- from last year probably. Continued on up along base of barranco – the latter is really edge of the lava flow – there is a wide semi-well used tortoise trail running uphill all along "barranquito's" base with frequent trails and sign leading off onto less vegetated lava flow – certainly many more nests scattered though here - ♀♀ obviously search out open spots such as that where #41 nest is in completely in open on barranco's top.
Nest #42 – exactly same type of site and soil – completely in open too – lots of recent and old tortoise sign – about 75 ft higher in altitude but same conditions as to vegetation, soil, etc. Also found in fresh wet state on 23 Sept 1971. [Marginal note – corral built 26 Sep].
Opened nest – Deepest part – 21 cm in one half, other half at about 18.5 cm from top; 31 cm wide, 19 cm front to rear; almost no undercut because roots filling front half of cavity. Also large roots in side wall and bottom on shallow side. ♀ clearly must have had trouble digging here and perhaps roots plus small stones stopped her. Nest real full of eggs, 10, (Pg. 36) all in good condition. Depths from top to top of eggs – (more or less 2 layers, 4 on bottom, 6 on top).
To first (egg) – 5 cm;
3 at 7.5 cm (shallow half)
2 at 9.5 cm (deeper half)
2 at 12.5 cm (shallow half)
2 at 14.5 cm (deeper half)
Upper eggs completely impacted in wet soil and fecal material, lower ones partly in this; hard cap right down on top of eggs.
Eggs – armed, measured and re-made nest.

1	50.5 mm x	56.8 mm
2	59.0	57.5
3	59.7	55.6
4	58.9	55.9
5	59.5	57.3
6	60.4	56.4
7	60.7	55.2
8	58.1	57.0
9	58.0	57.6
10	58.7	54.9

One destroyed nest (pigs) from past year near this one.
Returning by same trail to pick up trail which runs N to 4 other nests. Back at 150 ft altitude more or less.
New ♀ - #10,181 – huge - CL 92.6; CW 106.4. All smooth and very old and huge – marginals in rear with deeps grooves between them. Huge area of last costal on each side and small patches on vertebrals and rear marginals with flaking disease. (Pg. 37)

Black-green algae in same areas. Yellow-green algae in same areas along flaking disease/normal scute material borders, growing heavily on flaky papery – like scutes material where it is rotting.
Same basic form as large ♂♂ and she must be their equivalent. No lichens; white growth increment present and moderately thick. Ticks: as in first ♀ examined today; no mites that I can find.
Roll 371, photos #16-19.
Just 50 feet beyond here another ♀ - unmarked ♀ - CL 77.7; CW 89.4. immutably worn and diseased by flaking disease whole back and covered wit yellow-green algae also; black green algae also scattered about. Basic form that of large ♂♂, very depressed and ova-shaped from end view. White growth increments clear and thick. See Roll 371, #20-28 of her and her terribly afflicted carapace. No lichens. Collected ticks –0 a few mite spots and a few translucent looking ones. Reached trail just after this and turned uphill again passing 2 recently destroyed (pigs) nests and reaching nest (#44 just above these. See Roll 371, #29-31 of this area at 210 ft [Marginal note – Thomms 1200 hr; thus probably 25-30 feet too high.]– a mostly dense Pisonia, small Psidium and Xanthoxylum forest now, full of low bushes and herbs - nesting sites are just small open areas in canopy which allow sun to hit nest at most from 0800-1600 more or less (when there is sun in this season) and probably for even less time, i.e. 0930-1500 more or less. (Pg. 38) Soil is a pale brown with many pebbles and small rocks I it but only moderately moist from garúa – not as moist as Region 3 below Caseta on Santa Cruz.
Efficacy of corrals proved here – 1 nest laid right by #44 and 2 nests below dug up by pigs since wall built here.
Nest #44, 23 Sep 1971, discovered – very fresh then. Arnaldo Tupiza passed through this zone of 4 protected nests in early Aug and were none here then. Opened nest – much better soil than that of nests 41 and 42; forms a good hard cap; in this case hard cap flush down on top of upper 5 eggs and 6 eggs in bottom layer with lots of surrounding air space in cavity. Cavities greatest depth from ground surface 25-26 cm with about 1.5 cm loose soil and gravel in bottom; rock in one tiny part of bottom but ♀ could have dug much deeper if leg length permitted – no blockage. Cap full of abundant fecal material. Eggs. More or less in 2 layers, in fact nearly perfectly so filling nest. Top 5 at 10.5 cm to their tops; 4 of bottom six at 16 cm to (Pg. 39) tops and other 2 at 18 cm to their tops. Cavity really full with 11 eggs. Cavity size roughly 24 cm front-back and 28 cm wide at surfa e – no real leg undercut, only about 4 cm deep. Eggs measured, marked, and returned to cavity and nest re-constructed.

1	63.1 mm	60.1 mm
2	62.8	60.5
3	62.8	60.7
4	63.8	59.6
5	62.3	60.0
6	62.0	60.7
7	61.8	6.15
8	60.6	60.5
9	62.0	59.5
10	60.7	59.8
11	62.5	60.1

Nest #45, also found fresh on 23 Sep 1971. Dimensions – only 23 cm deep – rock in bottom on one side (1.5) other side diggable. Corral built 25 Sep. Hard cap as in last nest, compact, full of feces and flush on tops of upper eggs, some of them embedded very well in it. Lower 5 eggs in relatively open air space. Nest about 25 cm wide and 27 cm front-rear, wand with no undercut – a wide shallow hole basically. Really full of eggs to brim – 16 eggs; two topmost ones on 8 cm down and fully embedded in hard cap – 12 broken, 1 (Pg. 40) with crack in top but membrane intact. Below these a group of 8 eggs at depths of their top of 11-14.5 cm but more or less a layer; then 1 egg at about 15.5 cm to top and 5 on bottom of nest at 16 cm to tops more or less also a layer of 6. Nest could not hold another egg; 1 of those in bottom 5 and 3 of top eight also cracked but membranes intact. Measured and marked eggs and re-covered nest.

1	60.3 mm x	58.6
2	63.3	60.7
3	59.5	59.3
4	61.0	60.9, cracked
5	59.0	58.8
6	58.9	58.6
7	61.3	61.0
8	61.0	60.0
9	60.2	59.2
10	59.8	58.9
11	58.2	58.2
12	58.9	57.8
13	59.7	58.8, cracked
14	59.2	58.7, cracked
15	60.7	59.0, cracked

16 broken

(Pg. 41) Continued on up to 345 ft (1345 hr, Thomms) to location of nest #46 and 47; vegetation more or less same but understory becoming very dense with “palo negro” and other woody shrubs and vines; again, nesting spot (see Roll 371, #32-33) is a small open space along a well used tortoise trail – are trail all through here by the way. Nest #47 is as much in open as 44 and 45, but 46 is more shaded due to an overhanging guayavillo full of dead branches of vines and a shrub. This nest probably gets direct sunshine from 1000 – 1400 or 1500 at most. Two nests are only 1 m apart and enclosed by 1 corral; both protected on 26 Sep 1971, fresh, with corrals; #47 laid between 23 and 26 Sep. Nest 46 – 10 eggs – found 23 Sep 1971. Soil with fewer pebbles than below; more or less moist here at surface and for a few cm down but not below; nest not as fresh as all others seen today because not as moist. Cavity with more or less deep undercut of 7-8 cm; size hard to measure exactly but could have gotten perhaps 1-2 more eggs in at 2 levels used. 5 eggs in bottom, at more or less 24.5 cm to tops; 5 above these at slightly varying depths but most at 16.5 cm to tops; hard cap full of feces, especially bottom part right on top of upper egg layer; air space ample around lower 5 eggs; upper ones also [Marginal note – Two nests recently laid and destroyed by pigs beside these nests in same open spot]. (Pg. 42) very little compacted with mud due to fecal material “buffer” zone. Nest as deep as could be, i.e. 30 cm because no rocks in bottom at all. Rather deep for

eggs to be in this shaded spot and with weather conditions of garúa season. Eggs measured and marked and cavity re-constructed;

I	60.8 mm x	58.2 mm
II	60.5	58.8
III	59.5	58.0
IV	59.5	59.0
V	59.8	58.7
VI	59.8	60.4
VII	60.6	60.0
VIII	59.2	58.7
IX	58.6	58.6
X	60.1	59.6

Nest #47 – hard cap and age as in #46 (found 26 Sep 1971) – Nest a very well-formed typical flask – abut 23 cm wide, 20 cm front-rear excluding undercut of 7.5 cm (deepest part); undercut in front ¼ of nest. Depth to deepest point (undercut area) is 28.5 cm ; big rock in rear center limiting depth there to abut 24 cm; nest otherwise with no bottom obstructions. Eggs 10, 4 in bottom (undercut) at 22 cm from surface to their tops, 2 slightly above these at 19.5 cm to tops, (rear part of nest), and 4 above them, 3 not far, and 1 above all (Pg. 43) others at 14.5 cm to its top. Hard cap right down flush on top 4 eggs and full of fecal materials also; air space around lower 6 eggs for most of their surfaces save tops where mud was on them.

Measured eggs, remade nest, (marked eggs).

I	58.7 mm x	57.8 mm
II	60.6	58.3
III	61.4	57.6
IV	58.9	59.2
V	60.0	59.8
VI	59.0	57.9
VII	60.7	58.3
VIII	61.3	59.2
IX	60.0	58.5
X	61.4	60.8

Note for below nests – 100-125 m - a large unmarked ♀, CL 88.0, CW 1005 All smooth, bad flaking disease on rear; white growth increments and other carapace conditions and ticks as in ♀ #10,181.

Near here also a naturally dead ♂ - no scutes, but carapace entire, thus probably some 4-6 months at most. CL 116.0; CW 122.0 approximations – thus a bit more because of missing scutes; old, huge and of typical shape for this area.

Another 50 ft lower – a large ♀, CL 83.6; CW 99.5; also like above ♀ and #10,181 as regards shape, carapace conditions, and ticks (Pg. 44). In addition to those seen today, saw 2 other huge ♀♀ and 1 other huge ♂ tortoise in upper parts of trail yesterday – i.e. 200-300 ft altitude, and 1 ♂ at about 50 ft altitude yesterday. None marked and all with carapace conditions as in others examined of their size and sex.

Returned to near coast to another trail which leads inland to 4 nests. Will go up and check nearest nest as time is getting short today- Photos of planchonada, Roll 37, #34-

36. In route saw a big ♂, maybe 0.5 km inland at an altitude of 50 ft – much of his sign here – eaten Opuntia pads especially. Photos of him, Roll 372 (KX) # 1-2.
Nest #48 at 60 ft altitude – fig open area with Opuntia and short croton – more like a small nesting area on Santa Cruz than other spots seen so far. Soil here like that of Nests 41 and 42, but a bit less rocky and fewer pebbles.
Extremely hard cap – dense, moist and well mixed with feces; pressed right down on eggs and encasing upper 7 completely; Nest very small only 20 cm deep (rocks filling bottom and surely stopped ♀'s digging). 20 cm front to rear. (Pg. 45) plus 3 cm undercut, 18 cm wide. 13 eggs fully filling nest. Above measurements – should note that depth of nest only accounted for by 5-6 cm of hard cap pile above ground surface. Thus increasing effective depth. 6 eggs more or less in one layer at bottom with depth to deepest being 14.5 cm to their tops; 7 piled above these, 4 of them being cracked , 2 so severely that membrane broken and rotten already; 1 other missing 1/3 of shell and more than 2/3 clearly air space – will discard also as will never survive; 4th cracked one may make it as crack is only 2 x 1.5 cm and membrane is intact. [Marginal note – 4 of lower eggs also cracked a bit.] Then 4 eggs highest ones of 7 and must have been broken during covering process, 3 more severely damaged ones only 9 cm from hard cap surface (to their tops) as were probably only 3-4 cm below ground surface when ♀ began filling nest cavity after laying. 2 rotten ones impossible to determine as to fertility; one dehydrated one has tiny embryo spot.
Others measured, marked and nest covered.

I	59.0 mm x	58.1 mm
II	59.6	59.0
III	59.0	58.8
IV	59.8	58.0 – cracked - dent
V	58.2	57.1
VI	60.7	60.0 – cracked – dent (Pg. 46)
VII	59.5	59.5
VIII	58.9	58.0
IX	59.7	58.0 - cracked
X	59.6	58.7 – cracked

[Marginal note – also 3 nests from this year destroyed by pigs in this small area.]
From this nest returned to camp. Yesterday when we went up to "Cinco Cerros" area, found 3 nests, all destroyed by pigs and all from this year (recent and fresh) in an open herb pampa at base of 2nd hill (when going inland) – these at an altitude of approximately 650 ft probably 575-600 ft really, Thommen reads high 1100 hrs). Surrounding vegetation very dense and more or less like that of 450-400 ft in Caseta – Zone 3 trail on Santa Cruz. Soil very moist from frequent garúa though not as wet as in Santa Cruz-Caseta region; a dark brown rich humus soil but full of small pebbles. [Marginal note – nesting at this attitude seems rather amazing.] See Roll #370, # 1-5 of this area and destroyed nests. Oswaldo says that at base of next hill, just 75 ft more or less higher than here are some small ponds with water. Have noted this area and others visited past 2 days on map. Also Chappy says that tortoises do not go all way inland to Cerro Azul pampas from this region but only as far as Cerro Bravo. This is also shown on map. Anyway, have seen abundant, though scattered tortoise sign everywhere have visited so far and tortoises certainly can pass from this zone to Cape Rose and beyond to E and to

W to Caleta Iguana, Las Tablas and higher parts of Cerro Azul. Probably (definitely I would say) was all one big population on Sierra Negra and Cerro Azul before man and feral animals began destroying the "galapagueras" in certain parts. Have seen 3 cats at altitude from coast to 150 ft altitude, 1 dog at coast, and pig and cattle sign at all altitudes have visited. Certain that pigs are nearly destroying all nests in this whole zone and dog/pigs getting few that hatch. No small or medium-sized ones found anywhere in the area by 3 wardens on either this trip (19 Sep through today {29 Sep}) and trip in Aug of this year made by Sr. Tupiza and 1 assistant.
Nesting – appears that ♀♀ leave to lay at coast in a narrow zone of sand or very sandy soil or mainly above the "planchonada" at altitudes of 100-150 ft plus – since this side receives so much cloudy weather and (Pg.48) intermittent garúa; thus is relatively green for such low altitudes. Also, of course, I am seeing it in a garúa season after heavy March rains so greenness could partly be due to earlier weather of this year (e.g. as in Santa Cruz). Has been cloudy here all 3 days have been here with only weak warming radiation from more or less 9830-0900 till 1600-1730, no direct strong sunlight.
30 Sep 1971. – Nest #43 – laid by ♀ #10,060, CL 83.0; CW 91.8, 23 – 24 Sep 1971(3 Sep 1971, O. Chappy) in very sand soil in playa, only some 100 ft from rocky coast. Small patches of sandy soil and sand here amongst planchonada rocks – a lot of Scalesia and Waltheria shrubs and Opuntia of all sizes. See Roll 372, #12-14 more or less of this area at coast. A number of old nests in same area, all destroyed by pigs. Soil right at nest site full of old egg shells.
Opened nest: Depth in center and rear 25 cm; in undercut 27 cm. A rock in rear to one side limiting depth – rest not limited. (Pg. 49) Undercut 5.5 cm deep; 18 cm front to rear, 20 cm wide, sloping inward/downward a bit from rear. No real hard cap, because soil so sandy and loose; nest still very moist. No fecal material used in construction. 8 eggs, at depths to their tops as follows:
1 - 13 cm ; 2 - 14 cm; 4 – 17.5 cm; 1 - 20.5 cm. Nest about full of eggs at all levels, except could have fit one more in at deepest level under undercut. Eggs measured, marked, and nest re-made.

I	60.6 mm x	59.2 mm
II	60.8	60.5
III	61.7	60.0
IV	60.8	58.5
V	60.8	60.0
VI	61.3	60.4
VII	60.5	60.5
VIII	60.5	59.4

Opuntia here quite like those on Santa Cruz, though not reaching same maximum height. However, older and larger trees with well formed bark and smaller trees and spalings with very dense, heavy covering of thick spines all over trunk. See Roll 372, Photos 15-18 of 2 15 ft tall trees illustrating these growth forms. These trees and even smaller ones down to 7-8 ft high have moderately large pads which are covered with only small groups of very short flexible (Pg. 50) but sharp spines. It is these pads that tortoises eat in great numbers when they fall. See Roll 372, #21-22 of this. These pads do not grow on plants down below 4-5 ft and higher off of ground level, [Marginal note – see Roll 371, #21-22 of a 7 ft high sapling.] i.e. beyond reach of tortoises. Seedlings and very young saplings,

i.e. smaller Opuntia have pads and forming trunks covered with dense, very sharp and moderately long spines and tortoises do not eat these for obvious reason - See Roll 372, photos 19-20 of a 5 cm high seedling as an example of this. Noticed also that frequently fallen trunks and pads give rise to new seedling pads here and that even if fallen pads is one of type only short scattered spines from a larger sapling or tree, that seedling pads have dense longer spines which tortoises can not eat – see Roll 372, 23-24 of this – an older fallen pad with 3 15 cm high sprouting pads with dense spination. From here left camp to return to (Pg. 51) San Pedro Bay and transfer to Caleta Iguana.
In route Sr. Gordillo found a fresh dog dropping full of bones and scutes of a tiny hatchling sized tortoise. Preserved this – located in rocky area 300 m inland and 2 km E of camp area. Arnaldo Tupiza notes that directly above here 0.5 – 1 km found a nest in a spot of soil in very broken rocky, lava terrain. This area well vegetated but extremely tumbled rocks – certainly supported a good tortoise population but no sign seen here on this trip – area frequented by fishermen from San Pedro Bay in recent past.
Arrived Iguana Cove at 1630, disembarked and camped. To Las Tablas nesting area tomorrow.
Another (natural mortality) dead tortoise, just inland a short distance at "Planchonada de Cinco Cerros" area. – large adult ♀, 96.7 cm CL x 101.8 cm CW – scutes gone but probably only 6-12 months dead or less because carapace whole and not breaking up yet at all. (Pg. 52) [This page blank.]
(Pg. 53) 2 Oct 1971 – At 0800 (same hour set altimeter at coast at Caleta Iguana) Thommens reads 450 feet at camp. Crossed from camp to W maintaining nearly same altitude to nearby hill which is all soil covered and surrounded on both sides and below by an old lava flow; from this hill and upwards on slopes Chappy has found nests. Proceeded to first nest, # 19-20, both found on 21 Aug 1971. The are at 440 ft altitude (0830 hr) on S (more or less steep) slope of hill where it has little level spots. Soil is a pale yellow-brown and quite full of small pebbles and rocks. Very open site – sun most of day, vegetation being Bursera parkland with scattered Waltheria shrubs. There are lots of old nests here and 3 other nests from this year in similar spots higher up on hill's S side. Lots of tortoise droppings and fresh tortoise trails all over the hill. Droppings full of Opuntia and guayavillo and some herbs (fresh ones) and older ones full of grass which was abundant here after heavy Mar rains. This year (dry now). Saw one ♂ of medium-large size in route here. Will check him later. Nests 19 and 20 only 2.5 m apart and within 0.5 m of (Pg. 54) Nest #19 are 3 other nests from last year, all with normal exite holes and full of egg shells and membrane fragments. No sign of dogs opening these nests at all. Oswaldo Chappy checked these 3 old nests and found the following (21 Aug 1971):
[Marginal note – Near here also he found 1 other nest, all young hatched and escaped normally and 1 adult ♀, slaughtered 21 Aug. 1971 also.]
Nest 1 – 1 dead tortoise in egg, 2 infertile eggs and others escaped.– more or less 10-12 eggs in total.
Nest 2 – all eggs hatched and escaped.
Nest 3 – more or less 7 eggs – 1 infertile; all others hatched and escaped.
Nest #19 – Normal nest with flask; hard cap right down on top of upper eggs, rest with air space. Depth in flask of nest 29.5 cm; in rear of nest only 25 cm because of rock in floor and downward/inward slant of wall. Rock in front wall also; but no obstructions

under undercut in floor. Width 18 cm; front – rear (excluding undercut 22.5 cm. Undercut 7.5 cm; nest full of eggs – 12, 11 normal one very small one with point at one end more or less drop-shaped. Depth from surface to eggs from center of hard cap – (Pg. 55) to top of eggs 12.5 cm; to next 2 eggs 13.5 cm; to next 5 eggs 15-17 cm (slight variation); to bottom 4 eggs (including tear drop) – 22-23 cm (slight variation). Thus more or less 3 layers of eggs, 3, 5, and 4. Hard cap with small amount of feces mixed in; nest completely dry now and eggs obviously developing.

Eggs – marked, measured, replaced and nest re-constructed.

I	60.6 mm x	60.2 mm
II	61.0	59.2
III	61.5	58.9
IV	58.8	58.2
V	59.3	58.7
VI	60.1	58.2
VII	57.8	57.4
VIII	56.3	55.6
IX	59.0	58.5
X	58.9	58.6
XI	61.8	59.5

XII tear-drop one – length 54.7 mm width at greatest point 43.9 mm; width to smallest point 41.4 mm.

Nest #20 – Normal size but not deep – greatest depth under undercut – 23 cm; depth in rear part 20 cm; with 21 cm; front-rear only 18 cm, undercut 6 cm. Made on a slight slope so ♀ may have had trouble digging; also front wall with a (Pg. 56) large rock in wall of half of it; rocks all along right side – thus probably limited surface and inner dimensions; no obstructions in bottom.. hard cap with a bit of feces and on top of eggs. All dry throughout nest now. Only 6 eggs, but one of these huge. Depth from surface to tops of eggs – 1 at approximately 8 cm; 1 at approximately 11 cm (large one); 3 at approximately 12.5 cm; 1 at approximately 14.5 cm. Nest not really full – undercut unoccupied and could have held 2 eggs more; eggs filling rest of cavity, however – all in central and rear portions. Eggs measured, marked and nest re-constructed:

I	75.1 mm x	68.0 mm (huge one)
II	59.4	58.7
III	59.3	59.0
IV	60.4	59.0
V	59.4	59.3
VI	59.8	58.5

From here I crossed to the large half moon crater which lies NW of Caleta Iguana, near the coast and opening out to it. Enroute crossed mainly lava, at first fairly broken difficult type, then nearer to the crater a large (Pg. 57) planchonada somewhat lite that of W of San Pedro area where tortoises come down to coast, but less vegetated. All across route was crossing small encañadas full of soil and vegetation and other little arms of vegetation which run up/down to lava which lies in planada along coast. Throughout these areas dominants were Bursera and dense Opuntia trees with lots of dry grasses and herbs beneath. Every area with vegetation had clear, well-used tortoise trails running up/down the slope and abundant tortoise droppings everywhere, filled mainly with

grasses (the older bleached and driest ones) and Opuntia (fresher but dry ones as well as many of old ones). Virtually every Opuntia tree had its base cleared for about 1.5-3 m around (radius) with lots of tortoise droppings beneath and the remains of eaten pads. Trails lead from one Opuntia to next, to next, etc. Found mainly droppings from medium-large to large sized ♀♀ and ♂♂ but saw an occasional one and an occasional trail which must have been left by a medium-small to medium sized tortoise – i.e. 60-75 cm CL. Early on hike before got into much (Pg. 58) lava and just after leaving nesting area saw a sleeping burrow and droppings which had to have been made by a 50-55 cm CL tortoise at biggest.

Opuntia in most cases are trees with trunks, but majority are only 7-10 ft tall and many have large lightly spined pads (as described from San Pedro tortoise area) hanging as lows as 2.5-3.5 ft off of ground only – on most of those with pads this low noted that at least part if not al of pad was eaten away on its underside, certainly by tortoises – bites look to be tortoise – sized. Some trees of course have majority of pads above tortoises reach; smaller trees, saplings and seedling all well protected by very spiny trunks (first case and second case) or very spiny pads (2nd and last case).

Not any tortoises here now and probably mainly enter this area after heavy rains to obtain swollen falling Opuntia pads and dense grasses which grow in (Pg. 59) clumps. Altitude across this area approximately 300-325 ft. Planada with dead ones (tortoises) lower. Proceeded to half moon crater and climbed it – there is a long strip of vegetation and soil coming down to its NW side and then running all around its base in a very narrow strip and then the same opening up on the sea side into a large rectangular planada. This planada is covered with Bursera and scattered Opuntia trees and fairly dense dry grasses from heavy rains of Mar of this year. Did not go down into planada but from top of crater can count 62 carapaces of slaughtered tortoises, running from its base all way to sea and scattered throughout, many of them lying under Opuntia trees. About 60% of those I can count are collapsed or partly collapsed carapaces., the rest being whole and bleached white but without scutes and not broken up by weathering yet. Therefore these must extend in toto over at least last 10 years. Probably area a lot more than 62 because many must be more broken up and thus hard to see and others more hidden by grasses and shrubs. [Editorial note: this is the area known to park wardens as El Cementerio.]A tremendous (Pg. 60) slaughtering has been occurring here. Unfortunately, only time of year when fishermen can disembark here is precisely in hot season (calmer) when tortoises come into this open following heavy rains to obtain Opunita and grasses in this parkland situation. Tortoises must come in fairly large numbers as trails leading down into the planada around base of the half –moon crater are clear and well marked and with lots of dry droppings. From here started up a lava planada running inland toward a large vegetated hill – the latter is in arm of vegetation which runs down to NW corner of Media Luna Crater. I am heading up more to SE of there up planchonada that runs down on SE side of Media Luna and which has tortoise droppings and Opuntia all over it. Not far up it – more or less 300 m and at an altitude of 380 ft (1300 hr, Thommens) thus probably more like 330-350 ft) found a long well marked tortoise trail running like a roller coaster curve down part of steep bit of planchonada into a tiny (Pg. 61) soil filled area of 8 x 2 m – there are 3 nests placed as follows:

[Diagram of three nests in approximate triangular pattern with 25 cm between nest 1 and 2, and 5 cm between nests 2 and 3 with note that #2 and 3 are not well separated].

Some old nest sign here – broken shell fragments – can not determine for sure but dogs may have dug up a few here but do not think so.
Opening nests –
#1 – 6 eggs, all in 1 layer, lying at 19.6 cm to their tops; whole bottom of nest at approximately 26.0 cm is one big flat rock - ♀ could not dig any further. Since nest is fairly recent, i.e. hard cap all dry but soil around eggs quite moist, and it is sunny I do not want to expose moist soil, so opened only from 1 side – nest full at this level, and roughly 22x25 cm as best as I can judge. Hard cap full of dropping material and grass from ground level cooked into it too. Soil is a pale brown and very pebbly – hard cap loose and easily broken. Will measure and replace eggs and since fresh can not take them – put piece of paper inside calling this nest 1, 2 Oct 1971, my mane. Eggs all in beautiful condition. (Pg. 62)
Eggs:

I	58.7 mm x	58.0 mm
II	59.8	58.1
III	59.6	58.8
IV	58.5	58.0
V	58.8	58.6
VI	58.8	58.3

Nest # II – Older than # I, because dry throughout, 8 eggs, more or less 2 layers; 2 on top at 13.5 cm from surface (upper layer), 6 below these, 4 at 15.5 cm, 2 at 17.5 cm (bottom layers). Nest just about same size as other in dimensions, depth same all over bottom, being 23.5 cm deep – rock in bottom covers 40% of it (part of center and one side) at this depth – rest of nest bottom not excavated any deeper. Hard cap of similar construction – lots of feces and grass mixed into pebbly soil. As in other nest hard cap down on top of eggs and some loose soil but some air spaces around them. Eggs marked and measured as in other case and note left in nest.
Eggs:

I	58.5 mm x	58.0 mm
II	58.3	58.1
III	58.5	58.0
IV	59.5	58.9
V	60.3	58.7
VI	56.0	56.0
VII	59.4	57.5
VIII	61.7	58.1 (Pg. 63)

Nest # III – between other 2 in age – slightly moist around eggs, dry everywhere also; nest about same size. Maximum depth 28 cm, with about 2 cm – loose soil on bottom with deepest egg resting on this – slightly more of this soil in other places on cavity floor. Rock obstruction only in rear corner of nest – not really any hindrance to deeper digging; 5 eggs of noermal size and shape and 1 miniature; definitely not filling nest except at bottom level – depths to their tops: Deepest egg 1 20 cm; 2 eggs 19.5 cm; 2 eggs 17.5 cm; more or less level- depth varying due to soil on cavity floor.
Hard cap as in previous 2 nests. Lots of old egg shells in nest – all look as if hatched naturally – embedded in walls of nest – definitely nest dug up by dogs. Treated nests in other 2 cases; Nest closed and with paper inside.

Eggs:

I	61.0 mm x	58.1
II	58.4	58.1
III	56.0	55.5
IV	58.0	57.5
V	60.0	57.4

Miniature (collected) – 33.5 x 32.0 (Pg. 64)
Left here and began following tortoise trail – found that it runs toward long vegetated arm running up from Media Luna Crater in stead of uphill- this is not surprising since above there little vegetated spots in planchonada there is a long steep rise made up almost entirely of very lightly vegetated, crumbly coarse lava. Only 200 m from 3 nests, trail dropped into another small patch of open soil (1.5 x 3 m) in a small vegetated spot. Here are several nest attempts some old hatched nests and 1 nest from this year. 'will perhaps return to it in awhile but want to dash over to long vegetated area to see what is in it. Incidentally, cat droppings dense all over planchonada and through these vegetated zones also. A fairly fresh cat dropping right beside this nest – contains finch feathers, lizard lets and skin and Schistourea parts. No dog sign yet. These small vegetated areas stop about 100 m from vegetated arm and a lava flow intercedes there. Crossed it and (Pg. 65) entered vegetated arm and discovered it is an old lava flow covered by a Bursera and Opuntia parkland – dense grass in under-story but all dry now. Immediately began seeing tortoise sign, mostly old, but only 40 m into vegetated zone found a tortoise under an Opuntia tree with3 freshly eaten fallen large, lightly-spined pads. Tortoise – a very large unmarked ♀, scutes nearly smooth save for outer 1-2" but some of costals still show lots of worn growth rings. No lichens or algae; flaking disease only in a few old spots. May have nested recently as fresh pale brown mud on tail and rear feet. White growth increments clear and moderately thick. CL 98.4; CW 110.1. Very round in outline from top view, also, even though front is elevated some at nuchal notch, she is nearly a dome-shaped, remarkably different from San Pedro area forms – See photos #32-36, Roll 372; see photos # 1-3, Roll 373 (KX).
Ticks: common mites in heavy infestation on plastral midline and along skin border of underside of supracaudal and interior of leg pockets. Common ticks mainly in hidden areas (only engorged ones there) a few scattered on legs and leg pockets. Tiny lack ones on interior of leg pockets. (Pg. 66)
At 1545 hr altitude reads 480 ft here. Went downhill though area continuing toward upper base of Media Luna crater – only covered some 250 m more or less and in this distance found 2 clear nesting areas – 1 with 4 old nests from which all young had left – but impossible to tell number in each nest; 2 new nests here, and 1 recent attempt 15.5 cm deep and full of mud ♀ used cloacal fluid – rock in bottom. Other nest spot had 2 old nest from which all young had left – no sign of dogs here and no digging up of nests. However, cat sign everywhere. Not best nesting area have seen because rocks very near surface, but in small spots of several and several l to 5 x 10 m more or less there is deep enough yellow-brown powdery soil. Also passed 3 slaughtered ones – 1 very recent (scutes still one) ♀ of 77 cm CL, another ♀ 73 cm CL a bit older, collected skull and lower jaw, scutes off but carapace whole. Another older – also a ♀ but larger – can't measure because too broken up. Determined sex from size and fact that scutes ½ - ¾ smooth on all 3 of (Pg. 67) them. So fishermen extend raids way beyond media luna

crater – how much higher can't say. Certainly must be many more nesting spots and dead ones all though area I made a straight line walk through and probably uphill for quite some distance also. Tortoise trails and sign dense all through here, mostly from when grass was green but a lot of it more or less recent – few weeks to 1-2 mo (probably ♀♀). Muddy (nest) attempt and 1 fresh nest on 75 m downhill from ♀ checked above. From here had to return rapidly to camp as is late – in route, just as started, found a cat dropping (old) with skin and leg bones of a tortoise hatchling.
Others split into 2 groups and examined higher areas for nests. Sr. Gordillo and A. Tupiza found old nesting zone they located on a previous trip more or less just directly above camp, but at 500 m altitude (used altimeter) old nest impossible to examine because cattle had rolled in dirt there – but could see egg shell fragments in soil. Here were also 2 new nests from this year (un-numbered). Two large ♀♀ in the area; area still quite dry (Pg. 68) transition zone even though so high – very little garúa reaches here. No dog signs here, but cat signs there. O. Chappy and P. Cartagena found nests and 51-52 at an altitude of more or less 300-350 m in same general area above camp. Marked and left these. Found a tortoise of more or less 50-55 CL at an altitude of 350 m near lava flow – killed by dogs – marginal scutes full of tooth marks and bites. Right near this a large ♂ slaughtered by people.
3 Oct 1971 – To other marked nests above little hill near and just NW of camp. Went up through very dry transition zone from hill, passing nest all way; tortoise droppings, mostly dry, a few recent, beds, and trails all along. Slope rather steep and nest made in small completely open areas where ground is level or nearly level for short distances. Area mostly covered by brush and trees (big Pisonia), but ♀♀ chose open spots of soil in little grassy pampitas. Soil is pale brown –beige and powdery with some pebbles in (Pg. 69) it. Went up to highest nest of this bunch of eight. At 1060 ft altitude (correct, Thommen, 0800 hrs) –
Nest #32 – found 2 Sep 1971; I opened nest – very well made nest; this soil makes a very smooth hard mud so easy to see dimensions, form, etc. – a regular flask:
Width 16 cm; front to rear (excluding under cut) 16 cm; undercut 8 cm in center front; maximum depth (half of undercut) 28.5 cm; sloping downward and inward from rear, so not as deep there and with no obstructions anywhere save for a rock in floor on right side (half) of undercut – depth here only 25 cm from surface. Minimum depth in rear of nests is 24 cm from surface. Nine eggs, filling nest full and quite stacked up. Depth to their tops from surface as follows:
1 (deepest) at 22 cm; 1 at 20 cm; 2 at 18 cm; 3 at 12.5 cm; 1 at 11 cm; 1 at 10 cm. thus more or less 4 layers, 2, then 3 , then 2, then 2 – quite tumbled in and nest crammed full. Hard cap very durable and with lots of feces and grasses mixed into it; presence of feces in this case perhaps unnecessary as mud quite hard in and of itself. Nest dry throughout. Measured eggs, marked them, replaced them and covered nest. (Pg. 70)

Eggs	mm	x mm
I	62.4	58.5
II	62.8	57.9
III	61.6	60.5
IV	60.6	60.6
V	60.0	59.7
VI	59.6	59.4

VII	60.9	59.1
VIII	60.9	59.8
IX	61.8	58.2

Nest #31 – 50 m lower down, same kind of site and soil; hard cap without feces and not as hard; more recent nest as soil around eggs is slightly moist still. Can't really measure cavity because dimensions not clear. [Nest photos, Roll 373, #4 and 5.] But considerably larger than last nest. Maximum depth is 30.5 cm but some 1-2 cm loose soil scattered all over floor; no obstructions in nest anywhere. 9 eggs, mostly in 1 layer save for 1 egg on top of 8 below depth from surface to tops of eggs – 1 deepest 25 cm; 7 others all between 20.5 – 22.5 cm. 1 on top at 16.5 cm. (Pg. 71) Large air space around sides and bottom of eggs but tops impacted in mud of hard cap.

Eggs	mm	x mm
I	59.4	58.7
II	59.3	57.6
III	64.0	61.0
IV	58.9	57.6
V	58.0	57.3
VI	63.8	62.0
VII	61.0	60.9
VIII	62.7	61.0
IX	59.9	59.7

Nests 30 and 29 – also found on 2 Sep by O Chappy; 2 old nests nearby (see below). Has 3 old nest in notes but opened 1 of these supposed old ones and found it to be a nest from this year – thus already here on 2 Sep thus nest #53 – huge cavity – 32 cm wide, by 26 cm front to rear and 33 cm deep all over floor except rear where slopes down/in. Well made, dimensions clear; no obstructions anywhere in nest; on a slight slope – one 1.5 m from other two nests, 29-31 and 53 at some altitude. (Pg. 72) Hard capt hick and more or less hard but no feces in it. Bottom of it fallen-in in pieces so 9 eggs inside in a large hollow air space. Seven in one layer on bottom at 25 cm to their tops, 2 in interstices of these a 22.5 cm to their tops. Nest full in bottom, but could hold many more eggs in 1 or 2 upper layers. Re-made nest as usual and Chappy marked it; eggs marked and measured

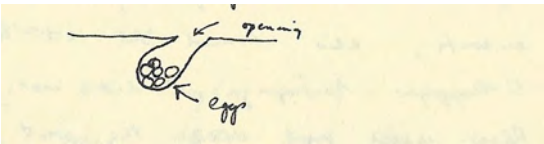
Eggs	mm	x mm
I	65.0	60.0
II	61.4	61.3
III	61.5	61.0
IV	61.2	61.0
V	60.7	60.3
VI	61.7	60.3
VII	63.6	62.0
VIII	61.0	59.0
IX	60.9	60.9

Opened both old nest here – both had normal exit holes – found that ll young had left each nest and all eggs hatched – each contained 8-10 eggs, one almost certainly 9, the other nest impossible to say exactly whether 8, 9 , or 10.

Just below here noted large naturally dead ♂ which Chappy had found before – more or less 110 cm. (Pg. 73) CL but without any scutes – at least several years old. Form very

flat on top, nearly as depressed as males from San Pedro area and quite like them except that in rear drop off is slightly more gradual – begin at rear of 4th vertebral scutes rather than at beginning to middle of 5th vertebral and then straight down nearly as in those from San Pedro. Collected vertebral scute and pieces of costal-vertebral bone area.
Nest #26 – this one found on 22 Aug by O Chappy , another 40 m bleow last nests in altitude – vegetation and soil same. 1 slaughtered huge ♀ nearby, many years old and very broken-up carapace. This nest was open on surface when found and contained 2 strange eggs in addition to normal ones –
One had size and shape of 2 joined eggs; other in form of a "light bulb" – will open to check on nest. When found nest it was open to one side only, not as if ♀ left it this way but more as if caved in or was stepped on – eggs are under top of nest:

[Diagram of eggs in cavity with opening to surface angle to side.]



Nine eggs in all; from above one could see only double eggs; in side surrounded by loose (Pg. 74) dirt and caved in pieces from roof were 7 very normal sized eggs all about 58-60 mm diameter and nearly round and other of normal size but sloped to point at one end and really looking like a light bulb with a short neck. Opened nest to see if any hatching – 7 OK, 1 of normal ones was cracked and rotten (addled). All eggs in one layer (filling it) in bottom of a large cavity and all at 24-26 cm to their tops – much like nest #53 – on a slight slant and of approximately same size. Removed rotten eggs, filled entrance with dry herbs to prevent excessive entrance of powdery soil and covered entrance to form a dry cap. One old nest here from last year which O. Chappy opened contained 1 addled dry egg and shells of many more – all escaped and exit hold size of 2 tortoise hatchlings. Number of eggs unknown. This old nest and dead ♀ here not in his notes.
Continued downhill passing nests #24 and 25 in route, also found on 22 Aug 871 by O. Chappy and A Tupiza – did not open these. Also passed Nest #23, the nest which was found on 22 Aug 71 also with 11 eggs, (Pg. 75) 2 already hatched and out of nest and gone, with cat feces (fresh) right at normal exit hole. Inside were 3 more hatched out, 5 eggs with small holes where tortoises beginning to hatch and 1 closed eggs; they took these to protect them from cats (note: on 27 Aug 71 Chappy notes that last egg, one which had no sign of hatching on 22 Aug had hatched; other 5 hatched out between these 2 dates; they lost 1 of the when carton they were in was turned over by wind at Caleta Iguana. Others now at CDRS for raising – thus 11 eggs, all hatched. [Marginal note: 1 slaughtered ♀ 20 m away from here.] No new nest today in area of nest #23.
Stopped at nest #21, found on 21 Aug 1971. Another 50 m below last nest (#26). Will open this one. Soil more pebbly than those above as we are near base of small hill where nests #19, 20, 23, 28, 49, and 50 are located (last 2 found yesterday, 49 very fresh, right before probably, and #50 a bit older, more or less 3-5 weeks(?). Soil here at #21 however is nearly same powdery, yellow-brown type.
Nest #21 – very large cavity – almost uniformly same depth save for rear down/in slant – depth (greatest) is 33 cm. (Pg. 76) Width of cavity 21 cm, front to rear including

undercut 24 cm; Cavity easy to see because of muddy scraped wall. Hard cap thick but with only small amount of feces – moderately hard only because of pebbles; moist sil still around eggs, rest dry. [Marginal note – no obstructions at all in nest.] Eggs basically in 2 layers filling cavity at these levels – 12 eggs. Seven in bottom all at 25.5 – 27.0 cm to their tops from surface. Six above these, 20 cm to tops of 2, 21.5-225 to tops of other 4; then 6 resting in interstices of lower 7.
Eggs: treatment of nests as in others above.

	mm	x mm
I	57.8	56.9
II	57.9	56.5
III	58.7	57.3
IV	59.6	58.0
V	60.3	57.3
VI	58.7	57.9
VII	59.2	58.0
VIII	57.8	58.5
IX	58.1	56.2
X	57.2	57.6
XI	57.5	56.2
XII	57.8	56.9
XIII	58.4	58.1

Went on to hill where soil is much redder but also rather gravelly – redness due to lava and not a fine (Pg. 77) good nesting type of red soil as on Santa Cruz – soil here is much same consistency as yellow brown in nest just examined – Nests #27 and 289 – found 2 Sep 1971 by O. Chappy and P. Villa in an area frequently examined so relatively fresh – in same area are 5 nests from last year, all with normal openings where young left and all with all young hatched and escaped – not possible to count egg shells because not sufficient time. These nests only meters apart.
Nest #49 – very fresh when found as noted above – in same general area, some 30-40 m away.
From here headed directly back toward campsite, in route, some 150 m E of hill where 6 nests are found ♂ #10,161, CL 117.2, CW 122.6; large, quite rounded and see Roll 373, # 6-11. Scutes smooth in more than half of central parts; no flaking disease, lichens, or algae. Ticks – abundant – scattered common ones on skin around tail area or leg pockets, but mainly in protected hidden areas; tiny (Pg. 78) black ones and inflated translucent ones rather common in interior of leg pockets, but rare elsewhere. Common mites fairly dense in more exposed, unusual external sites and extremely dense in interiors of leg pockets, especially rear ones.
Returned to camp, packet up and headed toward Caleta Iguana. Enroute, within first half km of camp saw 3 tortoises – one large ♂ just like #10,161 in terms of shape and carapace conditions. One medium ♂, circa 75-80 cm CL – scutes smooth only in 1/8 – 1/10 or less, no lichens, algae, flaking disease. Very dome-shaped. One ♀ CL 85.5; CW 92.5. See photos 12-14, Roll #373. Completely all smooth scutes, shell depressed at nuchal notch so that almost perfect dome-shaped form in front. However, in rear a long very gradual shape, such as in some chathamensis ♀♀. Then along trail at about half way between Las Tablas camp and point directly above Caleta Iguana, saw smallest one

of trip – moving (Pg. 79) downhill through dense vegetation along a fairly steep gradient – CL 67.5 cm; CW 70.4 cm. Probably a ♂ but am not sure. Shell not at all smooth save for tiny central parts of scutes; no lichens, algae, or flaking disease. Perfectly dome-shaped – could not detect any differences in shape of this one from most seen on Santa Cruz. Altitude here about 700-750 ft. From here back, so no more tortoises and no more sign. Under an introduced orange tree in pampas above Caleta Iguana at altitude of more or less 950 ft found some old dry droppings from past few months sometime. Apparently used to be great densities of tortoises in pampas which extend from some 500 ft altitude to rim above Caleta Iguana but were virtually totally eliminated save for a n occasional wandering relict (more on this below). We crossed into pampas from W at about 1100-1200 ft and descended through it to its end above Caleta Iguana – no tortoise sign anywhere except around the lone orange tree. (Pg. 80)

Some other findings of trip – On 2 Oct 1971 while I was more to W; other 4 split into 2 groups and searched for nest above camp as described on pages 67-68 – fairly certain that these must be nests all over this side of the volcano up to 500 m and perhaps even higher. Gordillo says found a nest once at 800 m altitude more or less on NW side of volcano. Oswaldo Chappy, who has been one person present at all stages of work on Cerro Azul has recorded all this in 2 long "informes" to Pepe Villa – a summary of his notes are as follows: see map for locations – (31 Jul - 4 Sep 1971; 16 Sep – 3 Oct 1971) – Tortoises marked or re-checked –

#	new?	Sex	Date	Location	Measurements (CL/CW)	
10,040		♂	2 Aug	Loma Lechosa	118.5	123.0
10,127	x	♀	2 Aug	NW Zone	80.0	88.5
10,128	x	♀	3 Aug	" gen. area	90.2	102.0
10,129	x	♀	"	" " "	75.5	81.5
10,130	x	♀	4 Aug	" lower area	88.9	98.3
10,131	x	♀	4 Aug	" lower area	64.0	69.5
--		?	4 Aug	" lower area	42.5	40.0
--		?	4 Aug	" lower area	36.9	36.8

Note – #200 scutes damaged by dog bites)

10,132	x	♂	"	NW – lower area	114.2	116
10,133	x	♂	"	" "	139.5	148.3

(Pg. 81)

10,134	x	♂	5 Aug	Rim W side	91.7	100
10,040		♀	"	1000 m above central pampa camp	93.5	108.4
10,135	x	♀	8 Aug	San Pedro zona alta	101	111
10,136	x	♀	"	" " "	79	91.5
. . .20		♀	"	" " "	94	106.8
10,137	x	♂	"	" " "	93	106.2
10,138	x	♀	"	" " "	86.6	103
10,139	x	♂	"	" " "	110	112.5
10,140	x	♀	"	" " "	98.2	108.6
10,023		♀	"	" " "	78.4	89
10,141	x	♂	"	" " "	101	115
10,142	x	♂	"	" " "	116.5	119.5
10,143	x	♂	"	" " "	123.5	127.4

All above for 8 Aug on a trip from high part of "San Pedro" toward San Pedro area – all in higher, very wet, green zone.

10,144?	Lost in notes.						
10,145 x	♂	15 Aug	El Tuno pampa		86.2	94.5	
10,146 x	♂	15 Aug	El Tuno pampa		92.9	94.4	
10,147 x	♂	16 Aug	Las Pegas		94.5	108	
10,015	♀	"	"	"	copulation attempt		
10,016	♂	"	"	"	"	"	
10,148 x	♂	"	El Tuno-pampita		105.8	112	
10,149 x	♂?	18 Aug	Los Crateres NA		40.3	41.5	
10,150 x	♀?	"	"	"	"	41.3	44.5
10,116	♂	"	"	"	"	----	
10,151 x	♀	19 Aug	"	"	"	91	101 near nest #17
10,152 X	♀	"	"	"	"	95.5	103.5

(Pg. 82)

10,153 x	♀	19 Aug	Los Craters		83	84.8	
10,154 x	♂	"	"	"	106	117	
10,155 x	♂	"	El Tuno		109	114.5	
10,156 x	♀	21 Aug	Las Tablas		75.6	85.5 near nest #20	

Las Tablas hill nesting area – 1 slaughtered ♀, 1 slaughtered ♂) probably 2-4 yrs ago.

10,157 x	♀	22 Aug	Las Tablas		87.5	93.5	
10,158 x	♀	24 Aug	Pampa above Caleta Iguana		88.5	94.5	
10,159 x	♂	25 Aug	Rimo n SE side		88	98 eating Opuntia.	
10,160 x	♀	2 Sep	Las Tablas		94	104	
10,161 x	♂	"	"	"	117.2	122.6	
10,162 x	♀	"	"	"	81.8	88.4	
10,163 x	♂	3 Sep	San Pedro (Planchonada de Cinco Cerros)		101.5	109	
10,060	♀	3 Sep	"	"	"	"	83 91.8
10,163 x	♂	19 Sep	"	"	"	"	101.4 109
10,164 x	♂	19 Sep	"	"	"	"	109.5 125
10,165 x	♂	19 Sep	"	"	"	"	115.5 122
10,166 x	♀	21 Sep	"	"	"	"	93.6 104.8
	Just laid nest #37 night before.						
10,167 x	♀	22 Sep	"	"	"	"	79.5 89.4
10,060	♀	25 Sep	"	"	"	"	beside nest #43 at

coast; came down to lay.

10,168 x	♀	25 Sep	"	"	"	"	83.7 103
10,169 x	♀	25 Sep	"	"	"	"	77 86
10,170 x	♀	25 Sep	"	"	"	"	78 97

(Pg. 83)

10,171 x	♀	26 Sep	"	"	"	"	79 89
10,172 x	♀	"	"	"	"	"	73.5 86.5
10,173 x	♂	"	"	"	"	"	112 119
10,174 x	♂	28 Sep	"	"	"	"	111.5 117.2
10,175 x	♂	"	"	"	"	"	103.1 110.5
10,176 x	♂	"	"	"	"	"	117.7 121.7

10,177 x ♂ " " " " " 118.8 119.5
(# 10,178 – 10,181 and most notes in my notes, see below for a few other comments on nests, etc.)
10,182 x ♀ 2 Oct. Las Tablas 74 84.4
10,183 x ♀ 2 Oct Las Tablas 84.3 96.4
10,184 x ♀ " " " 81.4 91.6
(Most notes for 1-4 Oct in Caleta Iguana and Los Tablas in my notes).
Nests and other notes –
Ferals killed – Cerro Azul
Cats – abundant virtually everywhere, especially in lower, drier altitudes; dense in tortoise nesting areas; 2 casts in Caleta Iguana area, but above in pampas; none killed though many seen in Planchonada de Cinco Cerros (W of San Pedro). None seen in Las Tablas area (perhaps too dry now) but sign in form of dry droppings everywhere. (Pg. 84)
Dogs – abundant in most areas (see below); 19 killed in Caleta Iguana (pampas above it), Las Tablas and intervening areas; also more or less abundant in San Pedro area but only 1 killed.
Pigs – occur from just E of Caleta Iguana to E; especially destructive in San Pedro – Planchonada de Cinco Cerros area – some seen but hard to find and none killed.
These kills based on following amounts of working time (2 wardens together except as noted).
Caleta Iguana pampas, Las Tablas areas – 31 Jul-2 Aug; 5 Aug-7 Aug; 11-14 Aug; 20-28 Aug; 30 Agu-2 Sep; 1-3 Oct – Total 26 days.
San Pedro, Planchonada de Cinco Cerros areas – 8 Aug - 9Aug; 3-4 Sep; 19-30 Sep; total 16 days.
These calculations can not be made very exactly but represent more or less number of man-days since 2 wardens move around together almost always, and even if not specifically hunting (this done only for an (Pg. 85) entire day rarely) they are always armed and looking for feral animals while hiking and working.
Nests, etc. – Nests #1-2 – found only 12 m apart in NW Zone at altitude (estimate) of 200-300 m in dry zone with palo santo and cindery soil; 3 Aug 1971; no dogs or cattle in area now and few if any cats, but sign of all 3 from hot season past. Beside nest #2, 1 m away, an old nest with normal exit hole. Opened this and found 1 addled eggs and shells-all other young hatched and escaped from nest. Neither nest protected with corral.
Near here found a young one of more or less 4 years age eaten by dogs – more or less 35 cm CL probably.
Nests 3-9 – all found 3 Aug 1971 at slightly higher altitude than #1-2 in similar soil and vegetation type. All these nests in a small area of soil of 2.5 x 4.8 m Same area with 3 old nests – opened these – 1 with all young normally hatched and left nest; 1 with 2 addled eggs and all others hatched and gone normally; 1 other with all eggs addled and no (Pg. 86) hatchlings (either 9 or 10 eggs – he does not remember). None of these nest protected. Near here 2 other old nests – all young hatched and gone normally from these 2 nests.
Nest #10 – found 4 Aug; very fresh, probably only 1-2 days old, NW zone also, in area of palo santo and pebbly soil. Not protected.
Nest 11 – found 4 Aug, NW Zone also, on a small hill, palo santo and cindery soil. Not protected.

Nest 12 – found 4 Aug; NW zone also, very near an encañada.
Total nests in NW area = 12 – none protected.
Nest 13 – found 17 Aug in Los Crateres area; in a river bed more or less, soil very sandy and powdery mixture. Not protected.
Near here one old nest with normal exit hole – 1 dead hatchling trapped in nest, 2 addled eggs, shells indicating 2 others hatched and escaped. Perhaps were other eggs but could detect only 2 shell remains (Pg. 87). Another old nest in Los Craters area – one dead trapped hatchling, 1 addled egg, all others hatched and escaped normally.
Nest 16 – at base of small hill near Los Craters – found 19 Aug – protected this nest.
Nest #17 – other side of same hill as Nest #16; found 19 Aug; palo santo and cat claw in area; 1 old nest near it from which all young hatched and left nest normally. Nest not protected.
Nest #18 – Los Craters area; found 19 Aug; planchonada terrain, palo santo. Not protected.
Nests 19, 20, 21, 23, 24, 25 and 26 covered in my notes; none protected.
Nest 22 – found near a small hill near lava flow on 21 Aug 1971, Las Tablas area; not protected.
Nests #27-32 – also covered in my notes.
Nest #33 – found 3 Sep in Planchonada de 5 Cerro (=pl)W of San Pedro; very shaded location in relative sense.
Nest #34 – same as #33.
Nest #35 – found 4 Sep; pl area; 1 eggs on surface, just a shell remaining , lying beside finished nest.
4 Sep in San Pedro area found following nests destroyed by pigs in same areas where were looking for nests and found nest # (Pg. 88) 33-35; 7 recent fresh nests; 5 older nests, probably from last year. None of these recorded in my notes previously; none of new nest protected yet.
Nest #36 – found 17 Sep, relatively fresh and moist on surface, in El Tuno area; 1 eggs on top of soil near nest, eaten by "birds". Not protected; no other nests in the area.
Nests #37-38. found side by side 21 Sep, pl area; protected both with one corral; #37 laid previous night and ♀ #10,166 nearby, CL 93.6; CW 104.8.
Nest #39 – found 21 Sep, pl area; similar site – pega-pega vegetation and much soil; proteted with corral; beside it 2 nests destroyed by pigs. [Marginal note – protected these (#37-39) 3 with corrals on 27 Sept 1971.
Nest #40 – found 21 Sep, pl area; same situation as previous 3 nests; protected with corral. Corral build 28 Sep.
Nests #41, 42, 43, 44, 45, 46, 47, 48 – covered in my notes – all protected with corrals.
Nests destroyed by pigs near many of these – recorded in my notes. (Pg. 89)
Found nest #35 destroyed by pigs when went to protect it on 28 Sep 1971. Nests #33-34 not re-checked at all, thus probably destroyed because no corrals were built.
Also on 25 Sep in another open spot O. Chappy found 3 fresh nests destroyed by pigs.
Nests 49-52 covered in my notes.
Interviewed Oswaldo Chappy a bit more right after return from trip – NW nesting area and tortoise area just below steep part of rim – very high up. He says that with exception of one tortoise (see following) all he saw in NW area, Las Tablas area, pampa area (S and above Caleta Iguana) and E area of Cerro Azul were of same more or less rounded,

dome-shaped form. All those he has seen anywhere on Sierra Negra were also of this dome-shaped or generally rounded form. One exception was a large old, smooth scuted ♀ in very high (Pg. 90) part of pampa (above pampa camp) on S side of Cerro Azul crater just below steep part of rim – this ♀ looked just like ♂♂ and ♀♀ of San Pedro area and even had same heavy covering of lichens and flaking disease as in the former area.

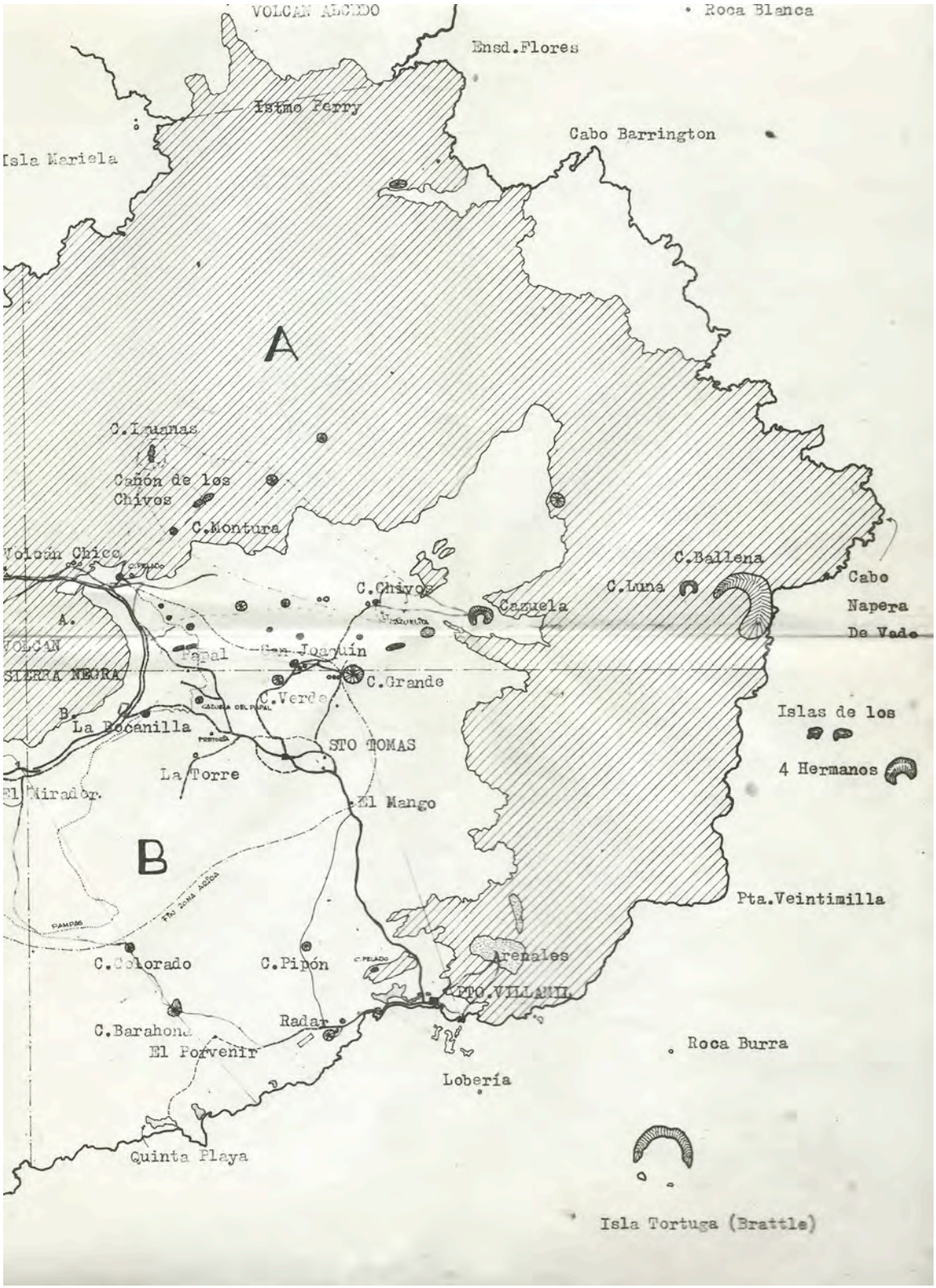
[Notes end here; back cover of notebook has pocket with a map of southern Isabela with some areas augmented with trails and or areas worked; pocket also contains tiny notebook pages with history of colonization of Isabela; notes of unknown origin. Both are included below.]

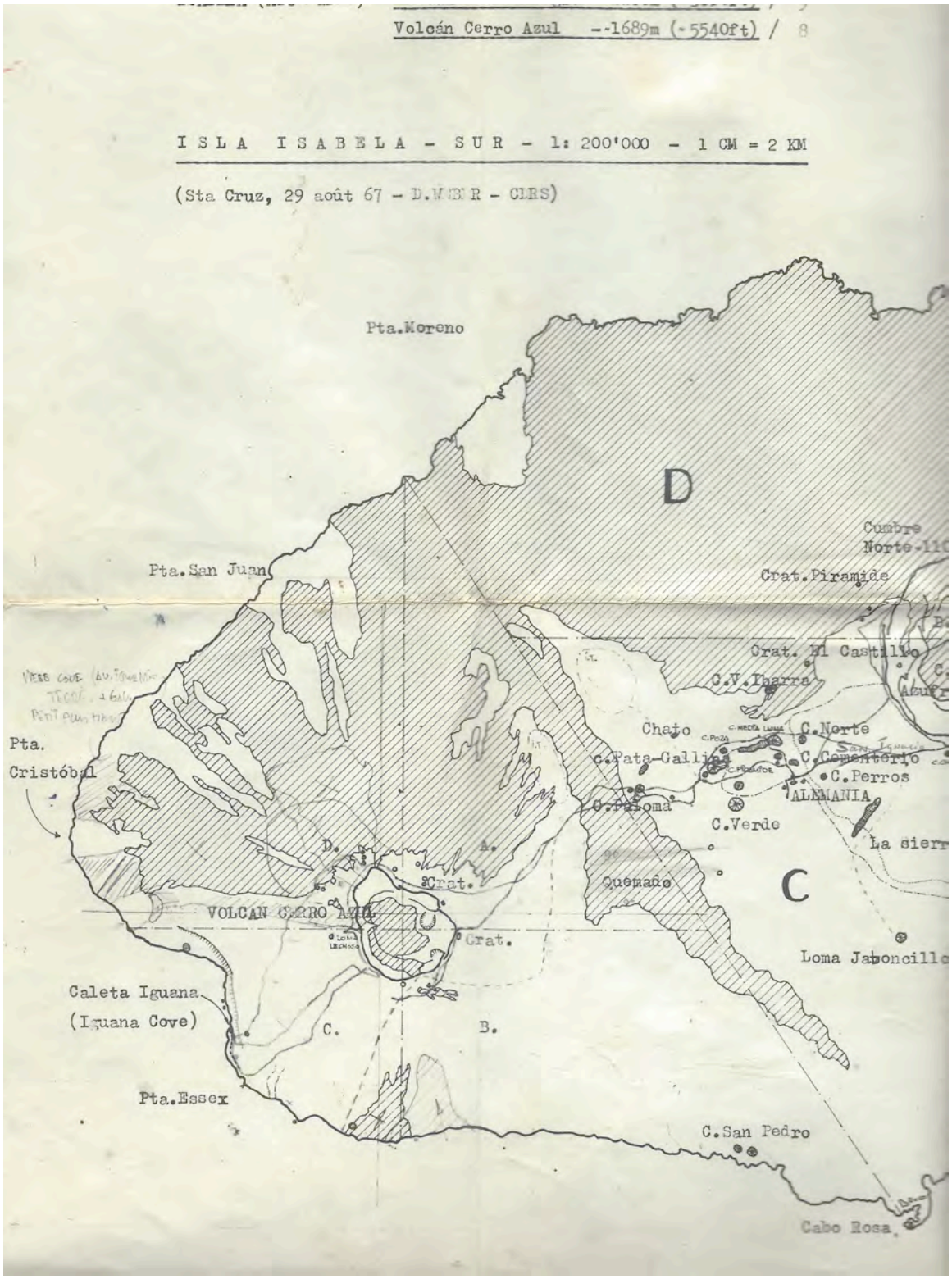
Notes from back of Cerro Azul/Sierra Negra notebook of CGM

Early history –
1875 arrival – wild cattle, goats?, rats?
Pigs, goats, dogs – after colonization?
1880-90 (more or less) sent people to Villamil by Cobos (more or less)
Sucre Gill – 73 years old- 20 burros sent to Villmil from San Cristobal – volante? Broken down on coast at P. Garcia or Cowley and burros onto Alcedo (he says was 60-8 years old at time).
Sr. Sucre Gill (more or less 70 yrs old) – still at Villamil
Prisoners – tanks – sent out and had to fill them – 50 gallon drums.
Sr. Pinchot (Balladeres) Carlos Gil – sold tortoises to same extranjero in 1925 – took them from Cerro Azul to Caleta Iguana – more or less 2 large ones.
Oil hunting – prisoners – before that by colonists – 1921-3 to 1932-33 or earlier.
Pigs in Caleta Iguana area – were not any in 1970 when Gordillo was there now there – recently 1971 – to Las Corrales – high up only now.
He says when father came in 1895 were dogs, rats and ccats. Goats and pgis brought after 1895. Horses much later – by Carlos Gil in 1920s.
Sheep – 1956 by Sr. Vivas.
Caleta Iguana and San Pedro much in late 50's. Even gave meat to villagers at Villamil – here and less 1960s – and since 1906 hardly any.
Astral 58-59 – lfet in early 1960 – slaughtered tortoises in pampas above Caleta Iguan – did not go to Las Tablas.
Ladd- 1968-69 1 year only – killed few tortoises in pampas above Caleta Iguan and entered to las Tablas to kill tortoises.
Flow of 1925-1930 – (trail via Cerro Verde, Las Animas to highland? E side.
Voclan Chico area, Papal? Area, Villamil area, were tortoise in Volcan
Chico till 1966 – killing htem still, Volcan Chico and below it. Fishermen – see entry points.
Pww and sil boats. Santa Rosa and Ballenita
Areas – after 1935 to 1956 motor boats – 1954 till now – San Pedro, Caleta Iguana, Las Tablas, Boasts from Villamil entered Las Tablas.
Destination
Alemania – 1946-Mayo 15, 1959.

All around Caldera rim till lava flow ; also Santo Tomas (other camp)
Also de Villamil. (other camp)
To Quinta Playa (wiped it out – "galapaguera de union"; also crossed and took them from whole east side of Cerro Azul. Las Tablas and Caleta Iguana by boat.
Colonists – mainly to whole Cazeuela area, P. Buenano, Almania area to Crater of C. Azul before large lava.
Burros- 1 alone on Caleta Iguana area – N of Santo Tomas, Volcan Chico, Alemania, Pampas de Buenano, way up to W of San Pedro on both sides of lava flow; in eat of Cerro Azul. Not past Caleta Iguana.
Cattle – almost everywhere; not east of road and Santos Tomas and only domestic in colonized zone.
Former and xxxxxx? (distribution?) – probably everywhere there was abundant vegetation and some soil, even on lava flows with more or less dense vegetation. Present distribution – see map –
Dogs – verywhere but Santo Tomas area nd eats of it.

Cats – everywhere.
Ratas – everywhere.
Chanchos – Santo Tomas area all of S and N – Sierra Negra; SE and S of Cerro Azul ; not
Sheep – very few in between Cerro Barahona and Cerro Pipon – Can't advance because of dogs – Goat.
Distribution of ferals – boats eats of road and population of S. Negra t o Cerro Pipon and Cerro Barahona.


VOLCAN AZCUDO
Roca Blanca
Ensd.Flores
Istmo Perry
Cabo Barrington
Isla Mariela
A
C.Iguanas
Cañón de los Chivos
C.Montura
Volcán Chico
C.Ballena
C.Luna
Cabo Napera De Vado
C.Chivo
Cazuela
A.
VOLCAN SIERRA NEGRA
Papal
Gran Joaquín
C.Grande
C.Verde
B
La Rocanilla
STO TOMAS
Islas de los 4 Hermanos
La Torre
El Mirador
El Mango
B
Pta.Veintimilla
C.Colorado
C.Pipón
Arenales
PTO.VILLAMIL
Radar
C.Barahona
El Porvenir
Roca Burra
Lobería
Quinta Playa
Isla Tortuga (Brattle)


Volcán Cerro Azul --1689m (-5540ft) / 8
I S L A I S A B E L A - S U R - 1: 200'000 - 1 CM = 2 KM
(Sta Cruz, 29 août 67 - D.WEBER - CERS)
Pta.Moreno
D
Pta.San Juan
Cumbre
Crat.Piramide
Crat. El Castillo
C.V.Ibarra
Chato
C.Norte
C.Pata-Gallina
C.Cementerio
C.Perros
ALEMANIA
C.Paloma
C.Verde
La sierr
Pta.
Cristóbal
Crat.
Quemado
C
VOLCAN CERRO AZUL
Crat.
Loma Jaboncillo
Caleta Iguana
(Iguana Cove)
C.
B.
Pta.Essex
C.San Pedro
Cabo Rosa

Volcanoes Wolf and Darwin [Isla Isabela] Volume #1.
Field Notebook of Craig MacFarland

(Pg. 1) 4 Sep 1971.
Left Academy Bay this morning at 0330 on "Santa Cruz" for a long trip (2 weeks) to Volcan Wolf and V. Darwin. Jan and Bennett to have a vacation on coast, Brad Jacobs looking for nests of Hawaiian petrel, and Linda Salisbury to stay on coast and study fur seals and sea lions. Arrived at Roca Blanca" – a small half-rectangular shaped bay just west of Radar site near Punta Albemarle, Volcan Wolf.
In passing along east side of Volcan Darwin was able to see that virtually impossible for tortoises to exist or cross between Volcan Alcedo and V. Darwin at least on eastern half of isthmus between the two; likewise entire outer SE to N slopes of V. Darwin are lava (see Roll 362, photos 9-12) and not inhabitable by tortoises save for their possible existence in same long strips of vegetation on NE flanks of the volcano. These strips appear to be cut off from rim by extensive lava fields, i.e. they are islands of vegetation in a massive surrounding area of lava. Are between V. Darwin and V. Wolf is likewise closed off by extensive lava fields. Are lots of long strips of (Pg. 2) vegetation on eastern flanks of V. Wolf but doubtful if tortoises in them because are very rocky, very steeply inclined (more or less 30° angle) and Daniel Weber went up one of them seeing no tortoises or sign anywhere.
5 Sep 1971 – Jan, Bennett, and I disembarked at "Roca Blanca" Bay. Linda and Brad to look for study site for her between here and Punta Flores to W. I started up directly from bay at 730, heading directly inland and nearly due S.
First tortoise sign at 560 ft – old dry turds from some months previous. To this area very , very rocky old lava flow covered with Bursera, Waltheria, Jasminocereus, Opuntia, and a host of herbs and other shrubs. Some dry grasses scattered also. Land iguana turds in this same site- a few soil patches here, but no nesting sign.
From here to 1020 ft followed same type of vegetation, thickening a bit and Bursera dropping out some, seeing more small Scalesia shrubs. Followed a raised lava ridge much of this distance, so not (Pg. 3) surprisingly saw tortoise sign (old dry droppings) only here and there, especially in low places where ridge is scooped out into an empanada-like form with a bit of collected soil and lots of grasses, herbs, and some sedges. Grasses and sedges are about half dry (half green shoots) and growing in clumps. Jasminocereus dropping off hill slope at 1000 ft (more or less). Tortoise trails here and there but all old (probably from rainy season). There is a large lower "valley" to my E all along here with another rocky ridge running down to about radar site. Perhaps are tortoises at these altitudes there because more soil and vegetation. To W as rocky as where am climbing. At about 1000 ft Pisonia began and vegetation became much denser and lava less prominent, though still very rocky. Began to see some small Psidium also, lots of Alternathera "bushes", Croton, still Bursera, but as I continued up to 1200 ft (very dense vegetation) (Pg. 4) Pisonia became clear dominant in places, in others mixed half and half with Bursera, scattered Psidium. At 1200 ft ran into a small plateau with surface soil and deeper soil spots. Right away found lots of tortoise droppings from large to small sized animals, of various ages from months to only a few weeks old, 3 land iguanas, a burrow site from a smallish tortoise, and 2 small tortoises.

1. CL 53.5; CW 55.9. No lichens, algae or flaking disease. Scutes smooth in central spot only. White growth increments present but thin. Ticks (ticks collected) abundant, large, engorged and non – engorged common type along scutes (Plastron/skin border just to either side of annals; same scattered elsewhere on skin in rear on legs but mostly small, unengorged ones. No engorged ones in open areas. Abundant (1 or numbers) of tiny black ones in interiors of leg pockets; some translucent ones there also by dozens; Latter also scattered on (Pg. 5) skin around anus and tail and a few on skin of legs. Ticks also thick (unengorged common ones, tiny ones, and translucent ones) along carapace skin border above legs in front.
2. CL 50.1; CW 50.5. No lichens, algae, flaking disease; scutes smooth only in very centers; white growth intervals as in previous one. (Marginal note: sex?) Ticks as in previous one – the only common ones of more or less large size are in hidden folds in the rear. This one does not have front marginals as elevated as the previous one. See Roll 362; # 13-17.

As soon as reached this area noticed ticks crawling all over me; did not note or feel them at all at stops at 560 and 1010 feet altitude.

Could be some nesting here – are droppings from large animals and soil spots of adequate depth but am not sure. Lots of green herbs and grasses here; also falling guayavillo apples; the small ones' droppings are full of these things and one small one was eating Psidium fruits when found him.

Another small one same area - ♀ probably CW 56.9; CW 59.0. Shell conditions as in #1 above but (Pg 6) white growth increments thicker; ticks as in above two. In shade resting. Shell curved more down in front - like #2 above.

Went up through this area another 200 m (additional 100 ft. elevation) – extensive well worn tortoise trails throughout. Within first 50 m of #3 above saw following tortoises –

1 about 40 cm CL.
1 ♀ - 69 cm CL
1 ♀ - 70 cm CL.
1 ♂ - 70 cm CL,
2 ♂♂ - 71 and 75 cm CL – All in shade along well worn trails; all healthy and with noticeable white growth increments. 4 under 1 Psidium tree. Lots of soil spots, but no nesting sign that is definite. Hard t tell because not much soil and tortoises use it for wallowing. Heard another 3-4 moving along trails off in bush. Trails lead in all directions, all well worn, much worn lava- but especially run N-S (i.e. up and down slope). Very dense population here. Also sign of cats at all so far, even on open dirt piles. Then out 200 m E and am going down. (Pg. 7)

Following well worn tortoise trails in especially fine piece of it at 1000 ft. See Roll 362, # 18-19. Well worn lava pathway. Mostly rocky, but some soil, vegetation not as dense so far as was on ridge I ascended on – much opening due to abundant tortoise pathways leading up and down. Pathways appear unused just now but old dry turds everywhere.

Cut over to E some 200 m and ran into an openish area running down to coast and beginning at about 700 ft altitude. This is obviously a part of the lava flow consisting mainly of long plates or "planchonadas: of reddish to yellowish brown rope, plate,

and river type lava on the surface, with extensive lava tubes and tunnels beneath the surface. Thus it forms a long flat area running from 700 ft to the cliff at more or less 80-100 ft above the sea at Bahia "Roca Blanca". The width of this part of the flow varies from 100-250 m in places to narrows of only 1-2 m width. It is paralleled to the coast on both sides by flows of rough tumbled black lava (Pg. 8) where walking is difficult. The whole strip has patches of soil here and there, sometimes of sizes of several meters in diameter. This is very fine, almost powdery yellow-brown soil. The dominant tree is Bursera, with Jasminocereus and Opuntia scattered throughout. The under story is made up of scattered bushes of Croton, Waltheria, Scalesia, Darwinothereus and Ipomoea vines. There obviously is usually only little in herbaceous layer but the entire strip is now covered with mostly dry or drying grasses and sedges and some herbs which obviously grew up in great profusion and density after the heavy rains of this past March.

There are tortoise trails running up and down all through this entire "parkland" area from 700 ft to within 100 ft of the cliff above the sea. There are dry droppings from this period (probably late Mar to mid Jun) throughout the entire zone, old tortoise burrows, and the trails are very well worn and marked. Obviously there (Pg. 9) were many tortoises here, up to the largest sizes judging from the droppings. But no recent sign. Both old and recent land iguana droppings and sign throughout the area. Since there are many soil patches throughout the strip I checked carefully for signs of old or recent nests but found none – also no sign at all of 1) tracks of small hatchlings or young ones; 2) droppings of the same; 3) egg shell fragments in the soil spots; 4) new or old excavations; 5) new or old nests; 6) with one exception, no adult ♀♀ of about 70-75 cm CL lying in shade of a bush, inactive, at 500 ft altitude. She has clearly not been digging near here. Much of the soil covered area not fit for nesting because soil is too shallow, but many small sites have deep enough soil, especially in upper 200 or so feet altitude of the strip.

Also found a fisherman's knife with the inscription "M" or "N" on handle at 350 ft altitude and remains of 7 slaughtered tortoises between 400 ft altitude and cliff at 100 ft – i.e. all within 1 km of coast. 1 was recent – scutes still attached – a small ♂ or medium ♀ of 65 cm CL – see Roll 362, photos 20-21, and only 300 m (Pg 10) distance inland from coast. Other 6 were all decayed and in pieces – i.e. probably 5-10 years plus old. But surely kills given locations – 3 of them were all within 25 m of each other and just 50 m distance below fresher kill. Other 3 were grouped at about 1 km inland. Probably many more slaughtered remains here, but I covered only 1 straight line through the area. Two fishermen on the Santa Cruz knew this site well and said they and most other fishermen entered it frequently to look for tortoises.

6 Sep 1971. – Went along coast to first bay past Punta Flores to W – terrain is clearly very rocky (jumbled), although vegetated up to some 600 ft at least all across here from "Bahia Roca Blanca" to this bay – (see my sketches on map) – thus very doubtful that tortoises are in these lower areas. Also clearly the best site for going up into tortoise country from this side is via "Bahia Roca Blanca".

(Pg. 11) 7 Sep 1971 – Began climbing from Roca Blanca bay at 0715 – sun out 0630 and hot as hell. (I and Brad Jacobs). Followed same route descended on 5 Sep – to about 550 ft fairly open planadas of soil with abundant tortoise trails and Bursera trees as described previously. From there up curved a bit E and more rocky and

denser vegetation but still following tortoise trails. No nesting signs in lower part at all. At 700 ft found a nest in middle of a trail where it runs along the edge of a steep hole- very dense vegetation and rock piles all around. Site just a bit of soil and very stony, pebble laden soil at that. Very poor place to dig and nest certainly shadowed (shaded) till about 0730-0800 and after 1600 each day. Soil so bad that ♀ could not dig very deep and hit torta like lava at only 21 cm and stopped. Nest of normal shape but only a shallow cup. (Pg. 12) 24 cm wide, 16 cm front-back at surface; 21 cm deep; undercut only in forward 25% and 5 cm deep. She used extensive amount of feces in hard cap and walls of nest – cap still moist only 5 cm down so nest probably only 2-3 weeks old at most. 5 eggs, all basically at same level and filling nest. Top of eggs varied from 12.5 – 14.5 cm below center ground surface of nest. Lots of small rocks, grasses and loose soil scooped over top of moist part of hard cap (2.5 cm of this material). 1 egg at highest, 1 at lowest and other 3 at abut 13.5 cm from top. All eggs slightly elongated. Filled nest at one level.

Egg:	mm	x	mm	
1	65.2		55.2	
2	67.5		51.7	55.9 (flattened)
3	64.6		54.6	
4	62.1		55.2	
5	65.4		55.4	

See photos 22-25, Roll 362 of nest location. (Pg. 13)
Continued on up passing into more or less changeover from Bursera dominated dry zone to lower dry transition zone at 1000-1100 ft. Eventually passed into same exact area at about 1200 ft where I found concentration of tortoises on 5 Sep. Saw most of the same ones here again. Quite a number of Geospiza fuliginosa in the area but not any really dense flocks of these. Scattered G. fortis also. Rested here for 1 hr (330-1430) as the sun is beastly hot and we are dehydrated enough (headaches also). From here continued straight up continuing on abundant tortoise trails but still having to cut a lot at chest to head level. Vegetation becoming thicker as we ascended to about 1600 ft where we stopped for night at 1630. Can not see around us in any direction at all for more than a few hundred feet. Vegetation from 1200-1600 still transition zone – more and more guayavillo and Pisonia, dense underbrush, less and less Bursera. Still scattered Opuntia trees, saplings and seedlings everywhere. Tortoise trails run up and down everywhere, many of them well worn, but mostly in disuse now. Counted only 4 more tortoises (Pg. 14) from area of concentrations to campsite. Only here and there are there patches of well worn soil trails, recent burrows and droppings. Mostly trails with old dry droppings, probably mainly from rain season. One is really compelled to conclude that most of the tortoise population must be higher up. Few areas we have seen them in seem to be areas where those present are just living and waiting out the garua season and relative dryness. However plenty of food available from 800-1000 ft and up, green grasses, herbs and shrubs becoming more prevalent the higher we go. Vegetation is basically thick everywhere since leaving coast – not really any open areas of more than a few to 5-8 m in diameter anywhere. Very interesting to see transitional zone vegetation of this type un molested and unchanged by the activities of goats and or burros. Have seen scattered

but very infrequent cat sign (*droppings) all way up, but only a few dung piles in total. There are clearly not overrunning the place. (Pg. 15)
Have also seen Tropidurus all the way up, concentrated most heavily in more open spots but not dense anywhere. Conolophus also all way up but very scattered – only saw 4 between 1200 and 1600 ft – 1 huge ♂ and 3 large ♀♀.
At about 1100 ft found 2 old, very decayed tortoise skeletons (remains only!) - bones crumbly and all in pieces – very doubtful fishermen this high because tough going and dense vegetation. I would very much like to know if tortoises have moved up in mass or not due to drying of garua season on this north slope or if they are simply scattered out in low density everywhere. Their trails and dry droppings have been so abundant from sea cliff at 100 ft more or less to over 1600 ft that I am sure they were in these areas in large numbers during or just after heavy rains of Feb – Mar.
Checked hundreds of droppings enroute today and found that over 90% of them are mainly filled with grasses and some herbs at all altitudes. Abundant dry grasses from coast to about 600-800 (Pg. 16) ft attest to lush growth that must have been here from Mar – Jun due to heavy rains. AT higher elevations, this grass is still green somewhat, the more so the higher we go. Occasional droppings full of Castelia leaves. Fresh droppings full of grasses, herbs, and guayavillo apple remains. Some old and some fresh droppings consist mainly or partly of Opuntia remains but there only account for 5-10% of total. They certainly use Opuntia for food but not main item at any altitude so far traversed. Especially at higher altitudes so far crossed (1000-1600 ft), have noted that ground around Opuntia trees is cleared completely of any fallen material – due certainly to tortoises and land iguanas. Land iguana droppings also are full mainly of grass/herb remains, but also some Opuntia remains.
Have continued to look in vain for further nests or nesting sign – perhaps are more nests and tortoises burrowing and other activities obscure there? (Pg. 17) Can not judge this yet.
8 Sep 1971. Continued straight up from base camp at 1600 ft with only day packs. Very difficult going, cutting continuously. Tortoise trails running up-down on slopes everywhere but few fresh ones – mostly months old ones. Same for droppings.
We have been moving nearly continuously through dense brush since 0730. At about 1100 hr entered a slightly different area at 1800 ft – still dense growth of underbrush and over story of trees, but some open patches and tortoise lanes covered with green grasses. Soon found a tortoise in it, moving uphill over rocks and though dense vegetatio9n. CL 68.3; CW 70.8; sex ♀ probably. Ticks collected. No lichens, algae, flaking disease, white growth increments thin; scutes smooth only in very centers. Ticks of all 3 types very common all o9ver- not surprising because she is in dense vegetation and no Geospiza fuliginosa here. Most ticks of all 3 types unengorged and attached especially along scute /skin borders, but also on open skin. Tiny black ones and translucent ones clearly prefer inner leg pockets, arch of skin above head, etc. Common ones prefer borders between skin and scutes. (Pg. 18)
This ♀ has slightly raised front end – about shape of most San Cristobal (chathamensis) ♀♀.
Cut up to 2150-2200 ft – vegetation getting continually thicker, with more and more Xanthoxylum. Tortoise sign continuing same as below. Climbed a tree and could see hill at 1800 ft and 200 ft to W not far – 1 km more or less above us could see base of

rim – all way around us entirely vegetation appears to continue as same thick horrendous mass. We are turning back to camp as it is nearly 1400 and this is hopeless.

On our trail just about camp 50 ft altitude – medium-sized ♂ tortoise CL 84.1; CW 87.4. No lichens; white growth increments clear and thick; scutes smooth only in 1/6 or less; two big spots flaking disease – one patch on last left costal and next to last left marginals. Ticks collected. Black-green algae (in dry condition) on rear 1/6 of shell; yellow-green algae on front marginals inner protected surfaces. Well raised and approaching saddle-back in front but not extreme at all – in fact top of 2nd vertebral some 1.5-2 cm higher than nuchal notch; (Pg. 19) long and oval in shape; carapace does not drop sharply down till top of 5th vertebral.

Ticks: all 3 types in great abundance; tiny black ones especially dense in leg pockets and on arch of skin above neck/head and forelegs, but also scattered all over skin, on neck, around tail and arms, along scutes/ski8n borders and dorsally and ventrally along scutes junctures. Translucent ones same; common ones also everywhere but especially dense along scutes/skin borders; most of the inflated common ones on more isolated areas like plastron/scute borders above tail and just to side of this. Most others more recently attached as have only slightly inflated or non-inflated bodies. As in previous tortoises examined here no red mites or common grey oval-shaped mites yet found.

As far up as we cut today were still occasional, scattered Opuntia trees, but definitely less and less common from camp (1600 ft) on up – main concentration of them from 1000 ft and downwards. Scattered Opuntia seedlings and sapling also all way up to 2200 ft at least. Also still large Bursera trees (very large) with trunks up to 20 in in diameter all way to 2200 ft; but most (Pg. 20) common trees were Pisonia and Psidium and small Xanthoxylum from camp to 2200 ft. Saw first orchids at about 2050 ft common epiphytic type as seen all over Xanthoxylum trees on rim of Alcedo – they appeared quite dry (though mostly green leaves) and not in flower.

9 Sep 1971. – To area of tortoise concentration at 1200 ft – directly blow our camp. Enroute at about 1500 ft altitude caught a large ♀ land iguana, 49 cm snout-vent length and examined her for ticks and collected them and mites:

1) a few of small red mites scattered about on neck and back.
2) Tiny black ones virtually everywhere but especially dense on neck and shoulders.
3) Common ones – largest and most inflated ones in axillae, at base of neck under skin folds (ventral) and on inner joint surface between lower and upper parts of each limb. Smaller and un-inflated ones scattered all over body and in more exposed places.
4) Translucent ones – as with tiny black ones – densest in slightly more hidden areas.

Very heavy tick infestation in total- doubtful that finches clean much if at all. (Pg. 21) Just below this found a small tortoise feeding on dryish grass, with his night burrow only 10 m away. CL 49.1; CW 51.5; no algae, lichens, flaking disease; white growth increments clear but very thin. Scutes smooth only in very centers. Dome-shaped. See Roll 362, # 26-33.

Ticks – no mites; 3 tick types abundant, but less so than on all others examined till now; fat common ones only in rear hidden area; other common ones, tiny black ones and

translucent ones in interiors of leg pockets. Latter two types also dense more or less on skin around tail and above neck/head.
Just below last area following well worn tortoise trails – found 3 tortoises – all actively moving at 1020 hr (cloudy). [Marginal note – 1270 ft]

1) CL 59.0; CW 63.1; ♀. No lichens, algae, flaking disease; scutes smooth only in very centers; white growth increments clear but thin. Elongated oval shape and somewhat raised in front but intermediate in shape. See Roll 362, #34 – end; Roll 363, # 1-3. Ticks – about as in previous animal for tiny clack ones – only a few common ones each in front and rear along scutes/skin borders; a few translucent ones in leg pockets.
2) CL 49.5; CW 50.6 – no lichens, algae, flaking disease; scutes smooth only in very centers; White growth increment clear and thick. Slightly raised in front but otherwise more or less dome-shaped. (Pg. 22) Ticks as in previous tortoise.
3) ♀; CL 70.0; CW 76.5; no algae or lichens; old patches of flaking disease in centers of 4th and 5th vertebrals; scutes ½ smooth in centers and very worn. Quite raised in front but not a full saddleback. Oval-shaped from dorsal view. White growth increments clear and moderately thick. See Roll 363: #4-10. Ticks: only very scattered common ones along skin/scute borders front and rear and around tail; tiny black and translucent ones common in inner leg pockets. Former common all over skin.

Back to area of concentration first found on 5 Sep 1971; At 1200-1250 ft altitude more or less. A number of tortoises here –

1) CL 45.5; CW 46.5; no lichens, algae, slaking disease; scutes just beginning to polish smooth in very central part of them. White growth increments clear but thin. Shape more or less dome - a bit oval from top view, but no saddle-tendency at all yet. Projecting nature or raised aspect of centers of carapace scutes more like Pinzon young raised at CDRS than porteri young from the Reserve. Ticks as in 2 small ones examined on 5 Sep (Pg. 23)
2) CL 64.9; CW 67.3; ♀; no lichens, algae, flaking disease; white growth increments clear but thin; scutes smooth only in very centers; oval-shaped from dorsal view, but otherwise quite dome-shaped to intermediate in form. Roll 363, #11-16. [Marginal note – ticks collected]. Ticks collected; common ones mainly concentrated along carapace and plastron borders with skin, only inflated ones in hidden areas; tiny lack ones everywhere; translucent mainly in inner leg pockets and on skin around tail. No common or red mites.
3) CL 68.4; CW 73.8; ♂. No lichens, algae, flaking disease; white growth increment clear but thin; scutes smooth in central 1/6 or less only; slightly raised in front – oval top view – real intermediate shape. Ticks – common type (engorged) in hidden areas in rear, scattered elsewhere in leg pockets and other open skin but no engorged. Tiny black ones in usual areas, dense on inner leg pockets; translucent few and mostly on skin around tail in rear and in leg pockets' interiors.
4) CL 68.8; CW 71.9; ♂; Carapace conditions as in previous animal. Ticks also same but common ones extremely dense and many, many engorged ones in rear hidden areas- stack up on top of each other – almost incredible densities for short stretches of 4-5 cm along plastron /skin border in rear. (Pg. 24)

5) CL 76.5; CW 77.2; ♂. No lichens, algae, flaking disease, smooth scutes only in very central 1/8 or less – very oblong shape and quite turned up in front – saddle-back/intermediate (half and half, more or less). White growth increments clear and well formed – moderately thick; see Roll 363, #17-24.

Ticks – as in previous 2 animals- only engorged common ones in a hidde3n fold above tail on carapace/skin border.

Moving back toward camp – just 40 ft altitude above where we found group of 3 tortoises this morning found 3 more medium-small sized animals –

1) CL62.2; CW64.1 – no lichens, algae, flaking disease, scutes just beginning to smooth in most central areas; more or less dome-shaped but very oblong –oval in shape. Ticks of all 3 types heavy but inflated common ones only in rear hidden areas. White growth increments clear and medium thick.
2) CL 58.1; CW 59.3 – carapace condition same as in above tortoise; also more or less dome shaped – less oval than previous tortoise. Ticks same as previous one.
3) CL 60.1; CW 62.4 – carapace conditions and ticks as in previous 2; but with small spot of flaking disease on last right (Pg. 25) coastal – also has 5 costals each side and 11 left and 12 right marginals. Very oblong shape, more or less depressed dorso-ventrally, but still more or less dome shaped in front and rear view.

Most tortoises seen today grazing on semi-dry greenish grasses, one eating fallen Opuntia pad, spines and all. All growing well and more or less fat and healthy. Many lying in dust wallows which they sleep in at night also. These they form usually up against flat rocks where there is a small overhang and soil beneath the plate rocks. Most of these in open spots. On hot days (cool and cloudy all day yesterday and today) they lie in dust wallows beneath Pisonia or Psidium trees. These altitudes (1000-1300 ft) clearly a zone of concentration of small to medium sized tortoises – only in these altitudes have wee found tortoises or their recent sign – i.e. lots of recent dung, well used paths in soil and dry matted-down grass, lots of fresh tracks, lots of recently used soil wallowing pits full of powdery dry soil. From 1300 ft up are tortoises and recent paths but not many sites where they seem (Pg. 26) to be living more or less permanently for this season – just paths running up/down where they have and are moving through from lower occupied zone to higher regions. Same holds true for below 1000 ft – except for 1 large ♀ seen at 500 ft on 5th Sept., only signs in lower regions are abundant droppings and trails from last rainy season.

Nesting definitely must occur at altitudes from more or less 1000 ft and downwards toward coast – vegetation is too dense and opportunities for nesting too limited from there above, on this side of Volcan Wolf at least. Will search for nesting areas tomorrow. No definite signs seen yet save for one odd nest at 700 ft on 7 Sep.

Returned to camp at 1415, packed up, ate, and left for coast at 1530 hr – ticks are becoming almost unbearable here and it is obvious we are not going to reach the rim or even its base from this die because of the extreme density of the vegetation. Also, think I have a good idea of tortoise (Pg. 27) distribution and activity and ecology on this die of the volcano. One thing still unsolved is location of majority of large ♂♂ and ♀♀ at this time of the year; also whether or not concentrated nesting zones occur as such or whether they place nest in scattered fashion in any available spots of soil from more or less 1000 ft to lower down.

Once again search for nests on return – we went back down same route more or less that I followed on return on 5 Sep., but covered different exact path. Saw no further signs of nesting at all; this is especially notable along open "pampa Colorada" strip from 700 ft to coast – this seems a likely nesting zone but there is no sign of such! At 500 ft once again found large adult ♀ where found her on 5 Sep. She has moved around only some 3-4 m total since then (her tracks are clear) and has obviously made no nesting attempts. CL 73.4; CW 78.7. No lichens, algae, flaking disease; white growth increments clear but thin; scutes very worn and about 50-75% smooth – she is clearly an old adult. She has few ticks of common type of medium and large size – only some scattered ones along (Pg. 28) scute/skin border below tail and to either side of it. Also some tiny black ones in interior of leg pockets and a few translucent ones in same area. In total she has no where near the density of ticks present on all other tortoises examined till now.
Her slope is interesting, for although she is somewhat saddle-backed in front, she still has a pronounced down=curvature of first vertebral to nuchal notch. She is oval from top view and rear marginals are not flared –up at all. She is very similar in shape to intermediate forms on San Cristobal Island.
On entire trip we say only 12 Conolophus scattered out over terrain from coast to 2200 ft, as follows:
100 ft altitude – 1 – just above cliff at sea in open Bursera "parkland". More sign all through this area to 700 ft altitude but none others seen. (Pg. 29)
700-1200 ft – 2 more (to where tortoises are concentrated)
1200-1400 – 5 more – zone of tortoise concentration.
1400-1600 – still tortoise area but not concentrated – 1 more.
1600-2200 – 3 more widely separated ones all in very densely vegetated area – tortoises also here but only very scattered out.
Saw Tropidurus as high as we went, densest in more open areas, e.g.. where tortoises and land iguanas concentrated, along coast, in open Bursera parkland.
Cats – very little sign – Brad saw 3 cats on coast between Point Flores and here – 1 here at Bahia Roca Blanca.

1) 2 skeletons found – 1 at coast on cliff – 100 ft altitude, in lower end of Bursera parkland; 1 at 1800 ft altitude in dense vegetation.
2) Droppings – also very few-

1 – 200 ft in Bursera parkland
1 – 340 ft in Bursera parkland.
1- 600 ft in Bursera parkland; all in open soil patches.
1– 1450 ft in zone of tortoise activity at present.
1 - 1750 ft – in dense vegetation but in an area with some tortoise activity at present.
(Pg. 30) All were old, dry droppings; all full of hair and other unidentifiable material p no tortoise hatchling bones or the like in any of them.
Predominance of smallish to medium sized tortoises at 1200-1400 ft altitude zone indicates reproduction here is presently rather successful. Main danger seems to be fishermen entering Bursera parkland strip to remove tortoises when they are in this area after heavy rains of rainy season – i.e. probably months of Mar through Jun or Jul. The vegetation is so thick from 100 ft altitude and upwards that I doubt they would penetrate further than parkland zone except rarely. All of trails seen were certainly within first 2 km of shore in parkland zone. Found old skeletal parts of tortoises, from 1000 ft upwards

here and there along tortoise pathways and several skeletal remains piles in 1200-1400 ft range where tortoises (Pg. 31) were concentrated. Could not determine if these were natural deaths or not because were very deteriorated – all were of medium to large sized tortoises judging from the femurs and humeri present.
We have seen not Rattus rattus sign nor been bothered by them at all during entire 3 day journey.
Hawks are abundant on this side of volcano as far in as we went – predation on tortoise hatchlings ??
10–11 Sep, 1971 – On beach recuperating from tick bites, relaxing, reading, eating and drinking large quantities of water. Collected ticks and mites from some marine iguanas at W end of Bahia "Roca Blanca"; also tried catching some Tropidurus here for some collecting but to no avail – can't run them down and they keep well away from a noose; will record marine iguana data from here in separate special notebook.
12 Sep, 1971 – "Cristo Rey" did not arrive till nearly 1300 hr and then sea was so rough at bay where Jan, Bennett and Linda were that we did not get them into boat till nearly 1700 after some trouble and getting wet. No time to move on so we went back just (Pg. 32) around Punta Flores to the E a bit and anchored in a much calmer little bay called "Las Letra (or La Patrullera).
13 Sep, 1971 – Continued on around to W toward Cape Berkeley. Just after passing it water very rough and rolling badly for next hour and till we past Punta Vicente Roca and proceeded close in along S side of Volcan Ecuador running to E looking for a place to put Linda in to study fur seals. Fur seals scattered all along here from E end of Volcano proper to nearly into "curve" of Bank's Bay. She was able to get out at only one spot, but near fur seals- water not to rough, but largish swell and strong wind.
Continued on to first 0.5 mi long black sand beach N of Punta Tortuga where Brad and I checked some cormorant nest for Mike Harris and Jan and Bennett walked about and frolicked on shore. (Pg. 33)
Big piles of old rust WWII army beer cans on beach here. Very tall mangroves in a huge lagoon here – we stepped into fringes of it and saw 2 mangrove finches busily foraging about (within 2 min or so of our entered to a point about 15 m inside the trees.
Enroute here I took some photos of the surrounding volcanoes.
Roll 363, # 25-30 more or less – just after sunrise between Volcan Wolf and Volcan Ecuador from N side just before (more or less) Cape Berkeley proper.
#31-33 – cliffs and vegetation along coast, N side of Caleta Black.
Roll 363, #34-36 – panoramic shots of Volcan Darwin from must N (1-2 km) of Caleta Black (i.e. more or less WNW) – shows clearly that most of this side is lava from rim to coast (of varying ages). Almost no vegetation, except near rim in places.
Roll 364 - #1-2 – N side of Fernandina (all lava) from same area N of Caleta Black where above photos of Volcan Darwin were taken.
Roll 364 - #3-11 – Volcan Darwin from Caleta Black – (panorama including back to Volcan Wolf) (perhaps some shots of Fernandina here but I do not thinks so – forgot to record these). (Pg. 34.)
Went in and anchored at Tagus Cove at 1620 and pack bags for tomorrow's climb of Volcan Darwin and prepared Jan's and Bennett's things so they can camp on shore for 3 days in Tagus Cove.

14 Sep 1971 – Have been questioning Sr. Morales ("Coca Cola") for past 2 days as we passed along N and W coast of Volcan Wolf and along W coast of Volcan Darwin about locations where fishermen have entered tortoise populations for slaughtering in recent past. He has provided much information. Will record this later when have it all in more detail. Went on shore at 0600 at N of main drainage into Tagus Cove, helped Jan set up camp and then began ascent at 0700. We passed up to rim at 550 ft on W side of Tagus Cove large crater. [Marginal note – set altimeter at coast at 0700 before leaving.] From here we could view entire low area between this crater and Beagle Crater to SW, down to just above the "Aguada" S (Pg. 35) of Tagus Cove, and lower slope3s of volcano above this large area up to approximately 1200-1500 ft (garua cloud obscured view above this elevation). Almost the entire area between these two craters and up to 200-250 ft elevation contour where outer slopes start steeper ascent is filled with fresh, almost totally un-vegetated lava –it is really an older flow which covers most of the area and runs nearly to the "Aguada", with a fresher more deeply black flow coming down on top of this earlier flow a short distance below the 200 ft elevation contour. There are several small fingers of vegetation running down from the slopes of the volcano:

1) one to NE side of flow running out just a short ways below 200 ft elevation contour and not coming anywhere near reaching the Tagus Cove ash soiled crater areas. Immense fields of this new and to the NE older reddish lava isolate the Tagus Cove craters and their vegetation from the main vegetated areas of the main (Pg. 36) volcano's slopes;
2) A longer, thin finger runs down into the center of the newer black flow of the huge planada between the Tagus Cove and Beagle Craters – it extends almost 1.5 – 2 more or less km down into these flows from the 200 ft elevation contour;
3) A vegetation covered soil-covered area runs from somewhere (probably rim) [Yes!] all the way down volcano's steep slope and all along the SE side of the 2 new lava flows, narrowing considerably along the base of the Beagle Crater (its NW side) and running down to the "Aguada" between the steep Beagle Crater slopes and the black lava flow of the main central planada. [Marginal note – This vegetated area extends far to SE all over volcano flanks.]

Went down and crossed lava flow heading for two divisions of fresh lava which run up/down steeper slopes of outer volcano flanks. Entered the finger of vegetation mention under 2) above at its upper end near base of steeper slopes beginning and then worked over (Pg. 37) way all through it to its tip out in lava flow. Worked down through its middle more or less and returned along one of its edges. It is full of tortoise droppings and trails, mostly from period of March-June of this year and quite sure; also some older droppings; also some wallows in soil. Largest part of the area is a parkland more or less of Bursera trees which has moderately dense dry grasses all over the area. However, probably 1/3 of the understory's total area is clogged with rather dense shrubs rather than grassy pampitas and the tortoises obviously use these shrubs for shade and also burrow trails through and under them. This area must be quite lush and green for 2-3 months after heavy rains in those rainy season when such occur; e.g. this past Mar, 1971. There is no recent tortoise sign in the area at all so tortoises must have come down into the area after heavy rains to stoke up on the dense grasses and then returned to higher zones with the drying of Jun and (Pg. 38) onwards. Examination of some 25 of the tortoise droppings indicates that all of them were full almost entirely of grasses, with some herb

material included in very small amounts. The soil of this area is a mixture of fine, pale, yellow-grey "powder" and coarser pebbles of cinder (washed in from lava flow) and pressed ash. There is no recent or old tortoise nesting sign here at all.
Saw no cats in the area at all but piles of cat droppings occur everywhere through it. Examined 6 of them and found them to contain: finch feathers and bones. Schistocera (large grasshopper) remains, centipedes (Scolopendra) remains, and rat hair and bones (probably Rattus rattus). Whole area full of actively used land iguana burrows, their tracks and fresh and old droppings. Saw two – 1 large ♂ and 1 large ♀.
From here crossed a bit of rugged lava along base of steeper slope to more southeasterly of two arms of lava flow which come down from above. Actually began ascent however (Pg. 39) in vegetated, soil covered island near this flow – this slope of vegetation will obviously then out to be a long thin island of several ridges and alternating ravines which is completely surrounded and cut off by two lava arms from other vegetated/soil areas at a higher elevation. One of these ridges is continuous with the finger of vegetation below. Ascended up through this from more or less 300 ft altitude to 850 ft altitude when came to juncture of 2 lava arms. Whole slope is covered with a fine yellow-brown powdery soil on ridges and same mixed with cinder and some lighter type of pebbles in ravine bottoms. Vegetation is dominated by Bursera trees, but with bushes of Lantana peduncularis, Croton, Lippia rosmarinifolium, Acalypha and others being dense in the understory throughout much of the area (more or less 50%); the other 50% of the area is occupied in the understory by small open pampitas full of dry grasses. There is tortoise sign from previous few (Pg. 40) months all through the area, on both ridges and ravine bottoms; old and 2-4 month old droppings, trails in soil, burrows in soil and under bushes. Not any recent sign till about 800 ft and no definite nesting sing. Since this is an island in effect, tortoise traffic here is probably less than just to SE in huge vegetated area beyond lava flow – the vegetation and soil is certainly the same there, but the area is vast and free of lava and not a small elongated island like this area we have ascended within. Scattered land iguana sign recent and old all through this area also, and saw 1 large ♀ and 1 large ♂ at 800 ft altitude (more or less). Found 1 large ♀ tortoise coming down hill (trail extends from above some 100 ft distance clearly) at 800 ft altitude just before came out onto lava. Marked (#4,046; CL 85.2; CW 91.6. Very large old ♀; all smooth save for (Pg. 41) outer 0.5-1 in of scutes were faint, very worn growth rings are present. No lichens, algae, or flaking disease. White growth increments clear but extremely thin. More or less dome shaped, but nuchal notch was slightly more raised in front than in porteri large ♀♀. Photos of shape – Roll 364, #12-19.
Ticks: mites (Argus) along mid-plastral line. Tiny black ones and translucent ones dense in interior of leg pockets and scattered on other exposed skin and upper legs. Unengorged common ones along plastron/skin border in rear above tail - more or less hidden by a fold of skin but not well hidden. No sign of recent nesting, but perhaps coming down for this.
Continued on up to 1325 ft staying on lava flow; very easy walking as has been weathered very much and is covered by long stretches of from several to dozens of meters of fine cinder pebbles and even lava when have to step over it is mainly small ridges and rivulets, not at all jumbled or clinker-like. Passed several more smaller islands of vegetation in lava, varying from 1.4 – several hectares in size, each containing much old and some very recent droppings and sign of tortoises. Scattered tracks and 2-4

months old tortoise droppings right out on flow running up/down these cinder pathways. (Pg. 42)
Clearly tortoises move up and down sections of the flow here where moving is very easy; some tracks indicate they pass from one vegetated area to another across the stretches of the flow; others show that they move up/down the flow near and along the larger long stretches of vegetation, especially the huge area which extends upwards to rim and down to Aguada area and far around to SE and ESE on crater flanks. At 1325 ft took photos – Hawk Roll 364, #20-31; Roll 364, #32-26 panorama and other shots of SE of Beagle Crater to almost Caleta Black from above looking more or less S through WSW. Much sign of land iguanas, tracks, recent and old droppings all over flow at these altitudes, lead to and from vegetated islands and especially from one Jasminocereus to another (eating fallen fruits). Saw 1 land iguana just above here. Continued from here up to 1820 ft, still on lava, tortoise and land iguana sign continuing as before. Vegetation on flow increasing a bit, but still very sparse; mostly very scattered Darwinothansus, and Jasminocereus. Latter especially beginning to increase notably. Took another similar panorama of area below – Roll 365, #1-7. From here continued on up to roughly 2500 ft (altimeter reads this at 1630 hr) where we stopped and made (Pg. 43) camp for night in a patch of cinder. From last stop to here stayed on lava, although flow was narrowing considerably as we ascended and becoming more and more vegetated, especially along its outer edges. By 200 ft Jasminocereus tree in very great abundance and continuing thusly to camp area and beyond at least some 100 ft altitude would guess from what we could see ahead. Much other vegetation also on flow and in lower "holes' in it where cinder and some soil is present; vegetation increasing steadily in abundance as we ascended. By 2300-2500 ft lots of shrubs (Lantana peduncularis, Lippia rosmarinfolium, and Lycium minimum and several others) (Commelina ?– this word unclear); also grass clumps, Polypodium ferns, little ground dwelling "pin-cushion-like" clump of fruticose lichens, etc. More exposed lava covered with this to maximum height of 4-5 ft in places, holes with even denser vegetation. Could see about 1.5 – 2 km around on flanks to W and NW and vegetation similar there – this low type on a cinder/lava base – quite flattish. Tortoises could move, and certainly do, all through this more or less sparsely vegetated zone. Amount of vegetation increases to W and NW on this low profile flow. To SE and E lava (Pg. 44) ends shortly and vegetation there is much denser and reaches much greater height on soil-covered volcano flanks. All through this area as we ascended found much old (this year's but 2-4 months ago) and some recent tortoise droppings, trail marks in cinders and pathways through vegetation – amount of sign generally increasing more and more as we ascended, especially a lot of it from 2000-2500 ft as amount of available vegetation increased greatly. Certainly they wandered in some numbers all through here for some months after Mar heavy rains to feed on scattered grass clumps on flow's exposed parts and denser grass in low spots. 'Some few are certainly scattered in the area still now given very recent (weeks old at most) droppings. Although have seen Opuntia here and there everywhere from coast and upwards, they are becoming more and more frequent now, especially from 2300 – 2500 ft. They will probably replace Jasminocereus as main cactus in next few hundred feet as is becoming cooler, wetter, and amount of soil is increasing and lava decreasing. Photos of sunset from camp – Roll 365, #8-11. (Pg. 45)

15 Sep, 1971 – Altimeter at 0700 reads 2410 ft ; probably correct. Heavy mist came in, in early morning hours – collected 1 gallon of plastic tasting H20 from a puddle in tarp. Left camp as is and started up in direct line, still on lava flow at 0800. Lava more jumbled now and less and less of it. Little valleys in it to W full of head high and taller vegetation – Xanthoxylum, Tournefortia, ferns, (Polypodium?), grasses (green), shrub which may be a Euphorbiaceae, Opuntia saplings and trees, etc. – this getting denser and denser as ascend. We stuck more to central jumbled lava where much of same vegetation, but only knee deep and lower in height. Reached top of this at 2950 ft at 0845. Tortoise trails, burrows and droppings, some recent, in lower more densely vegetated "valleys" and lots of scattered slightly old droppings on smoother parts of jumbled lava also. To E we are still paralleling dense arm of vegetation which runs all way to the "Aguada" and Beagle Crater. At 2950 ft found a smallish tortoise chugging up side of jumbled lava flow at its "top" – i.e. are where vegetation (Pg. 46) starts to become so thick that was more really exposed lava. Very much Opuntia last 300 ft of altitude. [Marginal note: we are still in dense mist to here]. Jasminocereus still to this altitude but has dropped off to nearly none. From here up will have to go through much denser vegetation. Tortoise - ♂ - CL 57.8; CW 58.8 cm. No lichens, algae, flaking disease, white growth increments clear but very thin; scutes smooth in tiny central parts only – very dome-shaped. Ticks: no mites; scattered tiny black ones in interior by pockets and elsewhere, but not dense at all; common ones – a few on upper leg, on skin around tail (unengorged) – 1 patch of very engorged and some unengorged ones in hidden area along plastron/skin border just beyond anal scute – to its side.
Heading for rim from here to 0930, running more or less straight up from where we left end of exposed lava flow. From 2950 to 3300 ft crossed area with little exposed surface lava – (Pg. 47) bed is a pale soil mixed with pebble cinder debris. Tortoise burrows, trails, and droppings, both old and recent all over these areas. Vegetation rather dense but only 3-10 ft high maximum and bulk of it shoulder high or less (i.e. 5 ft) – a lot of vegetation same as in little valleys below on either side of exposed lava we were ascending earlier this morning – Darwinothereus, 3 shrubs I don't know [Marginal note: Lippia rosanfolium, Lantana peduncularis and Dodonaria viscose – 22 Sep 1971] very abundant Opuntia treelets and trees, ferns, "pincushions" of lichens on ground, etc. Tortoise dropping full of Opuntia remains (pads) and grasses. Opuntia flowering now in great abundance. Tortoise sign quite dense here for first time since lowest areas we were in early yesterday when steep side of outer flank began. Two tortoises noted (recorded in temporary notes at final – Both unmarked –

1) ♀ - CL 64.5; CW 71.7; 3000 ft altitude – moving under an Opuntia tree foraging for fallen pads, [Marginal note: Have note that many of tortoise trails all through these altitudes – i.e. 2500 – 3500 ft. lead from base of one Opuntia tree to another; virtually all Opuntia trees are cleaned out around their bases.] no lichens, algae, of flaking disease; white growth increments clear but very thin. Scutes of carapace smooth only in very tiny central spots. Ticks – about same as tortoise sample just below here – a few more common ones in hidden (Pg. 48) areas along plastron/skin border in rear.
2) At 3100 ft - ♂ - CL 63.1; CW 65.45 cm; carapace conditions and ticks as in above ♀. Sitting under an Opuntia tree eating a huge, moist, beautifully textured fallen

pad. Has eaten 90% of the pad – about a 20x35 cm pad with many groups of short sharp spines all over it – tortoise obviously devouring it with ease.

From 3300 continued up, vegetation still abut same to 3500 ft. At this point vegetation began thinning considerably and found walking even easier because of large open areas of cinder gravel on top of worn exposed lava. Vegetation mainly knew high from her up to about 4000 ft. Easy traversing and still tortoise sign but much more scattered then before – none of it very fresh. My impression is that main tortoise area is from about 3300 down to 2900 at least along line we have come with stragglers up to 3500 in this season. (Pg. 49)

From 4000 ft to point where we came out on rim at 4250 ft (corrected) vegetation was very dense (as on NW rim of Alcedo – very similar) and about 8-12 ft high everywhere =- basically a shrubby forest of Scalesia trees, scattered Xanthoxylum, Croton, and 2 other tall shrubby species I don't know, one of which has reddish to pale orange tinted leaves and looks vaguely like Waltheria. [Marginal note – this is very likely Acalypha sp; other one almost certainly Lippia rosmanathalium, (22 Sep 1971).] Saw tortoise turds all through this dense bush, most obvious old trails running between bases of Opuntia trees. But not a great deal of activity indicated here on these dense, vegetated, outer slopes and wide more or less (200 ft) rim of dense vegetation – scattered old droppings and trails = nothing from past few weeks.

Reached rim at 1250 hr at altitude of 4250 ft more or less (see map for all details of route followed, etc.). Stayed here till 1400; eating lunch, writing notes and we are now trying to fix position exactly (1420) but difficult because of clouds flowing in all around "southern" sides of rim and filling and obscuring crater. (Pg. 50)

1430 – have finally fixed position very accurately – we are on a relatively high point of rim at something in excess o9f 4200 ft on a line running just about (slightly N of this line is our position) SW of center of crater. Also have been able to see that rim all way round crater (save for one section just about on E wall where large cone has spilled lava out over crater floor and lava runs down on inner slopes and probably to outside also, from fissure above the cone) is densely vegetated and of same "color" as that we just cut through to reach our arrival point so tortoises could occur virtually all around rim save for one small section. Inner crater slopes mostly all vegetated densely too save for this same section but very steep everywhere except in 2 small areas for tortoises to go up/down. Also crater floor is virtually barren in most of its area save for a big platform on WSW to E (Pg. 51) sides. However platform has such sparse vegetation that it is not suitable habitat for tortoises either – must be intensely hot on it as most is open exposed cinder –soil. Two areas where tortoises could go down appear to be exactly W side of crater rim, and on SE crater rim – each of these areas has more gentle densely vegetated slopes leading down to and out onto large platform area. [Marginal note: Aerial photos show that SE area too steep for tortoises W area possible – 22 Sep 1971] Certainly would not make very good nesting areas in lower parts of these "bajadas" also because soil probably with many pebbles and cinders as on rim and garua spill over rim so that it shades these areas very often during this season. However these 2 areas should be checked sometime.

Left rim at 1530 hr – never was completely clear long enough to take a panoramic view of whole crater with camera. Returned by same route – still clouded in down to 3300 ft so could not see much more than on our ascent. Arrived at head of exposed lava outcrops

at 1430 – so 1 hour to return over 3.5 hour route up – due to about 1 – 2.5 hr of machete work. (Pg. 52)
Just 0.5 km above camp (in distance) – a tortoise – Huge ♂ unmarked CL 117.5; CW 116.1. In a low area with sparse to moderate vegetation just E of lava outcrop we are following. Abundant Opuntia all over this area. Extremely old, all smooth, worn shell with lots of depressions here and there all over it. Some flaking disease on front marginals, first costals and first vertebral; also same all over rear area from back of 4th vertebral on down. Black-green algae dense all over theses same areas – almost a sheet of it all over rear of carapace; more of it in little depressions dorsally along scutes junctures. White growth increments clear and medium. 1 kind of lichen at right upper juncture of 5th vertebral with 4th vertebral and last right costal – looks like Dirivaria picta – pale grey-green and foliose, but am not sure and thus will collect. Also collected black-green algae and sample of flaking disease material. Very oblong and huge beast, not any different from many of largest ♂♂ on Santa Cruz – certainly a dome-shape . Took photos – Roll 365 - #14-18. Ticks- mites extremely dense in many places – all along plastral midline. (Pg. 53) and extending out on other plastral scute junctures; filling entire inner leg pockets to such an extent that skin is rotting and flaking away; all along carapace/skin juncture in rear – i.e. borders of supracaudal and marginal scutes. All along other scute/skin borders in patches in front and rear. Much of skin along these borders also dead and flaking away. Tiny black ticks and translucent ones scattered on skin front and rear, mainly in inner leg pockets; but mites occupying most sites. Common ticks- unengorged ones along plastral midline, along scute/skin borders below tail and either side of it. Some large engorged ones along anal scutes/skin border and gular scutes/skin border but only 6 in total. Not many ticks in sum. Plastron of animal is interesting – very yellowish cast to much of it – concave, old and very worn – and scutes worn off completely in very rear so that are no more than boss-like nubs – no hidden skin fold areas here as in smaller tortoises. Collected mites and common ticks. (Pg. 54)
Roll 365, photos 19-22 of sunset from camp – looking toward Fernandina over Tagus Cove Craters.
Other notes on tortoise distribution – saw tracks of small individuals of 40-45 cm CL more or less in higher zones today – 1 track of about 3700 ft altitude and another at about 3900 ft altitude – well up on outer flanks.
Land iguanas – saw no clear sign of them about above 2900 ft – i.e. about to end of exposed lava outcrops we were following; beyond this no signs. Have seen only 6 land iguanas in all – 2 about 200 ft altitude in little arm of vegetation extending down into planada of lava between Beagle and Tagus Cove craters; 2 at 800 ft altitude on lava flow/vegetation strip border near where saw ♀ #46 tortoise; 1 at 1350 ft on border of lava flow and on island of vegetation in lava flow. 1 at 2350 ft altitude just below camp – in main lava flow but where vegetation is more abundant. Their greatest density, based on areas seen so far, is definitely in strips of vegetation on lower slopes, but they walk out all over lava flow also frequently; a lot of their sign all (Pg. 55) over lava flow from 1900 ft down where vegetation is extremely scattered and occasional – i.e. mainly Jasminocereus trees and Darwinothamnus shrubs mainly. Their trails often run from beneath one Jasminocereus to another and they are clearly gobbling up the falling fruits. Would be interesting if % germination (success) were enhanced of seeds of this cactus by passage through iguana intestines.

Jasminocereus stop occurring above about 3000 ft – i.e. from end of lava outcrops to rim - they are replaced by very abundant Opuntia from this altitude to rim. Opuntia is flowering from at least 2000 ft altitude all the way to the rim. From about 2500-2600 ft and down main cactus on lava flow is Jasminocereus, being very abundant everywhere, especially in region from more or less 1800-2600 ft. Transition on lave from Jasminocereus to Opuntia dominance occurs between 2600-2900 ft. Jasminocereus goes all the way to the coast, but am not sure yet if Opuntia does – the latter certainly reaches greatest densities on this side of the volcano from 2700 ft more or less to rim, with (Pg. 56) greatest density being from 2900 to 3500 ft. These trends to E in more heavily vegetated, soil filled areas may be different. Jasminocereus occurs again inside crater on mostly barren platform – could see no Opuntia there but may be some scattered plants of it. Darwinothereus occurs from coast all way to rim and inside crater on inner flanks.
16 Sep 1971 – Arose 0600, almost clear till 0800 then cloudy and misty till 0900 = then overcast but clear at camp area and below. Altimeter reading 2410 ft at 1700; read 2400 yesterday so probably rather accurate for this one hour since this was hour set on coast. Have been observing Opuntia growth forms for past 2 days – largest adult trees reach 10-15 ft and have short trunk, sometimes with fairly dense long hard spines, sometimes with bark only, or both. (Pg. 57) These mostly have largest pads above 1-1.5 m out of tortoises reach but not always (i.e. sometimes have low hanging branches with lowest pad 0.5 – 0.75 m above ground, sometimes grow in cracks with pads right at ground level where tortoises can approach). Youngest and uppermost pads like all others on these trees – covered with somewhat flexible 0.50-2.0 cm long spines which grow in dense clumps and cover entire pad fairly well- they are sharp spines but due to shortness and moderate flexibility tortoises can easily eat the pads – e.g. see notes from yesterday. See Ro0ll 365 – photos # 23-28 of one 12 ft high tree with close-ups of upper pad. See Roll 365,, #29-34 of one 11 ft high tree and close-up of spiny trunk. Smaller trees and "saplings" which are starting to form trunks have very long dense spines all over trunk or "pretrunk" area and lower pads have mostly short spines as in older trees, but with some long spines mixed in – these longer spines offer some deterrent to tortoises eating pads which are well within (Pg. 58) their reach on most of these 5-10 ft tall younger Opuntia. The long spines are about 5-8 cm long mostly with 9-10 cm long ones occasionally. The smallest Opuntia all are all much more spiny; the tiny seedling from those just above the ground to up to 30-40 cm are covered with dense medium length spines (3-6 cm mostly) and tortoises could not eat these; these are clearly well protected. Taller ones from 30-40 cm up to 1 m and 1.5 m have the lower "pretrunk" covered with long dense spines of 5-10 cm length mostly and with smaller spines in between these; The uppermost pad on these has a mixture of short 0.5 – 1.5 cm spines and long sharp ones – those are well protected from tortoises also. So, Opuntia growth from here in general fit Yale Dawson theory, except that 4-10 ft tall trees (and mostly smaller ones of these (4-8 ft) (Pg. 59) have pads which tortoises are clearly capable of eating well within the reach of the tortoises; youngest plants are clearly well protected. See Roll 365, #35 and Roll 366 #1-4 of a seedling to sapling Opuntia of 80 cm height showing some of these characteristics. These photos taken at 2350 ft, just below camp. At 0900 left area, dropped down to 2300 ft and over into dense vegetation of long wide area that runs eventually down to Beagle Crater and Aguada along SE side of planada lava flow, going through this at 2130 ft

found a small tortoise. Very near him took Photos #5-10 (Roll 366) of a small Opuntia seedling, very spiny, 35 cm high and displaying characteristics noted above.
Tortoise – unmarked CL 43.3; CW 45.5. No lichens, algae, flaking disease; scutes smooth only in tiniest central points of first 4 vertebrals; white growth increment clear but very thin; perfectly dome-shaped little fellow. Too small to determine se. See Roll 366, photos #11-17 of this one. Ticks: no mites; no very abundant ticks – a few unengorged common ones on skin of arch above and along plastron/skin border in rear; scattered tiny black one and translucent ones in inner leg pockets. (Pg. 60)
Vegetation here rather dense – Bursera trees, small Xanthoxylum trees, large Opuntia trees, Scalesia and Darwinthamnus shrub to head height, Polypodium ferns, lots of green lush rock ferns, Croton, some Cassia shrubs, other shrubs, grasses about 1/3 green and herbs underfoot. He was eating grass when found. Still to dense and wet here (cloudy) for nesting area.
From here cut down about 100 ft elevation in this vegetation – terrain with no lava – all a rather gritty pebble soil but more a real soil by far than on ascent yesterday. Vegetation is described above and very thick – especially a lot of Xanthoxylum. Tortoise trails, new and recent turds scattered throughout the area; some burrows also; from here returned to lava flow edge. Certainly no nesting here for reason of vegetation density and cloud cover. Worked down lava flow vegetated area border to 1730 ft, noting tortoise droppings and tracks both out onto flow and in vegetation all way down – lots of tortoise paths down through vegetation. Cactus still as dense as above but more and more Bursera as we descend. At 1730 ft found another small tortoise, lying in weak radiation basking and sleeping on cinder about 25 m out from main vegetated area. Took some photos of him on lava flow. Roll 366, #18-22. (Pg. 61)
Tortoise: CL 42.1; CW 43.5; same carapace shape and condition as previous one – the look just alike. This one has more ticks but same types and distribution; no mites; clearly very healthy and fat. Examined several of his turds - full of grasses as with those of previous tortoise. Fresh tracks of a 60-70 cm CL tortoise near here leading onto flow in same place and then back into bush. Roll 366, #23-27 of same small tortoise also. From here entered vegetation and went down a deep ravine – upper part with dense vegetation and deep brown fairly rich soil- descended some 50 ft altitude, tortoise trails and fresh and old droppings from small and medium sized ones dense through this area. At bottom, ravine opened out onto lava flow and here found 2 tortoises basking:

1) ♀ k- CL 73.0; CW 75.7; no lichens, algae, flaking disease; white growth increments clear but thin; scutes smooth in central 1/6 or less but worn. Dome-shaped except that more gentle down slope in rear than in porteri race. See Roll 366, #28-32 of her in basking/sleeping position on cinder of lava flow. Ticks: common ones dense in hidden areas in rear (many very engorged) and near carapace/skin juncture of last marginal on each side (a skin fold hiding) (Pg. 62) this position on each side also; some engorged common ones also scattered o legs and leg pockets. Tiny black ones and translucent ones dense in interior leg pockets, along carapace/scute junctures and skin around tail for some distance. Some huge engorged translucent ones in rear hidden areas also. Collected translucent one in one bottle and other in another one. No mites; loaded with ticks.

2) CL 390; CW 38.4 – carapace conditions as in 2 smaller ones found earlier today – very dome-shaped; however, does have a tiny patch of flaking disease on outer and under surfaces each of last right rear marginal. Very few ticks – only saw a few common ones and tiny black ones scattered in various places on legs and along scute/skin borders in rear; no mites; see photos 29-36 of Roll 366.

Roll 367 – photos 1-13 – panorama and other shots of south of Beagle Crater through almost Caleta Black from 1600 ft altitude on lava flow. Then cut directly over beyond lava flow to SE at this altitude out into vegetated area – further into it than anytime since went in at 2300 ft – in about same distance now, but completely beyond (Pg. 63) lava – land here is a series of spokes of ridges and alternating ravines – vegetation is dense but open up by minimal numbers of well used tortoise trails. Soil is a rich, fine yellow, brown type, no lava. These spokes run up and down mountain. How much higher they go is unknown but certainly turns into vegetation as we saw it at 2300 and 300 ft above. Here is dense Xanthoxylum, Croton trees, medium-sized Pisonia, Opuntia trees, abundant green grasses, Tournefortia "treelets" and everywhere fresh tortoise tracks and droppings. Right after entering it found tracks of 1 35-40 cm and 1 40-45 cm CL tortoises; highways made by tortoises through these stripes, running up and down these elevations. Large patches of open un-shaded soil but no nest signs sighted here.

Found 1 large adult ♀, #50 marked, just where entered the area – CL 89.7; CW 98.2; nearly all smooth save for outer 1-2" of scutes. No lichens, algae, flaking disease; white growth increments clear and thin and she is fat. No signs of recent nesting. Resting in shade of a bush – clear trail of her's leads from above to here for some 200 ft plus. She is (Pg. 64) same shape as ♀ #46 exactly, i.e. nearly domed but slightly raised at nuchal notch. Ticks and mites about as in #46 ♀.

Continued down from this area – trails fantastic – sever main ones and others all over – really enhances walking and requires only minimal machete work. Took some photos of these area and trails – Roll 367, #14-19.

Fresh tortoise sign continuing throughout – trails all have been used within past few days! Tracks of nearly all sizes – 40 cm CL and up to large ♀♀. At 1560 ft saw some tracks of a small one – then found resting in shade of dense bush. CL 35.6; CW 36.3. Perfect domed animal – no smooth scutes, algae, lichens, or flaking disease. Growth rings many, many k- but certainly only 3-5 years old. White growth increments non-existent. Ticks – a few tiny flack ones and common ones – very few – distribution as in smallest one noted previously today. See Roll 367, photos #20-22 of this fellow.

Just 30 ft altitude and 75 m lower found an area with two recent (Pg. 65) nesting attempts – each hole shallow, dug in fine powdery yellow-brown soil. No rocks within 30 cm of surface so probably caving in (soil very dry and loose) caused stoppage – each only dug out 10-15 cm (hard to tell because tortoises moving by going up/down have knocked some soil in. [Marginal note – no cloacal fluid used]. Right beside these is a completed nest – will excavate . Photos of area of nests and nest on surface (foreground of last 2 photos) Roll 367, # 23-26.

Found ♀ which laid nest nearby (3 m) under a bush in shade – fresh mud on legs and tail and supracaudal. CL 85.6; CW 94.1; all smooth scutes and old. Almost dome-shaped just like many large porter ♀♀ - see photos – Roll #367, #27-32. No lichens or algae – only old worn spots where flaking disease was on last vertebral and supracaudal. Ticks dense – engorged common and translucent ones all over upper legs, skin/scute borders in

rear in hidden and open areas. Leg pockets full of tiny black ones and translucent ones. Mites all over on plastral midline and small patches of them on line of skin next to anals supracaudal and last 2 marginal scutes. (Pg. 66).
Nest – laid last night almost certainly – Depth in center – 34 cm from very top (only 0.5 cm loose soil over wet mud).
Width 23 cm. Length 20 cm – Both at cavity mouth, narrowing to inside –
Very slight undercut, almost negligible (perhaps due to fine powdery soil.
Eight eggs – filling cavity at 1.5 levels they are at.
Depth from surface to top of top egg 19.5 cm.
Depth from surface to top of next 3 eggs – 21 cm.
Depth from surface to top of bottom 4 eggs - 24.5 cm.
Bottom 3 eggs resting on soil in bottom at 30 cm. These 4 in loose wet soil in bottom of nest. Much fecal material all through "hard" cap but especially a lot down on top of eggs- first 5 cm of cap above eggs (right down on them) is mostly feces with some wet soil mixed in.
No rocks anywhere in nest or its walls or bottom (almost none in this terrain at all. Eggs really in more or less 1.5 layers, bottom layer of 4 then 4 in interstices of these.

Eggs	mm	mm
1	59.6	58.0
2	58.9	57.9
3	59.0	58.5
4	59.0	58.0
5	59.1	58.0
6	59.5	57.0
7	58.5	58.2
8	62.0	57.0

All but last one nearly perfect spheres; last a very regular slight oval.
Just discovered that this is a double nest – second nest made before this one by a few days to a well because drier further down – hard cap same – much fecal material right on eggs, also a lot in bottom. Nest dimensions almost same- 220 cm wide and 21 cm long more or less (interference precludes exact measures. Eggs, 9 of them in 2 layers mainly, but one balanced way up on top of other 8; 4 in very bottom, 3 in their interstice and 1 way up. Top egg only 14.5 cm from surface; bottom 5 are 21.5 cm from surface to their tops. Bottom of nest at 28 cm with about 1 cm of feces and soil in it beneath eggs. Two egg groups are remarkable unscathed yet cavities slight overlap and 55 cm separates 2 egg groups. See Roll 367, photos #33-34.
There is faint possibility this is one nest but very unlikely because ♀ would have had to stretch a tremendous (Pg. 68) distance to dig such a wide cavity and this would be impossible I am sure given her size and caving-in capabilities of this soil. Cavity width alone here of 2 nests is over 55 cm. Also each of nests dug to different depths and egg groups are distinct; also shallower nest is less moist at upper levels, thus slightly older.

Eggs-	mm	x	mm
1	62.4		58.2
2	63.0		57.0
3	60.7		58.8

4	63.0	57.1
5	61.1	58.1
6	61.0	57.9
7	61.7	58.2
8	61.3	58.2
9	60.6	59.1

Two egg groups definitely show differential in shape and size trend.

Restructured nests and filled in and left them. Just below here 20 m found another nest – opened but no time now for exact measurements, but about same size and shape as first of above 2 nest – Contained 9 perfectly spherical eggs; laid within last few days as nearly wet to top. Much fecal matter used also; in same soil type; (Pg. 69) deepest part in nest 32.5 cm in center, but about 3-3.5 cm fecal material and soil in bottom and 5 eggs on this; 4 above and interstices of these; eggs fill cavity at these 2 levels. Saw 2 65 cm CL ♂ tortoise near here – not marked; no time to examine.
Dropped down more - ridge starts dropping sharply down to nothing and toward lava flow as it curves to SE here. It is late and will have to cross to lava to get to Tagus Cove tonight. Tortoises move through this steep slope are but fresh sign much less than up on main ridge where slope is very gradual; all this occurred in a scant 100 m distance – i.e. drop off is sudden. In crossing to flow passed through a small low area, almost flat of yellow brown soil but full of almost pumice-like pebbles. Vegetation open in here and almost a Bursera parkland – flow right beside it. As soon as entered it found a nest in this crumbly pebble soil. (Pg. 70) Opened it – small cavity, only 20 x 22 cm and narrow, no undercut. Deepest point is 28 cm (correction –30 cm because 2 cm of loose dry soil on top of nest). ♀ hit 2 rocks in bottom at this depth. 9 eggs jumbled in a pile sort of, really filling cavity, top most eggs top at 13.4 cm from surface, bottommost one is at 22 cm (to its top) from surface. Egg spherical and white and fresh; nest 1 week or less could guess because only very top of hard cap really dry. Much feces in bottom of hard cap and right down on top of eggs. Altitude here about 1250 ft.
In this same area quickly spotted 2 more nests but no time to open them – have move rapidly now or will not reach coast.
Returned from here down lava flow and then to Tagus Cove by same route of ascent from finger of vegetation onward. Stopped on side of Tagus Cove Crater 2/3 way up and took 2 photos of lava (Pg. 71) flow and vegetation where we ascended and surroundings – Roll 367- #35-36. At "top: (circa 500 ft altitude) of Tagus Cove Crater took a panorama of slopes of Volcan Darwin including ascent route and some of rim – shows garua cloud from 300 ft upwards also – Roll 368 (KII) #1-5. Returned to Tagus Cove and boat at 1815 – cut it close – almost too dark to see and certainly too cold to bathe.
17 Sep 1971 – Roll 368, photos 6-9 of Fernandina from above Aguada at 200 ft altitude. Disembarked at encañada near the "Aguada" at 0630 and began "climbing" here at 0700. Quickly rose to a planada at 100 ft altitude by going up encañada. Then proceeded up this planada to base of steep beginning of outer volcano flanks at approximately 300=320 ft altitude. Followed open planada all the way, curving to S or right along lava flow till I reached the steeper rise. Gradual rise fro m 100 to 300 ft over about 3 km distance – very gradual, because I stayed in lowest flattest parts near base of Beagle Crater, between it and lava flow. Whole area is one hug parkland or almost a pampa, broader more or less

as one goes to sea or (Pg. 72) narrowing on other direction when flank of Beagle Crater comes down more steeply to meet lava flow. Basically a Bursera parkland, with vast stretches of grassy pampas. Probably is much drier in years when there are no heavy rains in hot season, but this year was such and pampas are covered with dense grass cover, now mostly dry, but with some green shoots till mixed in grass clumps. Tortoise sign begins in these pampas with ¾ km of coast and becomes very abundant at about 175-200 ft altitude and 1.5 km inland. From there on are tortoise trails through grass and brush everywhere, abundant droppings from recent months, (Mar – Jun probably) and older drier bleached droppings from previous years. Droppings all full of grasses, indicating animals migrated down here in considerable numbers to obtain dens, lush forage which was obviously prevalent after heavy Mar rains and continuing for several months. During this period Edward McIntosh and Walter Cruz, (Pg. 73) guides on "Golden Cachlot" and "Line A" respectively, mention seeing several tortoises every time they went inland with tourists only 1-2 km. Tortoise droppings so dens for last 1.5 km to base of steep flank, that must have been dozens of them here – could find none now and no dropping more recent than 1-2 months old and most droppings older than this 2.5-4 mo). Droppings indicate that most animals were medium-large to large sized ♂♂ and ♀♀, but also lots of medium sized ones, and some small droppings of 45-55 cm CL sized tortoises too. Burrows and matted trails lead to same conclusions.

No signs of nesting from past years or this year all way to base of steep flank – soil also not very favorable – that on slopes of Beagle Crater being formed from pressed ash and full of crumbly pebbles, that in lowest flattest plain near lava flow (where tortoise sign is densest) being similar in basic nature but full of small pebbles and rocks and cinder; very porous, loose soils; saw no nests or tortoises at base of (Pg. 74) steep flanks, but here yellow-brown fine powdery soils begin and nesting probably starts just above here given yesterday's observations. May even be some nest here at base where yellow-brown soil washes down and collects but I had no time to carefully check this area today. Certainly makes sense that ♀♀ do not go below here to pampas to nest when there is no need for it and when vegetation there is dry now – at least drier and hotter area than the steeper flanks. Found remains of two slaughtered tortoise about 2 km inland in pampa near lava flow also. Land iguanas also through out this area as well as Tropidurus.

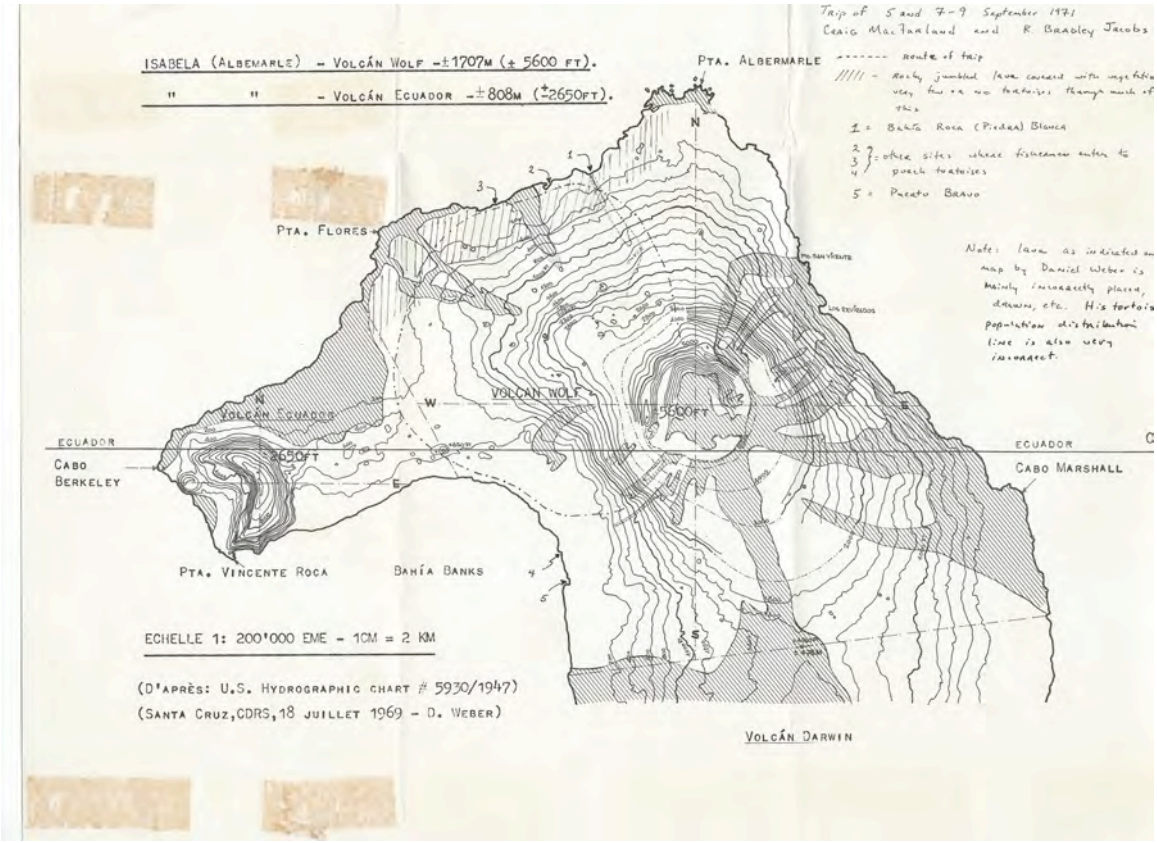
Went up on Beagle Crater slopes 100 ft altitude, inland 2.5 km and it is covered all over with same grassy Bursera parkland and tortoise dropping all over its sides too, but less activity here than flatter area below, probably because grasses and entire vegetation (Pg. 75) complex of pampas not as dense. Clear that this is a very lush foraging area for tortoises, but only temporarily for a few months in years with heavy hot season rains – not much garua here at all. Definite danger area for seasonal poaching therefore. Since area is a natural lower extension of steeper out lank where largest continuous areas of soil and vegetation occurs on Volcan Darwin it is understandable that tortoises come down into it when grazing is advantageous and leave it when it dries out somewhat. Opuntia scattered all through this pampa-plain and some droppings have some pad remains but not an important food here. A few Opuntia with low hanging large pads show some signs of grazing, but not much. Some of fallen pads look to have been eaten.

Roll 368, photos #10-16 – 9 ft tall Opuntia tree in pampa with very spiny trunk, but many pads with only short spines in range of 50-90 cm above ground – easily accessible to tortoise; fallen pads beneath it partly eaten and tortoise droppings nearby. No clear

evidence it has been grazed however above ground. (Pg. 76) Tremendous numbers of used finch nest all through planada and especially large numbers of G. fuliginosa probably from this past wet season in Mar – May.
Photos #17019, and 21-23, Roll 368 – Gossypium flower. Photos 19-20, Roll 368 – pampa area – now dry; #24-27 of same. #28-end, same.
[Marginal note: A small finger of soil covered area extends out into lava flow from SE toward the Tagus Cove Crater. Check it too- full of dry grasses and in places dense bush, lots of Bursera; tortoise sign abundant and same as in low vegetated finger examined on ascent on 14 Sep 1971.]
Dry cat feces everywhere as far inland as I went, but much, the most of it, first 0.5-1 km inland.
Land iguanas – on return (0900-1000, sunny now, overcast on ascent) saw 7 of them and noticed many active burrow sites and lots of fresh droppings, especially in flattest areas along lava flow's edge.
Cats – we saw cat droppings only up to about 1000 ft, and then again on crater rim during 3 day trip – saw no live or dead cats at all. Vast majority of cat sign seen in Tagus Cove Crater area and what I saw this morning. Sign very sparse above these regions; saw no cat sign in area of high tortoise density and nest when I descended yesterday. (Pg. 77)
Rats – saw none and not bothered at night by them anywhere, Jan ditto in Tagus Cove.
At 2400 ft Brad found 2 Rattus rattus skulls in a little crack in lava. Seems about same as on Volcan Wolf – they are there but not much sign of them. Boarded at 1030 and left to pick up Linda- enroute I took some well lit photos of W sides of craters – Roll 368 (KII) - #1-13 – Two panorama series and other shots of Volcan Darwin; first series from just inside S edge of Caleta Black; second series from well N of Caleta Black- near to point. Shot #10 of Volcan Wolf from this latter point. #14-16 – series of Volcan Wolf from well N of Caleta Black but still S of isthmus midline between 2 volcanoes.
#17-19 – panorama of Volcan Wolf (Banks Bay) through Volcan Darwin – almost to Punta Tortuga. #20 – Volcan Wolf; #21-24 – Volcan Wolf from N of isthmus central line somewhat. [Marginal note - #17-19 from just N of Center line of isthmus between volcanoes.] #25-27 – Volcan Wolf from N end of Bank's Bay near coast; we are moving (Pg. 78) toward Cape Berkeley, or to be exact Punta Vicente Roca. Photos 29-29 – of El Marñueco on coast on N side of Volcan Ecuador.
19 Sep 1971 - Returned to Academy Bay late this afternoon after some 35 hr of actual boat running time and 1.3 days of travel (1000 on 17th to 1600 hr on 19th, stops for night at Roca Blanca Bay near Punta Albemarle, and James Bay).
20 Sep 1971 – Notes obtained from Sr. Gonzalo Morales ("Coca Cola") fisherman in Galapagos for past 26 years and captain of "tourist boat" Cristo Rey" concerning poaching by fishermen of tortoise from Wolf and Darwin Volcanoes. Talked to him off/on from 12 – 18 Sep as we passed along sides of these 2 volcanoes in boat.
General comments – he claims local fishermen did not begin exploiting these 2 populations till about 1951 because prior to that time commercial fishing was restricted to inhabited and nearby islands; this was due to fact that were virtually no fishing boats with motors till 1951. (Pg. 79)
A few of the fishing boats had motors for short time periods before then, but they never lasted long and long trips were only rarely made. In 1950 a company from continental Ecuador organized at San Cristobal and in 1951 began commercial fishing utilizing a

refrigerated mother ship and 7-8 small : “Cristo Rey” - sized, motorized fishing boats. This company fished most of the time off/on from 1951 through 1957-58. He indicates that during this period and afterwards till 1960-61 fishermen visited Volcanoes Wolf and Darwin from certain little bays and inlets to poach tortoises. He thinks that mainly due to decrease in tortoises in these exploited zones that they have largely decreased poaching activities to almost nothing from 1960-61 and since.
He also explained that from just after the war, 1947 or 1948 till about 1953-54 was period of great activity of American tuna boats and that many sailors from these boats were anxious to buy small tortoises and hatchlings and that many of local people entered the tortoise (Pg. 80) areas in lowlands of many islands and volcanoes to obtain small tortoises to sell.
Specifics: Volcan Wolf – He knows of no sites where fishermen tried entered all along eastern coast. They went in from the Radar site more or less SE and S but he has never beard reports of any of them finding tortoises in lowlands inland from this area. Main entry places are indicated on accompanying map, i.e. sties marked # 1, 2, 3, and 4. Site 5 is used when site 4 is too rough to land. Site 5 is commonly called Puerto Bravo and Site 1 Bahia Roca (or Piedra) Blanca. The probably would have used many other sites along N short and in Bank’s Bay but virtually all other sites where tortoises are likely to be near coast (i.e. with vegetation down to or near to coast) are impossible or almost always impossible to land at in dinghies; this is especially true in Bank’s Bay. He claims that other fishermen have told him of finding small tortoises down to 1 yr old in (Pg. 81) size as well as medium to large-sized animals only 0.5 hr walk inland at sites 2 and 3. At site 1 they told him that tortoises found almost right down to coast (agrees with my observations), and from site 4, going directly inland to NW that tortoises could be located in only 45 min to 1 hr walk. He notes that site 4 preferred to site 5 because much closer to main tortoise area. Fishermen also claim finding very small ones inland from 4 in dry zone. He himself has only entered site 1 of all of these and his observations confirm what we found here.
Volcan Darwin – no entry spots that he has ever heard of save for the “Aguada” just south of Tagus Cove. Fishermen noted that they would go in to base of rim along lava flow in flat planada sometimes find tortoise. They have certainly poached many here, but in general they preferred Volcan Wolf sites because more frequently could reach tortoises with less walking. All other (Pg. 82) possible land spots along coast of Volcan Darwin either where there are no tortoise inland and or a lot of lava making entry difficult. Will question him about southern Isabela and Volcan Alcedo later and record in appropriate notebooks.

(Pg. 83) [Consists of map of Volcan Wolf with many annotations especially focused on landing sites 1-5 mentioned above .]

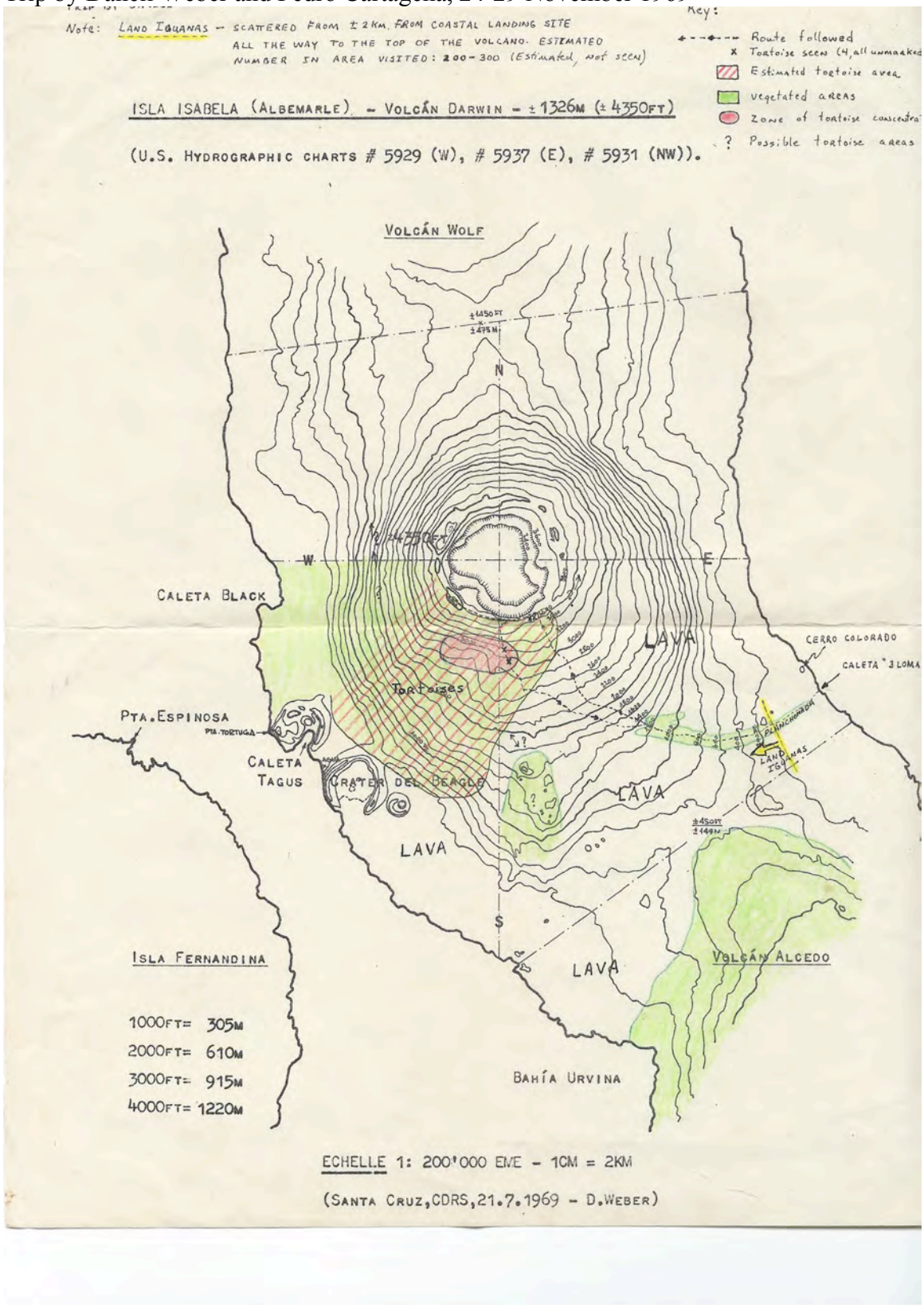


(Pg. 84-85) [Consist of map of Volcan Darwin with many annotation especially focused on extent of vegetation and lava and trip of MacFarland and R. Bradley Jacobs 14-17 Sep 1971.]



Last 3 pages of notebook consist of rough informal notes referencing extent of lava and route details for ascents (inland penetrations) and additional details on photographs taken. Inside back cover is pocket with map of Volcan Darwin entitled: Trip by Daniel Weber and Pedro Cartegena, 24-29 Nov 1969. –

Trip by Daneil Weber and Pedro Cartagena, 24-29 November 1969



Isla Fernandina Volume #1
Sept. 1969; Feb. 1970
Field Notebook of Craig MacFarland

1st Fernandina Trip; James Bay area, breakdown and return
2nd Fernandina Trip: Villamil, Cape Hammond, Fernandina, Punta Albemarle, James Bay, Santa Cruz

(Pg. 1)
10 Sept 1969 –
Set off with Julian Fitter aboard his yacht the "Bronze wing " at 0300 headed for James Bay this first day. Crewman is Lautaro Andrade; he still looks asleep most of the hours he is in fact awake. The Fernandina party consists of Bill Reeder, Daniel Weber, Oswaldo Chappy, Jan and myself; we hope to look for tortoises, interesting plants, collect (moths?), and generally do some sightseeing and observing.
It was unfortunately dully overcast and almost overcast completely till we were past Duncan Island – so still in fact that the sails did little good. Sun finally emerged just before noon and we had a fine view of Jervis and the southern and SW coasts of James.
Engine shut down about 5 miles from James Bay and we had to sail in; we will probably spend tomorrow here while Julian works on it. We anchored at Espumilla at 1400 and everyone went ashore till 1730 except for Julian and Lautaro. Chappy, Weber, and Julian all remarked that they have never seen this beach so calm and easy to land on except in the calm season and usually not even then.
The beach and 2 lagoons behind it were calm, serene, beautiful and alive with a great variety of animals. The lagoon (Pg. 2) was surrounded by thousands of pig tracks and some of these went up to and returned from the water as if they might have drunk it. We saw one group of 4 come out of the bush, pass along one lagoon sides and re-enter the bush. Bill Reeder said he found a small spring "flowing at a rate of several gallons / minute" on the W side of the southerly most of the lagoons. This was surrounded by dense pig tracks.
At the lagoon I saw and counted the following birds:
9 black – necked stilts
2 (at least) – 3 (may be) Hudsonian curlews
5 teal (blue-winged?) – two were an obvious pair; the other 3 mixed more freely. They are marked strangely.
Numerous small shorebirds which looked like semi-palmated plovers, but not sure.
Reeder thinks we saw a wandering tattler here.
(Pg. 3.)
Along the beach at Espumilla and in the lava rocks beside it were the following:
Numerous pelicans
Numerous blue-footed boobies
9 oyster catchers
1 sanderling
1 yellow legs (?)
5 penguins at least and perhaps more
Spent most of our time at the lagoons simply quietly sitting and watching. The curlews broke the stillness occasionally with their (disgusting sometimes) shrill cries. The black – necked stilts also have a rather sharp short oft-repeated piercing one-toned cry which they seem to use mostly when flying about but also when feeding around the logon edges.
At the beach heard the penguins give their sort of a honk (nasal sound if made by a human) in greeting to each other and sort of just in general every so often.
Jan took photos of the birds, the lagoons, and the general James Bay setting. As we were waiting for Julian to come with the dinghy, saw a group of at least 15 (probably more, lost count) rather large rays only a few meters off of the shore. Also, 3-5 (Pg 4). . .
sea lions came in between 1700-1730 and came up on the beach to rest and sleep – but our presence kept them on the alert and they would often re-enter the H20 and emerge down the beach again. All appeared to be females.
Chappy shot 3 goats (with 13 bullets only !), females, above lagoons and we had a monstrous and delicious supper of goat liver – the liver is solid , has little tubing, is extremely tender and 2 livers were plenty for 7 people. Before dinner we had rum and Okey soda pop mixed; the latter is a Mandurino soft drink which is

heavy on mandarinos and carbonation – sort of a poor Birclay's orange drink. The rum was fine however, and the combination is not really that bad. (Pg 5). . . .
In talking with Chappy before supper learned a bit about his observations on the tortoises of Santiago – they are apparently mostly in the highlands and within the main crater area where there are some nice open pampas and ponds. About 160 have been marked on this island. He says they have found only 2 nesting areas – 1 is about 1 hr and ¼ (for him!) from the salt mine and there is a cut trail to it – it is on the W side of the island – the other he pointed out to me is as best as I can tell on the SSE side and is E of a rather large, un-vegetated lava flow – it appears difficult of access except perhaps from the coast (?). He claims it is a "very large" area. -- There have apparently been no nests discovered this year in either place by himself or Juan Black (they have been here in August).
11 Sept. 1969
Spending day on James while Julian messes with his engine. Arose at 0615 to the sounds of "Rock of Ages" sung in a deep baritone courtesy of the Voice of America and Julian's shortwave. There was a veritable din arising from the lagoon area – most birds, and some goats. The shore was swarming with fishing boobies and pelicans also. Wind. (Pg 6). . .
from the S has picked up considerably. On arriving at the 2 northern lagoons about 0900 found 2 flamingos, 8 teal, black-necked stilts, and 2 curlews. The beach was covered from virtually one end to the other with ghost crabs by the hundreds. In places they had really stirred up the sand and many burrows and much feeding had been going on. They appear to be feeding on a marine green algae which washes in with the waves and remains on the wet sand as a thin greenish film. At the northernmost end of the beach in one area there must have been at least 200-300 of these crabs moving in a huge semi-coordinated mass when we landed. Took some photographs of (Pg.7) all these things. The sun has been out off and on since 0800 and the 4-6 mph (guess!) wind makes it all very pleasant. Have been watching the flamingos for about 1 hr. and although aware of us they fly only when closely approached (which we are attempting to avoid) and then only a short distance.
The view from the small rock outcrop just S of the middle lagoon is very exquisite; it is clear all around us as far as Isabela, and Alcedo is especially visible and clear.
The oyster catchers did not return to the beach again until about 1030 hrs today. Saw 3 different penguins along the beach strand this morning. The hills immediately above the lagoons have many trees which are flowering with a brilliant red blossom. Chappy calls the tree "caco porotillo" and Daniel says it is the species Erythrinea velutina, which grows along most of the western South American coast in dry places. There is also an abundant leguminous plant back from the shore just a bit – it is mostly dried up with dry pods, but most plants have a few green leaves and an occasional green pod is present. This a Cassia (Pg. 8) (Daniel says species is probably C. tora)

There was an annular eclipse of the sun today from about 1100 to 1600 (1700 –2200 Greenwich mean time) From our position it never entered a truly annular phase but passed along one side of the sun, thus giving the sun a "partial moon" appearance nearly all the time. To the naked eye it seemed that only a small portion of the sun, a nick, was blocked at any one time, but through a dark filter one could see that up to 1/3 or a bit more of it was blocked at one time. The leader on a roll of unexposed Kodachrome II 35 mm film worked fine as a dark filter and allowed direct viewing of the sun. During the part of the eclipse which we watched (1445-1600) the sea was almost completely still and a very strange light change was noticeable, especially (Pg. 9) by it color cast on the vegetation along the shore and hills above Espumilla beach. It was much like the color of late afternoon sun about 30 minutes before sunset – sort of a slight yellowish amber cast being given to everything that is green or light colored.
It was also noticeable sitting on deck under a clear sky that the radiation load had been lessened considerably. Went back on shore at 1600 till 1800 - took some photographs of scenery and other things while Jan and Daniel worked on his photography of the 2 flamingos.
Also watched the Tropidurus on the lava and sand around the beech; they come right down to the coast and even saw them on lava right next to the water in many places. They are very similar in size, sexual dimorphism, and color pattern here to those of Santa Cruz, but the females here seem a bit larger and the red on the head is not as extensive (i.e. especially not on dorsum of head) or as bright; also they seem to have more yellow on the throat here than on Santa Cruz – however these observations need to be quantified, as they are only based on brief inspection of a few animals.
Also I looked closely at several (Pg 10) . . . juvenile sized animals which were about the same size and of the general markings as those on Santa Cruz which we have seen. Here, as there, noted some red

coloration already on the throat which makes these otherwise very small non-descript juveniles look like incipient adult males. Upon close examination of 2, found that the red color was entirely due to little bright red mites. Which are thickened about the gular region and under the arms. - They often are as dense as 1 or 2 under every scale.
Had some very tasty curried goat (scapula to upper foreleg) for supper with avocado and onion salad, followed by a custard. Also, some of the Wittmers' orange wine which is not bad at all. Lautaro's comment on the wine however was "no good" (pronounced "no gooood"). He drank it apprehensively (Pg 11). And only after Julian assured him that it was not whiskey.
Lautaro later hunted up some "musica Ecuatoriana" on the shortwave and then asked Julian if he liked it – The question was deferred to me and despite all international feelings I had to own up to the truth – managed to get out a weak "mas o menos y depende". All of it we've heard so far has be disgustingly bad, sort of a cheap brassy – tinny 3 or 4 piece orchestra with some poor vocalizations thrown in between spurts of music.
12 Sept 1969
We are becalmed! After 8 hours of sailing so far today (1500 now) we have only come about a few kilometers away from the Espumilla Beach and are on the NW side of James Island. Julian wanted to make Sullivan Bay on the E side of James by mid-afternoon and go on to Academy Bay by way of Baltra, but the strange weather of the moment has everything in the form of plans fouled. There have been a few spurts of breeze today that pushed us along some, but it has been almost still most of the time. Julian took the jib in and put the Genova up but even this has not helped much – he even tried towing us out further away from the shore with the dingy and a sea gull outboard (circa 3 hp) but . . .
(Pg 12) . . .the breeze was not much better if at all. Almost ominously, we can see Marchena setting to the N offering nothing but her dry shore – can not help remembering the photographs by Allen Hancock of Lorenzo and Nuggerood lying twisted and dried up by their dinghy on the shore of Marchena.. We have been bobbing about like a cork for hours. 2300 hrs The wind has just finally come up after having progressed only 12-13 miles in about 12 hours. We are moving along rather briskly now. Julian tried to set up automatic steering and discovered that a vital part has snapped due to rusting – so he, Lautaro, and Chappy bristling about making S. I. Café and preparing for a long night of going around James and heading across toward Santa Cruz. (Pg. 13). It seems far away in space and time but in Wisconsin in the short time of one and one-half months the Macintoshes will be ripening and delicious sweet cider flowing, pumpkins will be ripened and carved up for Halloween, and the cool crisp mornings will have begun again – its hard not to miss that even if much of one's daily life we led in Madison revolved around cars, streets, stores, Laundromats, restaurants and the ever-present Birge Hall and its tight little society with seemingly nothing beyond.
Was just up top enjoying the breeze and the liquid movement of the boat. The bioluminescent plankton are out in spectacular force, showing up brightly with every tiny breaker and as broad flashes with every wash of the bow. Occasionally a sea lion breaks the surface and along with the general snorting and blowing which localizes him; the whole surface of the water around and the animals body show up brightly. We had a gorgeous sunset while still becalmed – the suns set precisely between Volcans Darwin and Wolf and sent out pale yellows, oranges, and reds blending all over the western horizon for half an hour. –
(Pg 14) 1145 – Just now Julian heard a whale blow near the boat- we went up and saw an eerie oblong light of about 10 meters length (varied depending on how much of a trailer it had) length; it circled the boat twice and blew once each time. Once it appeared to go under the bow a bit – the long slinking light was slipping along at several knots at least. I wonder how close such a beast must be to the surface in order to stir up the plankton enough to make such a bioluminescent record of its presence? Could this have been a killer whale? Julian thought perhaps so, since it circled the boat??
13 – IX- 69
Another long day at sea. Last (Pg 15) night wind suddenly picked up strongly at 2230 and we sailed around to Baltra by morning. Had good winds again till 1500 this afternoon when another calm set in: by dusk we were still several miles N of Gordon Rock.
However, besides the joy and quiet of sailing there are some real enjoyments and advantages to not having the diesel roaring constantly. For one thing you see much more of the sea life. Saw a number of whales this afternoon breaking the surface within a few hundred meters of the boat. One we got a good look at was about 15 feet long at best guess and Julian though it was a pilot whale. Also saw 3 green turtles swim right by the boat when were just a bit N of the S channel near Baltra – they came by right next to the boat and only 1-2 feet underwater. They all appeared small – probably under 100 lbs.

Lautaro is obviously bored at the wheel and every so often moans a bit about some "poca musica Ecuatoriana. Last night while he was steering we had an Ecuadorian station on and he would periodically sneak his hand into the aft part of the cabin and turn the radio up some trying to avoid being seen.
Daniel has spent most of the last 3 days flat on his back consuming 3 paperback nature-adventure books. I don't think the bouncing and rolling of the boat (Pg 16) agrees with him much.
14 – IX – 69
Finally returned to Academy Bay at 0930; just about 50 hours of straight sailing (at least attempted sailing) from Espumilla Beach, James Bay. Julian looks tired but is as cheerful and light hearted as always – he has had perhaps 7 hours of sleep the last 2 days and nights. It's to our benefit that he did not sleep because Lautaro especially and Chappy to some degree don't seem to have it in their heads to hold a very straight course and I do not think they have any idea what to do if the wind changes.
R. Perry met us with the zodiac and saw Fritz and Carmen Angermeyer on their porch looking at us as we came in. Fritz was cocking his head and cupping his hand behind his (Pg 17) ear listening for the motor. The station is the same and I can not say I'm very glad to be back so soon. It's a bit like returning to the Pension Parker for another huge German meal. As Daniel says, Fernandina is smiling. End of Round One.

Notes on Fernandina and the tortoises of that island:

1) R. Beck's animal – The only one known to have definitely been taken from Fernandina –

a) From Van Denburgh, J. 1915. Roc. Calif. Academy of Science, 4th series, Vol. II, Pt. 1, pp 299-302

Taken on Calif. Acad. Trip of 1905-06. Beck's notes indicate that he started (?) climbing at daylight on April 3, 1906 and reached a point about ½ way to top at noon. Here there was an island of more ancient lava than that below and as he worked up through it he notes "a few bushes and vines" and "scattering cactus" Saw some old tortoise droppings and examined them – discovered tortoise (s) had been eating cereus in "considerable quantity".
Went on upwards stopped once at one small mount of much older lava which he thought to be of (Pg. 18). same age as Tagus Cove (mtn?) [word not clear]) because of considerable quantity of soil. No tortoise sign here but iguanas plentiful. Reached base of main crater at 1700 hours and camped. Next a.m. to top where found a plateau ½ mile across on inner edge of crater. Plateau covered with "rank grass, clumps of Opuntia at outer edge, and scattering Cerieus . An "excellent place for tortoises" but none seen and no signs. Returned to half way area by 1630 hrs and found a still older lava island within the island where dropping seen on previous day. – considerable soil in the area and a tortoise trail from "the day before". Followed trail and found male slowly feeding on grass near the trail. Took skinned tortoise down to shore next day (morning – 1630 hrs.) – i.e. back at shore with animal on 5 April 1906 in late (Pg. 19) afternoon.

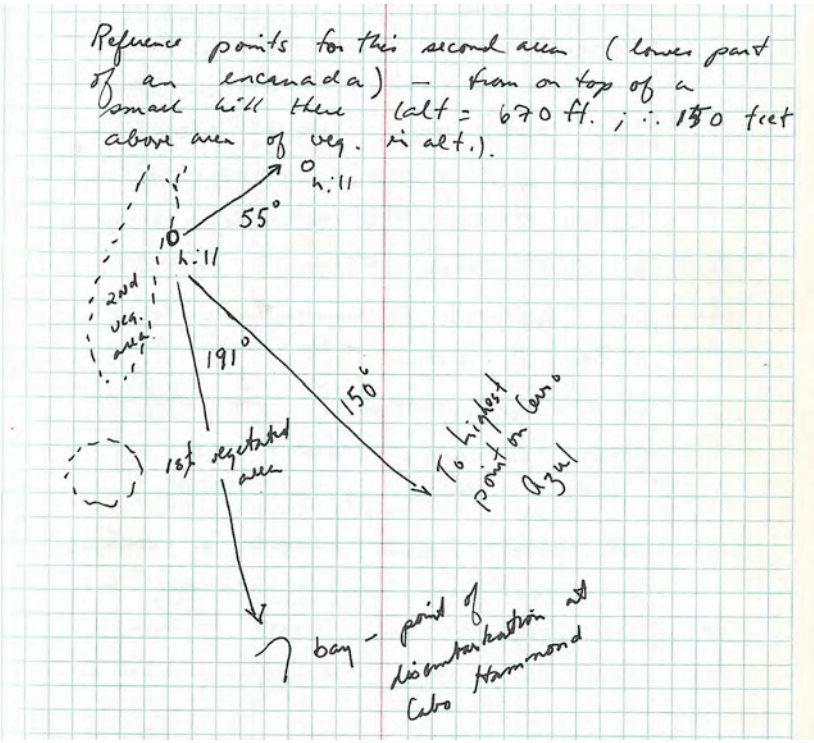
b) From Log of Schooner "Academy" by J. R. Slevin, 1931. Occ. Papers Calif. Acad. Sci. No. 17.
March 22 1906 (page 94) – sent party ashore on "east point " of Fernandina at 0800 – returned at 1200 having found a colony of f. cormorants and sea lions – nothing mentioned of tortoises.
April 2, 1906 – R. Beck, J. S. Hunter, and F. T. Nelson (mate) left from Tagus Cove in sailboat for Fernandina. * Landed at Mangrove Point in late afternoon and Beck and Hunter started up the mtn., Nelson staying with boat.
April 3, 1906 – Hunter returned to coast at 1500 hors. Beck kept onward toward top of mtn. and found tortoise in a patch of green brush"
*Skinned it out and packed it down to coast on return trip. Reaching top of crater found it covered with high grass and ferns.
Apr. 4, 1906 Beck returned to beach at 1700 hrs. and found Nelson and Hunter waiting for him. Loaded up after supper and set sail for Tagus Cove at 1900 hrs. April 18-19, 1906 – part worked on shore at Mangrove Bay, Fernandina. (Pg 20) . . . and along coast north of this point where in one area "vegetation came down to the sea". Plentiful land iguanas in this latter area: said most desolate area of all visited on the islands;

2.) Comments by David Snow – Oryx, vol. 7: 277-290.
"Rollo Beck collected only known specimen in 1906 not far below the rim of the crater on the southeast side."
"In February, 1964, Dr. J. Hendrickson and other members of the scientific project camped for a week on one of the "spokes" of vegetation on the south side of the mountain. (thin strips of vegetation that have been left between recent lava flows running down either side). An intensive search was made and fresh droppings were found, but no tortoise."

3). Captain David Porter of U.S. Navy in 1812 or 1813 - Both VanDenburgh (1915) and R. Broom (1929, Zoologica 9: 313-320) mention that he visited among other islands Narborough and that he said that they were found in "greater or less abundance " (see Van Denburgh) and abundant (see Broom) there. See Porter's Journal of a Cruise made to the Pacific Coast by Captain David Porter in the United State Frigate Essex. In the years 1812, 1813, 1814. 2 vols. Philadelphia, 1815. Second ed., New York, 1822. for full information.
4) E. Yale Dawson – 1965. Cactus and succulent Journal of America , 39: 135-148.
We (some undisclosed group of scientists during Galap. Intl. Sci. Project) observed this species (Opuntia insularis) . . . found the species on southern slope of Fernandina at elevations of 800-2000 feet. Plants there were sparse in part semi-arborescent to somewhat spreading among thick, low, bushing vegetation on rough lava "In another locality further east, in which some evidence of tortoises foraging was found, the plants were strongly arborescent according to personal communication of F.R. Fosberg who (Pg. 22) collected specimens at elevations of 1000 and 2000 feet." [Shows a picture of O. insularis and dense shrubby vegetation at elevation of 100 feet on the S slope of Fernandina. (hard to scale it, but veg looks as if may be 1 meter high at maximum.).]
5) Hendrickson, J. R. Pacific Discovery, 1965 – nothing useful – only statement of finding dropping on southern side and photograph of "partly eaten " cactus pad and him holding the dropping (or 2 droppings?).
6). David Cavagnaro – 1956 Pacific Discovery – Vol 18, No. 5. (1st week of February 1964) Landed at 1100 feet on SW slope and joined 3 others already there. Camp was situated "in a group of trees on the edge of a lush green meadow." Mentions "deep grass . . . alive with insects" (Pg 23) Opuntia cactus trees and fern draped lava – heaps; trees and lava ridges tangled with ferns and vines. Hendrickson and Ross Keister hiked to coast and back to 1100 feet camp in one day. Cavagnaro climbed to rim from here (see location in map – figured out by using his photograph by D. Weber).
7) Schuder, R. O. and A. A. Griganick – 1966 Tardigrade from the Galapagos and Cocos Islands. Proc. Calif. Acad. Sci. 4 series, 34:315-328. Mention examining "feces of a probably extinct species of tortoise in meadow of wet pumice, II – 6 – 1964, J. R. Hendrickson."
(Note: no tardigrades present).
8) Areas searched by Roger Perry, Tjitte DeVries and Camilo Calapucha, and Sr. Gordillo on 2 day trip, Oct 22-23, 1969; see map drawn by R. Perry and confirmed by T. DeVries – they had no altimeter and these areas are only their estimates of where they were. No tortoises or sign found!
9) Letter of Jan 9, 1970 from J. R. Henrickson, with map giving further details of his 1964 trip; see my letter to him also.

(Pg. 24) 2 February 1970
Arrived at small port on SE side of Fernandina at 1400 for trip up; transport via Julian Fitter "Bronzewing," with crew members Vicente Villagomez.
Party includes Daniel Weber, Swiss botanist and photographer, Juan Black, National Park Official, Julio San Miguel , N. Park Warden, and one helper Fausto Llerena.
The land spot offers no beach, but there is a small area of cinder sand for camping , or at least one could call it a place to try to sleep, but in reality it turns out to be a night long bout with the sea lions for possession of the spot and all your equipment.
But the place has a fantastic variety of wildlife – 25-30 penguins, 10+ cormorants, many sea lions with young, many fur seals with young, lava gulls, blue-footed boobies and brown pelicans. Very good site for photography and simply relaxing and watching, but rather exposed and hot and no vegetation for shade.
(Pg. 25). 3 February 1970. After breakfast and hiding water, food and other assorted garb. And paraphernalia we began ascent at 0800. All with heavy loads, but especially Julio (5 gallons H20) and Fausto (food for 5 for 8 days). Went up along the string of vents and cones which R. Perry and T. DeVries pointed out to us from their October, 1969 trip. At about point of last of these vents we went W and entered the lower end of a small vegetated area. This began at about 400 ft. altitude (Thommens) and went up to about 450 feet. It was only 50-75 m wide so on walking through we were able to survey the whole patch of vegetation. All areas below this one on first part of hike were entirely covered with lava (but of varying ages) – almost no vegetation on such areas – a scattered Jasminocereus, Sclerocarpus, Brachycereus sp., Scalesia gumifera, or grasses, but almost all pure lava. In this first area quite a good covering of Bursera gaveolens up to 15-18 feet tall, much S. gumifera, grasses, and scattered Croton sconleria, Waltheria reticulata, Cordia galpagensis, Cordia hookeriana, Xanthoxylum fagora, Jasminocereus sclerocarpus. But absolutely no tortoise sign. Plenty (Pg. 26) of land iguanas and their

droppings, both fresh and whole, dried, well preserved ones. This may be an indication that reptilian droppings at these altitudes dry before they have a chance to crumble into small fragments. Perhaps not surprising that no tortoise here because 1) lava all around is rough and broken, though not extremely fresh (has more beige colored oxidized look than fresh back kind), tortoises could cross it, but probably would not unless populations large and wandering (2) very dry and hot here and except for Bursera not much shade; even shade of these trees is sparse from 1000-1500 when sun is high in sky; most of vegetation is greenish however, thus may be rain recently; Burseras have leaves and grass clumps about ½ dry and ½ green; rest of plants have green leaves. Anyway, tortoises could live here but not even any old sign. 3) No real sites for H20 collection to any extent, even lava potholes. (Pg 27) Then up across bare lava and next arm of veg running toward coast; very near the former, and vegetation and aspects almost exactly the same; but larger area and runs over a greater altitude range than first, in part parallels the first and then runs on up higher. We entered it at about 520 feet just below area westerly of the 2 small hills which Perry and DeVries used as landmarks in Oct 69. (Marginal note: Plant species the same in this area as one below). Reference points for this second area (lower part of an encanada) – from on top of a small hill there (alt - 670 ft.; thus 150 feet above area of veg in alt.)



Will search up through this area on our way N. For the moment went to the eastern most of the 2 hills indicated by DeVries and Perry.
(Pg. 28)
It is covered with green Palo Santos, and has a fairly dense stand of half dry – half green grasses and some shrubs. Veg same as in two previous areas as to species and general abundances (relative) but more dense in totality. It is rather steep, but has a few acres of flat land at top and even sides are no steeper than areas tortoises use on Duncan and V. Alcedo. Also, mostly cinder (fine) and soil and some organic matter – few rocks. Veg runs from way above on steep side of crater all way down to this hill, to one side of it and a bit lower down. But the veg on the hill is continuous with that above and around it. But, no tortoises and no definite sign. Are literally hundreds of land iguana holes, droppings, and trails. In sum – seems usable by tortoises at least in wetter seasons, but no sign and I doubt have been here any time recently if at all.
2nd area – went on up in this to an altitude of 760 feet; then hit lava; appears to be isolated at this point from areas above, but can not tell –later from a higher altitude could see that was isolated (marginal note). (Pg. 29).

. . . exactly - certainly is isolated to the W, but perhaps connected with other vegetated areas to the E a little ways. But is heavily vegetated all the way up to 760 ft. point, becoming more so as one ascends. All same plants as below, but more and more green and in non rocky areas (= majority of the area) is covered with fairly lush green grasses. Also plenty of trees and shade: Pisonia, Bursera, Xanthoxylum, mostly the former 2. Also a lot of Waltheria , a large Solanum. Also 2 composites: Darwinthamnus lancifolius and Macraea laricifolia. But again no tortoise sign at all, but density of land iguanas is very great. Then went just to W a bit crossing over about 50-75 m of fresh broken lava to another encanada and started up again. Now (1600) stopped at 860 feet – again same kind of vegetation and again very dense – even more dense – much very lush grass – over 1 (meter?) high every where, large Burseras and Pisonias and lots of small sapling sized Xanthoxylum. Also same nice green sedges. All very lush and with much shade and forage, but absolutely no tortoise sign. Again, full of land iguanas. This continued up till about 950 feet or about that; then vegetation became (Pg. 30). . . . very dense as we followed a major encanada on up to the greener zones. This area had mostly Pisonia trees, some Bursera trees, but was mainly a grand tangle of Ipomoea habeliana(?) and Psychotria rufipes (= cafetillo, common Spanish name). Also a lot of Tournefortia rufoserrecia, grasses, the same large Solanum (marginal notes says "Solanum verbasifolium ?") and other plants scattered throughout. Absolutely no tortoise sign, but were land iguanas all the way up, being more predominant in the more open zones below. We arrived at an altitude of 1370 feet at about 1800 and could see that the encanada we had been following up has continuous vegetation all the way from well above us on the crater's outer side down to the area just above the 3 small hills where we had to cross a bit of lava after leaving the 2nd vegetated area we were in today (i.e. that which ended at about 760 feet altitude). (Pg. 31)

4 Feb 1970

Continued to climb a bit to about 1500 feet where made a very comfortable base camp on fine cinder at the base of a small hill. There is a nice Xanthoxylum tree draped with a profusion of Ipomoea to one side of our sleeping area which offers shade all day long in combination with the hill itself.

Went up on the hill, which is about 50 feet higher and just to the W of a large encanada (only one of dozens of stream beds in this area, most of which shows signs, in one form of bowled-over Palo Santos, of torrents of water recently, probably in Mar – Apr 1969). From here could see all the major green vegetated patches indicated by DeVries and Perry and our own impressions from the aerial photos, except for those to W which run all the way to the coast. These areas above connect with the long stretch of vegetation which we came up yesterday afternoon. For that reason I doubt we will find tortoises or their sign above here directly since we saw none in the lush grass covered areas below (not even bones which should at least be there if tortoises have ever been in the area much, especially since it is certainly several hundred years old or more!) It seems we will have more chance of finding them in areas to W or maybe even more to E where the vegetated parts are isolated by lava from the (Pg 32). . . areas we are now in and near. One notable thing – at about this present altitude we are just now seeing the first Opuntias since starting yesterday. Also, noted 2 plants on top of hill which tortoises eat on S. Cruz: Commelina nudiflora (species?) and Sida sp.

Toward top some more in right hand most area which DeVries and Perry indicated on their map of Oct '69. At about 1680 –90 feet came into an area with much Opuntia insularis. Can also see them for another 150-200 feet in elevation below us. They have a trunk which is durable and tough and mostly without spines, but are very short plants in height, most being 2.5 – 4 feet high and none more than 4- 4.5 feet. Many pads are very close to ground, no more than 1-3 dm above it, and although quite spiny tortoises could eat them I am sure. Yet no sign of this and absolutely no tortoise sign yet. The area is full of land iguanas but they do not see to have been eating them at all. The area is otherwise covered with a lush stand of herbs mostly with some scattered shrubs such as Tournefortia, Psychotria, and Darwinothamnus. The herbs include a great host of angiosperms, some fern species, and some vines (Ipomoea and others) Plenty of food for iguanas and perhaps thus why they are not eating the Opuntias. Soil is moist in this area. Took some photos of the Opuntias and other vegetation - roll 74, Photos #22-24. Certainly not tortoises here now and doubtful if ever – no bones and Opuntias testify to this - I wonder if height of Opuntias is due to strong prevalent winds here and openness of vegetation? – they seem to be fairly old plants, because although not tall, trunks are strong and durable and well formed and some are flowering.

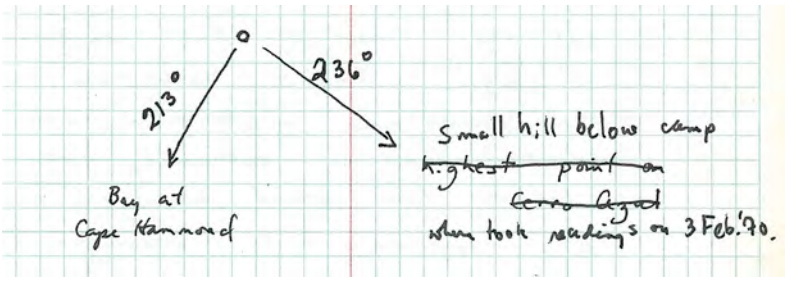
From here J. Black and I continued straight up through this vegetated area toward and ultimately to the rim – took about 1 hr. and 45 min in all - Thommens at rim reads 4640 feet.

Vegetation continued much the same to about 2000 feet; at 1830 feet left D. Weber with a Tillandsia insularis and an orchid, Epidendrum (spicatum?). Trees petered out at 2000 feet as did most of higher

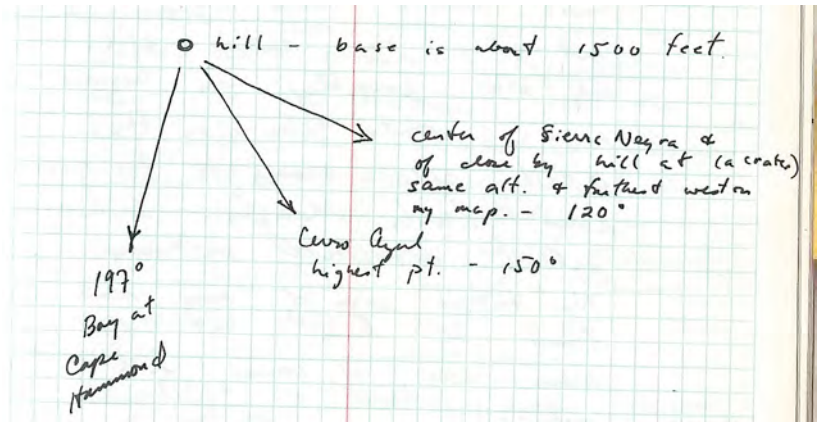
vegetation – remaining stuff not much more than a few dm high at maximum from this region upwards. The Opuntias were all gone by 2000 feet. From about 2000 to 3000 feet this low but abundant herb cover continued becoming less dense and lower in height gradually as we climbed. Some of plants that were particularly abundant and noticeable through (Pg 34) . . . .this region were Taraxacum sp., at least 2 and perhaps 3 species of grasses, a large flowering sedge (perhaps a Cyperus), the large Solanum mentioned before, several species of ferns, and some mosses in the wet cracks. The whole area is dissected with little rivulets and there are a large number or more major bare lava encanadas.
The soil appears to be a mixture of ash and organic matter and in general became wetter and wetter as we ascended; of course, this is probably a superficial wetting due to more clouds and dew at these altitudes for past few days to weeks in this area than the previous 1000 feet. At the beginning of this 1000 foot range (2000-3000) there were still plenty of small Psychotrias, some Darwinothamnus, and some vines (including Ipomoea) but these all rapidly disappeared as we ascended . There was absolutely no shade of high (height) or great enough quantity to cover an adult tortoise once we were above about 2000-2200 feet in this area – vegetation was simply too sparse. There was absolutely no tortoise sign but land iguanas (Pg 35). . . continued to be numerous.
Then at about 2800 – 3000 feet vegetation became very thin and virtually all these herbs disappeared and at the same time a very small moss about 1 cm or less high with fruiting capsules present became abundant. From 3000 feet to about 3800 feet this just carpeted the ashy soil in great profusion. [Marginal note: 'Also a hard little fungus here, mushroom shaped, and growing in open – looks like type in which top explodes']

The encanadas disappeared as such a bit below 3000 feet and this 800 feet above is a pale brown – beige ashy soil, quite moist, and dissected everywhere by hundred of little rivulets; lava is exposed only here and there in the larger rivulets: a few clumps of various grass species here and there, same sedge as from below, a few small sprigs of various species of ferns and especially in well shaded protected lava crack where there is more moisture there are other mosses, small ferns, and liverworts. On the whole however the area is largely devoid of vegetation save for the small moss. No tortoise sign and even if they were below I don't think they would venture into this area as it is larger and lacks shade completely and food almost completely. [Marginal note: 'Almost no land iguana sign through this area - but a few scat!]
(Pg. 36) The same could be said for the previous 1000 foot zone as regards shade. Then from 3800 feet to the rim there is not much of anything but a series of high ridges with intervening gradual slopes and planes and almost no plants. The moss is absent from all this zone. It is a more grey ashy soil than that from below, but still is dissected by hundreds of rivulets and a occasional larger more respectable stream approaching encanada size. The plants are few and far between and the ones most notable are: the large Solanum from below, a few species of grasses in clump form; the same sedge from below, and a composite which reminds me very much of Gnaphaliceum (= edelweiss). This latter plant is surely restricted to these higher regions because have not seen below. Soil still continues to be moist, about same as since 3000 feet; the whole area is very open, devoid of any shade, certainly raked by strong wind almost constantly and certainly quite cold in the (Pg 37) . . .garua season and at night. In fact the wind was quite chilly this afternoon in spite of the sun being out at times. The whole area right to the rim gives the impression of being quite old, and no fresh ash is present anywhere – seems likely has been open and barren like this for a long time. Certainly doubtful that tortoises would go this high in altitude and certainly couldn't live in this zone or even cross it if sun were out.
The only plant on the SW rim itself is this large Solanum, forming scattered groups of plants here and there – with flowers and fruits just as below at 1500 feet. Plants are quite large here also – up to 0.5 – 1 m, and although are fallen ones below near base camp.
Saw a few iguanas and abundant holes, trails, and droppings on the rim and just below it on the SW side , but from 3000 feet to rim saw almost none and no sign – in fact saw one at about 4000 feet and nothing more – probably due to lack of vegetation.
Inside crater itself was magnificent with light only on eastern end, the rest in shade, and sulfur fumarole at the eastern and northwestern ends. There were rocks slides into the lake (Pg 38). Just about every 1-2 minutes for the entire hour we were there. The only vegetation I could see inside the crater was rather near the lake's edge on the S and SW sides of the crater. Could not tell what it was and it did not appear dense or very tall – was bright green in color. Only possible descent route appears to be on northern side more or less and even that does not look very pleasant or facil (easy).
On return trip, again checked altitudes of vegetation zones – same! We came down a bit more to the W, down the small central vegetated area of the 3 main areas above our base camp. Noted same kinds of

vegetation in same altitudinal zones. Most notable difference was two large patches of chontilla (species unknown), a very nice fern and the same or very similar to the abundant one in colonized zone of S. Cruz. One large patch of several hectares was at 2750 feet, the other at 1840 feet. This is of interest, because although not (Pg 39) . . .
more than 1 m +1-3 dm high at most, this plant would offer shade to tortoises if they occurred here. Again trees did not begin till about 1800-2000 feet and main area of vegetation was from 2800 feet and below. Began seeing Opuntias again at about 1800 feet and saw many groups of very nice small, young ones. Also some taller ones than those seen previously but none more than 2 m (D. Weber who went further to S. side a bit than we did at about 1700 –1800 feet also agrees with 2 m as a maximum for Opuntias in these vegetated areas). In addition there were many adult Opuntias which had been knocked down by wind or water in this area but the pads had not been touched by the abundant land iguanas in the area. The same is true for the young ones which are not particularly spiny in a heavy sense. Thus it seems that iguanas don't need to eat them here because of the abundant vegetation. If tortoises were here I can hardly believe they wouldn't gobble these up - yet the Opuntia population seems abundant, healthy and of adult size at < 2 m height and even – though it has a tough trunk the pads are usually low enough so that (Pg 40) . . . even a dome-shaped tortoise would eat maybe ½ of them on an average adult specimen. This really seems to argue against there ever having been tortoises here in recent past (along with no evidence of bones in encanadas or cinder plains below, no bones, droppings, trails, burrows, etc. in any of vegetated areas visited from 300 –3000 feet). I would guess that Opuntias are of a density approaching 35-50 plants /acre in this area at about 1600-1800 feet just above our base camp - this estimate includes all ages of these plants.
Returned to base camp at 1500 feet by 1715 hours, tired and with sore feet, but well worth seeing the Opuntia, the lack of tortoise sign for some more potential areas and the Fernandina crater. One other observation – it is certainly clear that at some times of year, especially after heavy rains in rainy seasons, or even after several days of (Pg 41) . . . good strong garua, that these encanadas and ashy soil covered areas above must just flow abundantly with water. And because of numerous pockets, holes, and cup-shaped areas in the encanadas all the way from 3000 to 1500 feet there must be standing H20 at least for short periods of time. After heavy rains, the mountainside must just gush H20 down to lower areas for several hours, and indeed below at about 1000-1200 feet altitude along the encanada below our base camp there are areas where H20 must have been tremendous in '69 rainy season because are still living but prone, bowled over, Palo Santos of 10-20 feet in height. We found one small hole yesterday in an encanada with about 2-3 liters of cool, clear, very refreshing H20 and drank it. But it was the only standing H20 we saw and was at about 3000 feet. But were lots of little pockets with fine cinder floors and very moist soil in shade where moss was growing in these encanadas. One problem is that being so open higher up, any standing H20 would evaporate in 1-2 weeks or sooner with good strong sunlight for a number of days in succession. (Pg 42).
5 Feb 1970. J. Black and C. MacF. Went over to eastern most crater which I have marked on my map to try and see what southern slopes look like in terms of vegetated areas and their degree of connection with those we are inside of now. In the process crossed the easternmost of the 3 arms of vegetation indicated by Perry and DeVries from their trip in Oct. 1969. Crossed in different places going and returning, one at about 1500 feet, the other 1440 feet in elevation. Both areas crossed very similar as one would expect. Lots of trees (Xanthoxylum and Bursera, ferns (Pteridium I think mostly), grasses, and many herbs in abundance; also a fair abundance of Opuntia insularis but all same sizes and appearance as yesterday. Most of area rather open but rocky with a good covering of plants, but even some places with extremely nice flat open areas covered with grass clumps or in some cases Ipomoea vines on the ground and these areas in turn surrounded by trees draped (Pg. 43) . . . . with vines and offering abundant shade. The area goes down much lower to the vicinity of the first 2 vegetated hills we passed on the 3rd of February. But once again, the areas is loaded with land iguanas but shows absolutely no signs of tortoises. Took position compass readings for the hill from its northern rim.



Then took 2 photos from ½ way up hill on its northern side of vegetated areas above – one to right showing vegetation of part of southern slope and one directly above showing fresh lava flow – these overlap . Roll 76, #'s 4 –5.
Then tried to draw in vegetation as it appears from this hill and as I hope photographs will show it. Most of area on S side proper is too far away to tell much but it is mostly lava with some long thin strips of green vegetation in between but none appear to go lower than about 1400 – 1500 feet. Also, from here appears herbaceous and unshady. Closer to me can see that directly above this hill is more vegetation. (Pg. 44) . . . than we thought from the aerial photos but 1) the lowest any of it goes is about 1500 feet, that is, any that is continuous with the major patch above; 2) there are trees and thus shade in only a small part of the area, probably from about 1700 –1800 feet as far as I can tell; 3) all the rest of the vegetation is either low and herbaceous (above tree-covered areas or an herbaceous – shrubby mixture that is extremely sparse (below tree covered area) 4) all of it appears to be connected to the areas we have examined to the W at an altitude of 1800 -2000 feet, and even despite this connection or if it were lacking, there are several areas where there is only a bit of lava and cinder to cross to get to the next vegetation to the west; admittedly some of the lava is rough but I think tortoises could cross it at least in the narrow areas.
There are a few islands, very small ones, of vegetation below the vegetated upper portions on the S side, probably about (Pg. 45). . . 500 – 800 feet in elevation, but they are completely isolated, sparsely vegetated, and offer no potential nesting areas either within themselves (because of isolation or below them). Went up to top of hill where our camp is and took positions with Sunto compass.



Then completed map for this area - indicated vegetation, hill, lava, etc.
6 Feb 1970
Yesterday Daniel Weber went to the tree covered part of the arm of vegetation which lies just E of the crater which is directly W of our camp. He initially crossed along the same line to the W as J. Black and I used, then went a bit higher up to the tree area at about 1600 – 1700 feet. Then he went up some and came back across the vegetation at an altitude of about 1800 feet to our camp. He found more orchids. (Pg. 46) Epidendrum in flower and otherwise the vegetation as far E as he went was similar in species composition to the 3 areas just above our camp – but a bit more dry to east and with less trees. It appears that the most humid areas are the 3 patches just above our camp site. The only other possibly more humid area would be on the SE side closer to the rim, above Punta Mangle. D. Weber's path is indicated on my map. No tortoise sign of any kind was found by him, but the areas were, of course, full of land iguanas.

This a.m.: D. Weber, J. Black, F. Llerena, and C. MacF. came across vegetated area to W of campsite (western of 3 patches on map) - first ¾ of it very hard going 2-3 m. high tangle of Ipomoea, Xanthoxylum trees, Pteridium, Psychotria, with some Tournefortia and many other vines, herbs, fungi, mosses, and one species of terrestrial orchid. [Marginal note: See Roll 76: photos 8-9] Then on its very western edge . . . (Pg. 47) . . . . .above the hill there, found a little meadow like area covered with 1 dm high herbs, and with shade from scattered Tournefortia, Psychotria, Xanthoxylum and Ipomoea tangles [See Roll #76: photos 10-15] Very nice and open and seems ideal for tortoises.

In previously crossed more densely vegetated area were a few open places with grasses and Psychotria – all OK for tortoises. All this first part had abundant iguanas, especially in the more open areas. Also whole patch of vegetation is dissected by many large encanadadas and soil is quite humid in heavily vegetated part, but much more dry in the meadow area. Absolutely no tortoise sign across any of this area – we crossed from 1500 to about 1750 – 1800 feet, slowly and gradually climbing all the way. We left Daniel Weber here and other 3 continued W.

Arrived at two hills furthest to W on map at 1200 feet; altitude at base of taller one on eastern side is 1190 feet and they (the hills) are in this area of veg which runs from the coast to way above, probably to 2500 ft. plus. Am certain this is where Hendrickson and company were and also that their base camp was probably quite near these hills or a bit below them. Will describe rest of trip to this point (Pg 48) . . . and campsite area and vegetation near hills later after more close examination.

It was beastly hot, so we found an absurd little campsite beneath some horribly scrawny Xanthoxylum which are draped with Ipomoea and thus offer some shade (but only minimal): at least there is some breeze so everything is not at a complete loss.

[See Roll 76 photos #17-20, land iguanas and terrain] The area we crossed from the western edge of the meadow-like area described above to the vegetated area including and running above the two western-most hills was very interesting. We came directly across it at about 100 feet to just above the hills, then descended to the latter area through the vegetated zone along an encanada. The area between these 2 areas of vegetation separates them completely in the sense that it is almost completely devoid of plants. However, it does have widely scattered, 1-2 dm high plants, mostly ferns, grass clumps, and sedge clumps. It also has a good and fairly abundant population of land iguanas. Most interesting is the fact that on the (Pg 49) aerial photographs and from the sea this area looks as if it is covered with lava, whereas in fact it is really almost entirely an ashy soil of a very soft consistency, now dry and very dusty. The whole area is of moderate slope, 5-10 degrees and is dissected by numerous rivulets and small and large encanadas. It is very easy walking, the only exposed lava being in the encanadas and in small rubble piles where the action of running water has exposed the lava. On the whole, as in the area above our base campsite all the way to the rim, the area appears to be very old and certainly is not of very recent origin. It is quite a long stretch from the meadow to the E to the nearest vegetation with shade above the 2 hills to the W, probably 1 ½ - 2 km. And there is absolutely no shade of any extent for tortoises throughout the whole area. However, given a few straight days of cloud cover, I do not see why they could not cross from the long stretch above the two hills to the E to the meadow area and even beyond into the densely vegetated and shady parts which we crossed this morning. Thus there is some question as to whether the 3 continuous, connected patches of vegetation (Pg. 50) . . . above our base camp are really isolated from the vegetated area near the 2 westernmost hills. In the hot sun a tortoise wouldn't last more than a few hours in this intervening sparsely vegetated areas, [Marginal note: '"This stretch is at an altitude of 1400 – 1800 feet inclusive"] but given enough years, a sufficiently large population of tortoises, and some lengthy (2-3 day) periods of shade (e.g. in the garua season) I think tortoises could easily pass from one area to the others.

Secondly, I have to examine the areas more closely, but it appears that there is a similar situation at lower latitudes e.g. 1000-1200 feet, between the two western – most hills and their surrounding vegetation, the next vegetated zone to the E and finally the westernmost part of the 3 vegetation patches above and around our base camp. The 2 stretches, 1 between the latter and the vegetation near our base camp, both appear (Pg. 51) to be mainly ashy soil with very sparse vegetation and encanadas. Given this, the same argument applies for the possibility of tortoise movements between the vegetated areas at these altitudes. I will comment more on this after further examination. This afternoon, the 3 of us (minus D. Weber in other words) worked our way S of the 2 hills along the major encanada running toward the coast. We went slowly and carefully, about 50 m apart, abreast, from the hills (base of) at 1190 feet to about 400 feet in altitude. This took about 1.5 hours, most of the time spent in the vegetation. The vegetation did not change in any noticeable way throughout the whole descent, so I will describe the main dominant plants we observed. The area clearly used to be dominated by quite abundant Bursera graveolans of 10-20 feet in

height. Now however, virtually all of these are prone or semi-prone, completely dead or nearly so, and dried out considerably. There are a few standing ones here and there but they are also dead and leafless. The cause of this great calamity seems to have been a fantastically strong mass of water rushing down from above. The encanada itself bears witness to this, as it is huge in places – circa 50 m wide, and is mostly barren and consists of a fine (Pg. 52) . . . .cinder base; it also contains many huge lava boulders, and in some places with sharp drop offs, the lava beneath the cinder is bare and exposed. But this mountain of water which came through here was as wide or wider than the entire vegetated area, because the mangling of the trees extends well beyond the encanada itself and in fact encompasses the entire vegetation arm which runs toward the coast from the two hills. The area now has abundant vegetation but it is all shrubby, herbaceous, and sapling-sized trees. All the larger trees, mostly Bursera, but some Xanthoxylum were uprooted, smashed to the ground, and are now dead. It must have been really a fantastic wall of water and probably occurred during one general heavy rains of 1969 – probably in the Feb – Apr period. I will have to ask about the general extent of these rains on other islands in addition to (Pg. 53) Santa Cruz. I took a number of photographs of the encanada and surrounding vegetation on our return. All these are taken from below facing the 2 hills above: #28-30 from altitude of 430 – 500 feet, #31 from 700 feet, and #32 from 800 feet.

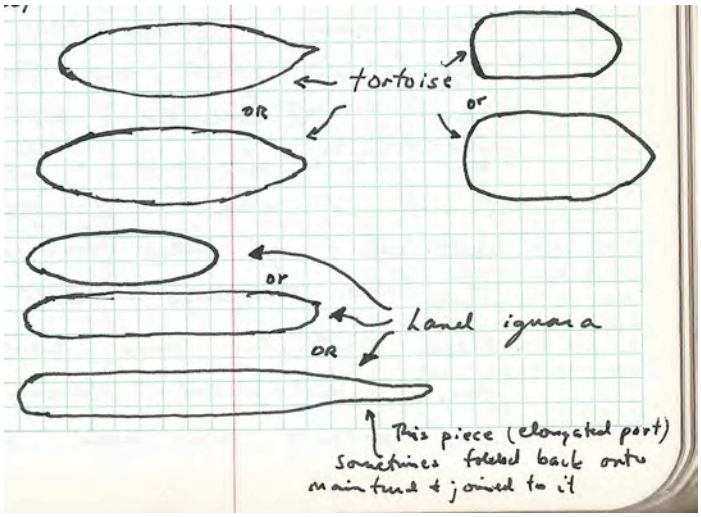
The vegetation now is predominantly shrubby and herbaceous. There are a number of small sapling-size Xanthoxylum rarely over 2.5 – 3 m tall and these and the prone and semi-prone Bursera are draped heavily with vines, especially Ipomoea, but also 1 or 2 others species. This offers plenty of shade for tortoises and iguanas. The predominant shrubby or shrub-sized plants are cotton (Gossypinum), Galapagos tomatoes, Cassia , Darwinothamnus, Waltheria, Cordia galapagoensis, Cordia hookeriana, Scutia spicata, the large Solanum mentioned previously in my notes, here reaching the largest size I have seen yet – 2 m or even a bit more occasionally, and an occasional small Pisonia sapling. The herbaceous vegetation is composed mainly of grass clumps of at least 6 or 7 species. The same sedge we have been seeing all over this side of the island, and a host of other small plants, the only . . (Pg 54) . . . one I recognize is an Alternathera sp. , but I do not know the species.

Along the first part of the hike, saw some scattered, smallish, shrub-sized Psychotria, but not much after the first 200 feet as went down. Same can be said of Tournefortia. At the other end, saw Scalesia (probably gumifera) but mostly at 400-600 feet. However, also saw what I think is the same Scalesia at base of the 2 hills. It probably runs throughout the area from the hills to 400 feet, but the plants are few and scattered and one sees only a few.

At 400 feet there is a small hill which we climbed. With the binoculars one could easily see that the same general vegetation and destruction by water continues S for at least another 100-150 feet lower in altitude. Then the last 250 - 300 feet of altitude to the coast does not appear to have (Pg. 55). . . been as strongly affected by the water and most of the area of vegetation through this zone is clearly dominated by standing, live, mostly leafless, Bursera graveolins. This certainly offers abundant shade when in leaf, but is only very slightly green here and there now – extremely dry in other words. If there were tortoises in this arm of the vegetation I am certain they would be up here and on up higher to the hills and above as well as in this dry zone. – in fact I would predict they would be mostly up higher around the hills and above where the vegetation is both more denser and more lush, and more moist. There were land iguanas all throughout the whole region we searched and I am certain they probably go all the way to the coast.

But once again, there was absolutely no tortoise sign at all. No bones, no droppings, no resting spots, no evident trails. The absence of resting spots or burrows is especially notable because there are abundant potential sites all the way down through the area and the plants have clearly not been used for such – absolutely (Pg. 56) . . . no signs of animals of tortoise size having burrowed up under any of these plants. Also, the absence of any tortoise bones or scutes is interesting. J. Black and I have noted the same lack in all the previous zones of vegetation and encanadas visited and the same is true here. If tortoise have ever really existed here as a population of even small size, one would expect to find bones in the vegetated areas here and there (as on Alcedo and S. Cruz where this is always the case) and especially one would expect to find some in the encanadas. We searched the encanada all along its length for 1 hr on our return and found no tortoise bones at all. This is of great importance because we did find many of the heavier bones of land iguanas – vertebrae, femurs, pelvic pieces – scattered all along this encanada. This was also the case in the vegetated areas of encanadas to the E, above and below our base camp. (Pg. 57) . . . .Being lighter, one would expect the iguana bones to be even more scattered and carried further below by the water, yet they can be found easily in small lava cracks and in open cinder outwashes along the stream bed. Tortoise bones, being heavier, should be easily found here if they ever existed here as a population. Finally, I found

a number of large land iguana droppings at various places along our trek some in the vegetated areas, some in the stream bed. Most of these have a characteristic shape and are longer and thinner in breadth in a relative sense than tortoise droppings – they can thus be easily distinguished from the latter. A quick sketch of the two types will illustrate what I mean (not to scale, only for shape). [Diagrams follow showing 4 rather thicker and rounder tortoise dropping examples and 3 rather thinner and more elongate shapes depicting land iguana droppings. One particularly elongate iguana dropping has elongated tip noted as: "this piece (elongated part) sometimes folded back onto main turd and joined to it."



(Pg 58) However, found a number which could not be easily differentiated by size or shape from droppings of a tortoise of about 60 –75 c. curved length on S. Cruz. And from internal contents of some I examined one could still not differentiate them. For example, some of these iguana droppings which look externally exactly like small tortoise droppings, internally contain large sticks, and long whole, quite undigested grass fiber, just as tortoise droppings often contain such material.

One other contributing factor which might allow some confusion of the two is that perhaps as the iguana droppings dry they expand in width more than in length. I collected one very fresh group of droppings which I saw a medium large male leave at about 520 feet in altitude. I also took photos of these dropping – roll 76; #'s 26-27. These particular ones could be easily distinguished because of the few pieces of uric acid which (Pg 59) . . . are deposited with the solid droppings and because of the longer and thinner shape than tortoises leave. However, it will be interesting to see if the shape changes upon drying. Also, the uric acid pieces are no good as a criterion because they disappear rapidly. I have found many iguana droppings which were clearly distinguishable as such and which were not yet very dry, throughout this area and only rarely is the uric acid portion still present beside the more solid droppings.

The largest piece in this group measures 80 mm in length by 34 mm in width at widest point. The other pieces were too small and broken to be confused with tortoises' droppings. This piece is broken off at one end. Also I collected a number of other droppings in this area, the largest ones I could find, from altitude of 520 – 720 feet. These are all in on plastic bag and measure as follows –

Length in mm	x width in mm(widest point)	comments.
98.0	44.0	Full of large grass shoots, undigested. Broken at one end (at widest pt. It seems) Hard to tell from small tortoise dropping
125.0	35.0	Also much undigested grass and leaves with veins remaining; clearly iguana
108.0	39.0	Ditto to above one, but broken off at one end and could easily mistaken for tortoise.
117.0	34.0	Broken off at one end; also much undigested grass shoots and leaves and small sticks. Has long slightly twisted tail on it like on many iguana droppings.

2 pieces – not worth measuring now, but short and fat and literally packed with grass shoots in undigested form.

135.0 33.0 and 34.0 "hot dog" type – two well formed pieces connected in center by a more thin juncture. Certainly iguana but might be mistaken for tortoise by someone who wasn't quite familiar with both types, has an undigested (pg. 61) tomato fruit in one piece; also full of grass.
All of these but the first one and the 2 pieces, are quite recent as they still are dark brown in color, solid, and the action of wind and mainly rain have not yet washed way any of the fine excrement which surrounds the large grass shoots and non grass undigested parts. The first one and the 2 unmeasured pieces still have some of the fine material but a lot of it has been washed away superficially and the color has turned to a light grey – beige on the surface because of drying. But internally, the color is still a yellowish brown, like in more fresh droppings, and the majority of fine filler is still present.
Finally, one could argue that if tortoises were here that this deluge killed off last ones and removed all sign of them – it certainly for example would destroy all the droppings; but this still does not resolve the lack of bones and also I seriously doubt such a water deluge would kill off tortoises if it did not do so to the smaller and more vulnerable iguanas; and the whole place is swarming with iguanas.
(Pg. 62)
7 February 1970
Found 3 more droppings just slightly above hills, about 75 m above them. All in one small area where there are at least 2 very large male iguanas. Vegetation here is very sparse and is mostly bare soil. Looks as if received a strong lashing from the flood waters last year. Not much shade in the areas, but some nearby under some small tree and vines in an encanada. Absolutely no tortoise sign, but plenty of iguana droppings, holes, tail tracks, iguanas themselves, etc. vegetation: Psycotria (0.5 m); tomatoes with fruits, large Solanum (1 m or less) with fruits and flowers.; Darwinothamnus, a few Scalesia, a small composite like Gaphalium, Faraxacum, some Ipomoea on Xanthoxylum saplings, a few other plants I don't know at all, and 3 or 4 species of grasses, and 2 sedges. I collected all the grasses, the 2 sedges, the composite, 1 vine I do not know, and 1 herb I do not know. There are also some small Opuntia (Pg. 63). . . insularis in the area, none over 12-15 dm high and most 5 dm or less. More comments on these below.
The droppings – certainly from land iguanas
Length in mm width in mm(at widest pt) Comments
95 (main body) x 43, 118 (including drawn out tip) Full of pieces of grass, fibers, and undigested rot; looks very much like tortoise dropping Dry, but H20 has not washed much of fine stuff away. Color extremely pale grey –brown.

113 x 39 Ditto to one above
90 x 37
60 x 36 Two connected pieces. Ditto to above but not as dry, more fresh, external color dark brown – black in part; uric acid superficially attached to one part (i.e. smeared on it, in two pieces with junction – "hot dog" structure.

Took photos of these in natural positions – First one above – Roll 77 #'s 142
Third one above – Roll 77 #'s 3-4
Photos 5 and 6 of general area where these were found.
(Pg 64)
Photos of Opuntia insularis in same area - # 7 and 8 – group with tape for scale (and mockingbird in #8) – shows one on far right , 22 cm tall, with bite out of it – iguana sized bite; also trunk of dead one on left – must have been about 1.5 – 2 m. high originally.
#9 – piece on ground ; partly eaten
#10-13 – photos showing a prone, smashed down, mostly mud covered Opuntia insularis; must have been a minimum of 2.5 m high (measured) and probably 3 m plus with all pads on it. The only living parts are the branch in center coming out of half buried trunk, and another smaller one to left in photo coming out of buried trunk. Mud mound on left is old trunk. A few of the old dead pads are lying about but not in photo. Large Opuntias Hendrickson saw here must have all been smashed down by wall of H20; saw a number of what must have been 2-3 m (Pg 65) . . . or taller ones below hills on walk yesterday – all bowled over; mostly buried by mud and dead. Through out this area now are only examples such as in the photos – branches off of prone trunks and new young ones (presumably from seeds). Interesting thing is size of trunk on this example – large, tough, durable, and of red color! Diameter of trunk, as best as I can measure it was about 15 cm.
Photos 14 and 15 – Same general thing – downed Opuntia.

Photos 19-20 – Same general thing – downed Opuntia
Photos 16-18 – shots of terrain showing what H20 did – fantastic destruction.
Photos 21-22 – side of hill in area (N side) showing how H20 washed out base from trees even there – all dead and prone on hill.
Photo 23 – effect of H20 on Jasminocereus trees.
Photo 24 – same as #'s 21-22 but more immediately below trees at base of hill.

After taking these photos saw even more Opuntias and Jasminocereus in same condition as those in photo. Most of Opuntias at least 2 m. and many closer to 3 m in height with large trunks. From this conditions of bowled over Palo Santo trees, and dissected bare look of most of soil here I would (Pg 66). . . guess that much of this area was a pampita with Bursera, Opuntia, and Jasminocereus for shade and plenty of grass and herbs in clumps all over the soil surface. It appears that the rain simply wiped clean most of the area and it is just now being re-vegetated with herbs and shrubs. The Opuntia seems to be making a comeback mainly from the knocked –down trunks. But the Jasminocereus is mostly dead and standing; only saw 2 small ones about 2-3 dm high starting to re-grow from mostly mangled stumps and these 2 were small when the flood came through here judging from the size of the trunks.
Judging from the dispersion of the land iguanas, i.e. essentially everywhere there is even a bit of vegetation, and considering that they are large and adults, (in fact largest have seen on Fernandina up till now), it seems clear that they survived the flood out in the open in their (Pg. 67). . . normal habitat. They probably mainly made it by getting hung up in low vegetation or simply by staying in their holes. The water when it came probably rushed down for only an hour or 2 at a time and then all was over till the next severe rain. Also, there are Tropidurus everywhere we have surveyed here and they must have also survived in a similar manner.
An additional interesting note-- found some iguana bones partly buried in mud on the crater-facing side of one of the hills in a place where the H20 rushed by – just another example of the fact that if these were tortoises here we should have been able to find bones somewhere.
Another fact: inside the eastern one of the two hills found 2 deep holes which tortoises could have fallen into if there had ever been a population here – yet no bones inside whatsoever to indicate this; also, tortoises could have gotten into this crater fairly easily because at one end of the crater NW side) it is much lower than all the rest of the way around and not too steep – the total altitudinal difference from base to top in this area is about 30 –40 feet and the slope only 30 degrees or so – anyway (Pg. 68). . . it appears that tortoises could have easily gotten inside. Also, a small tiny crater just below this eastern one has an extremely sharp drop right at the top, after a very easily climbed slope of only about 10-15 degrees. Again, inside this tiny crater (20 m. diameter) with no exit for trapped tortoises there is a deep hole – both in the hole which occupies only a small part of the crater floor and in the crater floor itself there are no tortoise bones or sign whatever any tortoise which fell in here could never escape and it is likely one might fall in because of vegetation to edge.
Another thing – the eastern one of the 2 large craters also obviously survived the flood well – no real flood inside in other words; these are nice shady Palo Santos and Xanthoxylum draped with Ipomoea and a good stand of grass and herbs inside it. If tortoise had been here during flood one might have expected some to survive simply because they would be (Pg. 69) . . . living in this nice shady area with good forage – but again no sign at all.
Later, I found 2 fresh and fairly large iguana droppings – will save these to see if expand upon drying; they are quite obviously from land iguanas with no possibility of confusion because are a bit longer and thinner than any tortoise droppings I have ever seen. These were in exactly the same area as the 3 previous ones, and the same site where I collected a number of plants. (see pg 92 for measurements). Also collected two more species of grass, the large Solanum, and a Scalesia near campsite just at base on NW side of the eastern of the 2 large hills, - this is only about 150 m distance from area where made collections this morning.
While I was examining the pampitas and what one could call the "former pampitas" around the hills this morning (searched carefully for 4 hours), J. Black and Fausto went up through vegetated area to hill just N of here and then on above that to an altitude of about 3000 feet. They went up along the encanada but through vegetation and returned by the encanada. They say absolutely no signs of tortoises of any type anywhere, but found plenty of iguanas and iguana droppings, tracks, and bones. The destruction of the vegetation in this region was also (Pg. 70) very great from the water last year and I am certain that this area was even more green than it now appears. All the cacti in the area have been knocked down and destroyed

and the area is littered with Bursera all dead and either prone or nearly prone except for a rare standing skeleton. Will examine this area more carefully tomorrow when we go up toward rim through this area. In sum for the area around the hills and below: am quite sure now that Hendrickson was in this area and that it was at that time a pampa of grasses with a lot of shade from Bursera and Xanthoxylum with large Opuntia and Jasminocereus with trunks. From everything we have seen in the area it does not appear that there are now any tortoises here and I seriously doubt there ever were. This leaves the question of what to do with Hendrickson's dropping and partly eaten cactus pads as a foul-tasting remainder of the whole idiotic mess. I will have to demonstrate it more clearly by comparing the (Pg. 71). . . land iguana droppings I have found with those of Hendrickson, but I think he simply failed to recognize what were quite large iguana droppings and nothing more.

For the first time since the afternoon of 4 Feb when we had some clouds off and on for shade, we had a nice shady afternoon from about 1300 on. In fact it rained enough from 1600-1800 in small intermittent bursts to collect about 4 l of cool but slightly grimy (dirty tarp) water.

The rain didn't hold and its now a mostly clear sky above (2000 hrs). The rest of the days here up to now have been clear and damned hot – enough so that one does not want to work from about 11-1500. In fact, on 6 Feb it was so hot just after we arrived in this area and set up our tarp, that we went down into the hole in the tiny crater, just below the two hills here. Inside it was about 70 degrees F and quite moist. We couldn't find any water, but it was fresh, cool, and nearly completely dark. The cinder made a very comfortable bed and was very cool – I covered my bare feet and hand with it to add to the enjoyment. Should note that in this area we have seen land iguanas eating Galapagos tomato fruits and leaves, and saw one female up in one of the large Solanum plants eating the leaves. (Pg. 72). . .

The iguanas are abundant all throughout this vegetated area and have also seen Tropidurus of almost all sizes except small hatchlings, and of both sexes. There is also a great abundance of doves in the area and it is not rare to see 10-15 feeding in a small area of only a few square meters. Also plenty of mockingbirds and both yearling and adult hawks in the area.

Each night here we have been visited by a Tyto alba which may be a young one – I'm not sure. But it is notably more darkly colored than the adults I have seen on S. Cruz in the Caseta area – there is a more beige –brown color on that part of the face of this one than on S. Cruz and all the rest of the feathers seem to be in general slightly darker. We also had a Tyto alba visit the main base camp at 1500 feet on the nights of 4 & 5 Feb. – same color as this one near our present camp.

Finally, found a dead and dried up Dromicus in this area – only skeleton and outside skin remaining. (Pg. 73). 8 Feb 1970

Going up N of this camp through upper part of this arm of vegetation and will then go over to NW side of rim of crater to look out over vegetation in that area- this of course only if we find no tortoise sign in the area immediately above. Took a number of photos of veg arm from beside hills – both up and down directions. See Roll 77, #'s 33-36. Also some of slightly more dense vegetation near our campsite on western side of easternmost of the two hills – this area was more protected from the full force of the flood from above and was not apparently stripped as bare, although all the larger trees in the area (Bursera, Xanthoxylum) are dead and knocked down. Roll 76, 30-32.

Then began ascent, noting right away that conditions above much the same as that around and below the 2 hills. Were a great number of Bursera tress up to about 1700 –1800 feet here but all are knocked down and or dead; likewise were some tree cacti of both genera for first few hundred feet in altitude above the hills – also all dead and demolished. The area up to the next small hill which is at an altitude of about 1800 –2000 feet (extends up and down in lengthwise fashion). (Pg. 74).

Is quite green now but is all fairly low growing vegetation being a mixture of things such as Psychotria, Tournefortia, Ipomoea, the large Solanum, ferns both small and fairly large, grasses, sedges, and many herbaceous species. The veg is not extremely dense as it is more to the E at this altitude, but it forms quite a tangle, especially with the Ipomoea and dead Bursera trunks all wound up together.

On reaching the side of this hill at 2000 feet discovered it is covered with a lush growth of ferns (Pteridium – most of them, and some smaller species), Tournefortia, Psychotria, and the large Solanum, with mixtures of grasses and sedges. It is, however, much drier here than the soil and vegetation at the same altitude more E, i.e. above our main base camp at 1500 feet. Also, the vegetation here was probably not taller than this before the flood because the dead stumps and prone trunks of Bursera and Opuntia (Pg. 75) . . . peter out about 100-200 feet below this hill in altitude. Even as it is now however, the hill would offer enough shade for tortoises under the ferns and other shrubs, especially where they are covered with Ipomoea vines. From this hill upwards vegetation becomes more and more sparse, and by 2000-2300 feet no more Pteridium or

other large shrubs and thus no more shade. Mostly grasses, sedges, Taraxacum and other herbs, small ferns by 2300 feet, become less and less dense till by 2700-2800 feet plants are very scattered. Same trend continues up to 3400-3500 feet where there are practically no plants at all. Only very scattered sedges, grass clumps, and Taraxacum here and there. From this point upwards there are virtually no plants at all till near the rim and even at the rim only a few grass clumps, the large Solanum, and a sedge here and there.
At 3400 feet I took a photo of the arm of vegetation through which we came up and which runs to the coast below – Hendrickson's area of searching in other words – shows one extent of the veg and the effect of the water and the size of the encanada from a distant perspective. Roll 78, #'s 3 & 4. (Pg. 76)
Also took a photo in upward direction at 3400 feet showing how barren this area is and the effect of water eroding the slopes; Roll 78, #5.
Then as we climbed a bit more I took photos 6-10 on the same roll – all these were taken from about 3800 to 4000 feet in altitude looking upwards and they show very nicely the extreme barrenness of all this area on this outer slope of the crater and the extent of which the H20 has eroded the soil here. At about 3900 feet we started heading to the NW side of the crater rim, thus ascending only very slightly as we walked along. In this process we were able to see a lot of the outer slope on the western and western northeastern sides; all was virtually totally devoid of vegetation over the range which we could see – 3700 – 4300 feet or so. We were also able to (Pg. 77)
. . . see Cape Douglas almost perfectly from the coast to an altitude of about 2600-3000 feet I would estimate. We could see this whole northwestern side of the island and all of it is virtually entirely barren. It is a great mixture of fresh, fairly new lava, as well as older more oxidized worn lava, and plate lava in places. There are also a few small cones at altitudes of about 2000 and 3000 feet. But virtually no plants at all over the whole area.
We then went to the NNW side of the crater rim and worked our way along the rim to the NW side, into the area where there is vegetation right up to the edge of the rim. We wanted to see below from this area to see how far down toward the coast this vegetation extends – on the NNW side of the island. But it was very foggy and we were in clouds for the whole 3.5 hour trip into this area. I worked through the vegetation along the rim here from the NNW side to the N side almost and then down into the vegetation to about 4200 feet. Throughout the entire area there was absolutely no tortoise sign but the land (Pg 78). . . iguanas were fantastically abundant. I wanted to go lower into this vegetation and spend another day searching here but we are completely devoid of food, have only 4 l of H20, my liver has been acting strangely and I'm semi-dehydrated. And hungry. Therefore will have to save this area and the southeastern sides near the rim for another trip.
The vegetation in this area is quite thick, mostly reaching about 1 – 1.5 but sometimes 2 m in height. The most abundant plants in the areas I walked through are as follows: Scalesia microcephala (sp.?); Tournefortia; Xanthoxylum; several species of grasses, one reaching 1 m and slightly more in height and in quite large clumps – 1.-1.5 m in diameter; some Psychotria; the large Solanum: Galapagos tomatoes; the small herbaceous Papilonaceae (Pg. 79) . . . . which saw below in the 2 hills area at 1100-1200 feet; some very low growing viney species which reminds me of Cryptocarpus but which I am sure is something else; sedges in small clumps; and a number of herbaceous plants which I simply do not know. There is an occasional Darwinothamnus here and there and some species of Cordia reaching small shrub size (the latter one has very tiny lancelate leaves).
The light was much better today than on 4 Feb '70, and could see all over the inside of the crater. It became quickly evident that there is vegetation on the rim over much of the following sides: NW; N, SE, E, NE. The only really barren area at the rim itself seems to be the SW and W sides.
Also on a previous trip I noted vegetation growing down inside the crater only on the SW side near the most predominant small crater – i.e. near the lake on one side. But today could see that vegetation is recolonizing down into the crater in a great number of sites and almost on all sides. In some sides, e.g. (Pg 80) . . . . the NW & N it is quite abundant and extends well down into the crater from the rim. I can not tell what the plants are, but all I can see appear to be herbaceous or a most small shrubby species. Near the rim on the western side, I could see some of the large Solanum and some Darwinothamnus about 100-150 feet below me inside the crater on a steep gravelly slope.
Again today the water in the lake has that deep, murky, forest-green color – I wonder if this could be an algal bloom of some kind or if it just the color due to the lighting?
Anyway, we waited for about 2 hours in the NNW area of the rim hoping to see the extent of the vegetation below but the clouds never lifted and in fact generally became (Pg. 81) . . . . worse the longer we sat still. Also it was quite cool and damp in these clouds and the wind was strong – 10–15 mph most of the time. If

tortoises occur on this side it is certain they are lower down and do not come up this far to the rim – I wonder if the vegetation goes low enough to have a warm enough area to nest – or is it warm enough for incubation at these high levels? One thing for certain is that this whole area, regardless of how low it goes, is well segmented by many kms of lava, both old and new, from the closest vegetated area on the western side – i.e. that in which we have spent the last 2 days searching without finding any tortoise sign. Also, should note that the more western of the 2 arms of what appeared to be vegetation in this area on the aerial photos (i.e. the 2 hills area where we camped) is in fact devoid of vegetation almost entirely – it in reality is an arm of older more lightly colored, worn and mostly plate lava which runs from the 2 hills to the sea. This explains why Hendrickson did not mention 2 arms. (Pg. 82) . . . of vegetation in the area in which his party camped and searched.

A few notes of interest on the other reptiles in the area:

1. Land iguanas – a) we saw them all the way from the 2 hills area to about 3400 feet where the vegetation essentially stopped. To about 1800-2000 feet they were fairly dense, but afterwards fewer and fewer till 3400 feet. From here to the rim in the unvegetated area of the western slope we saw none or no sign. At the rim began to see a bit of sign again – holes, droppings, tail tracks, and as we started into the vegetation on the NW side of the rim they became very abundant. When well into this vegetation found these to be fantastically abundant, more so even than in the warmer, more lush areas below our base camp at 700 – 1000 feet elevation. (Pg. 83). . . . where we climbed on the first day (3 Feb.). In places near the rim, I saw as many as 6 or 7 iguanas within an area of 6-9 square m, all basking and flattened out on the warm soil. Thus a cursory examination of these distributions would indicate that they and the distribution of vegetation (no matter how little of the latter) go hand in hand. Whenever we have found even a few scattered plants have found iguanas or their sign also, but areas devoid of vegetation are also devoid of the Conolophus. B) also, noted 1 presumably hatched iguana egg right at the rim at 4600 feet on the NW side; out in the open; also in vegetated area on NW side, I saw one young one of about 25-30 cm total length, tail included – it was extremely skittish, more so than the larger adults and I was able to watch it only briefly before it ran into some dense grass and into a hole. It makes me wonder why one hardly ever sees young animals- this being the first I have seen on this trip – season? Or their behavior? Or what? C) saw land iguanas eating Ipmoea around base camp. D) also, noted them all stretched out on warm (35degree C+ I would guess from feeling it) dark cinder sand. (Pg 84) . . . .all throughout this NW vegetated area when seen was totally or partly obscured by clouds and fog. It must get fantastically cold here in the garua season with fog, mist, rain, and strong winds. Down below in the 2 hills area, where we had plenty of sun the last 2 days, saw them basking only in early morning (0600-0830), late afternoon (1700-1800) and during the rainstorm (1600-1800). A study of their thermoregulation especially near the rim and at the higher elevations – 3500 feet + would be most interesting.

2. Tropidurus – have also seen them everywhere there is vegetation, no matter how sparse. They are especially abundant in the lower more densely vegetated and warmer zones from 700 to 2000 feet. But they occur all along rim and in higher (Pg. 85) . . . regions also where there is some vegetation. One puzzling thing however, is that about 200-2700 feet where veg is dense (depending on how far W or E one is on the SW side), have seen only what I think are juvenile animals, and perhaps a few females which are not in bright breeding colors (but probably only the former). Have seen definite adult females and larger adult males only in lower regions from coast at disembarkation point to about 2000 feet and slightly above. It is interesting that they are abundant at the desembarkation point where there is no plant life save for some very scattered Scalesia gumifera, Jasminocereus sclerocarpus, grasses, and Brachycereus. All those I saw in dense vegetation at and near rim on NW side were juveniles in terms of size and coloration. (Note: at least I think this is the case; of course there could be a cline in size from the coast or warm, lower altitudes to the rim, such that animals are smaller as adults at the higher altitudes). (Pg. 86). One other thing worthy of note is that in the area of 3800-4100 feet on the western slope, above the 2 hills area, and where there was absolutely no vegetation visible in any direction for ½ -1 mile, we saw 2 of these small, seemingly juvenile Tropidurus and the droppings of others. They seem to be living in the shady areas along encanada walls; also there were a few spider webs in these same barren areas in similar locations. Therefore, there simply must be insects in these barren areas. This suggests that Tropidurus probably occur all the way from the coast to the rim,

be there vegetation or not, but this contention remains to be demonstrated. The certainly are present in only very low densities in the barren areas devoid of plants.

2) Dromicus – saw two live ones, one about 1 m long, the other about 60-70 cm long at coast on 2 Feb just after disembarkation. Only other one seen was dried up specimen at 1150 feet near camp in 2 hills area. Therefore, much remains to be done concerning their distribution.

Finally, at rim on NW side in vegetated area, we also saw several young (1 yr more or less) and adult hawks, doves, mockingbirds, the endemic species of flycatcher, and several species of finches. * One very interesting observation – I saw an adult female land iguana basking (attempting to do so because was cloudy) with her body and legs flattened on the grey cinder soil near a patch of Scalesia microcephala at the rim on the NW side. A small finch approached her hopping along and jumped onto the base of her tail and began feeding on something there (ticks? seeds?); the (Pg 88) . . . finch then began to work its way along her side while hopping along the ground. As the finch approached her foreleg, she very clearly and slowly began to rise up and by extending her forelegs. The finch then continued to in front of her and began to clean in her neck area. Simultaneously, she extended her forelegs about ¾ of their potential length and very clearly raised her head and stretched out and exposed her neck, chin, and area between her forelegs on her ventral side. The finch then continued to clean her all over this area, in part using her partly angled forelegs and in part by clambering about on the folds of skin on the side of her neck. This continued for about 30 seconds and then in response to my moving (Pg. 89) . . . a bit closer to get a look at the finch, she moved sharply and the finch flew away. Anyway, the female iguana clearly responded to the finch's presence by offering it areas to clean – probably for ticks? Could not definitely identify the finch but will try to do so when return to the station. Perhaps Geospiza dificilis or G. fuliginosa.

After this 3.5 hr search for tortoises with no results, we headed E for the encandadas which run directly down to our base camp at 1500 feet. We (or rather our "leader" J. Black) overshot the proper area by a bit and since it was 5:15 p.m. and we were a bit lost, it was at least 2 hr to the camp but only 1 hr till dark, and everything was covered by clouds, we stopped at 4100) feet in a flat area devoid of damn near everything, especially plants and firewood. So we had a delicious supper of powdered milk, petit beurre vanilla crackers, and 1 small box of rasins apiece. The wind is cold as will be the night and my (Pg. 90). . . stomach is behaving at best rather poorly. It should be, since the best meal I have had in 7 days was 2 cup fulls of rice mixed with sardines, tomato soup, and asparagus soup. This stuff was the one meal that filled me up, but buffalo dung would probably be as savory.

Anyway, the culinary arts on this trip have not been so smashingly great. But by this time I do not really care; in fact my sole wish at this point is that we had left most of this fancy crap like sausages and raisins below and simply filled up on light weight but bulky items like pinol, avena, milk, crackers, and water. But most of all – sardines, never again!!

9 Feb 1970

Arose at 0630, very cold, in a cloud, very windy, but first fresh crisp cold fall –like air I have yet inhaled in the Galapagos. Plus for the first time on this trip I slept well on my bed of cinder sand, devoid of nary one beastly little tick. About 5 more days of my present filthy condition however, plus a bit more moisture and I will certainly have a colony of bromeliads seeded in and growing strongly in my butt.

We started down the hill at 0700 after the clouds cleared enough such that we could spot the encanadas below us. Black and Llerena took off below like a cold blue norther in Dalhart, Texas, but I amble on down the hill for 3 hours taking photographs and altitudinal reading of 4 Feb. and all agreed once again. One interesting thing – apparently this beautiful little moss is a short lived thing and it requires H20. I only noted it in abundance where otherwise bare soil had been recently wetted by light rain. Also it seems to (Pg. 92) . . . . do quite well if given any extra organic fertilizer. For example, very healthy patches of it occur around just about every hawk dropping I saw from 3800 – 2800 feet. Also, found a dead almost entirely decayed iguana with a very healthy patch of this moss growing all around the site and in amongst the bones; it was in fruiting condition also.

Arrived at base camp at 1000 to find that Daniel has gone off to W at this altitude to collect plants. I am going to go down and to W a bit also to photograph iguanas and double check for tortoise sign. First – measurements of 2 last droppings of land iguanas collected on 7 February near 2 hills area.

One is double, connected by a thinner juncture in between. It is dark brown – black in color, fresh – only a day or so old, still a bit moist , and full of partly (Pg. 93) . . . digested grass shoots, leaves, tomato fruits, and perhaps a large Solanum fruit? Correction – measured this one the other day (7 Feb.) - it is the one indicated on Pg 63 as being made up of 2 pieces 90 x37 and 60 x 36 mm. Now these 2 others.

1. One very long piece, partly broken at one end making it difficult to measure – so will measure as 2 pieces; also slightly curved. Very fresh – 1 day old at most, dark brown - black in color; can see it is full of leaf veins, grass shoots, and small sticks and more finely digested organic matter.

1st piece 124 mm long x 32 mm at widest pt.
2nd piece 34 mm long x 25 mm at widest pt.

2. One large elongated turd, but with one end curved back on itself; will measure only long part) and ignore small curved back portion. Color and freshness as with one above. But can see that it is full of grass shoots an remains (hard parts and veined wings) of at least 2 or 3 of the common learge grasshopper from this area (and also (Pg 94). . . . common on S. Cruz , or at least extremely closely related.

137 mm long x 34 mm wide at widest pt.
Interesting at the folded back end, from one side the dropping appears solid and can't tell it is folded back (can easily tell so from other side) Anyway appears quite wide at this point – max width here is 45 mm. If one could imagine such a doubled back piece being more obscured on all sides so that could not detect doubling back; then one would have an easily confused example of an iguana dropping which looks like a tortoise dropping.
Am now down in this area at an altitude of 1200 feet – NNW of base camp. Beautiful area for tortoises; only a slight slope, nearby encanadas for temporary H20, and although dry lots of vegetation. And shade – lots of grasses, many shrubs (Cordia hookeriana, Corida galapagensis, large Solanum, Scalesia gumifera, and several others I do not know. Here and there are nice Ophuntia insularis, Jasminocereus sclerocarpeus, and Bursera gaveiolens. The latter trees are quite large, up to 20 feet tall and offer plenty of shade – even the shrubs offer plenty of shade. The area is loaded with land iguanas There are a lot of Opuntia insularis in here, with trunks and between 2 & 3 m high. There are some partly knocked down or flood damaged but most are standing. One for example is shown in Roll 78, photo #33. it is 2.3 m tall, has a sturdy trunk of about ___cm diameter at midpoint below tunas. Something has taken several bites out of the lower pads; I measured the distance from the ground below to the top of several of these bites and the sizes of the bites - Examples - measurements taken:

1. Depth of bite, 2) width of bite at edge of pad, 3) distance from ground to top of bite

# a. 1.	2. 5 cm	2. 3.5 cm	3. 54 cm see photo #34 Roll 78
# b. 1.	3. 4 cm	2. 4.5 cm	3. 43 cm see photo #35, Roll 78.

However, one must be careful in calling these bites – from their general shape and position (either underside or tip of vertically positioned pads) are sure they are such. But this cactus (and many others here) has a rather severe infestation of something, probably this caterpillar such that there are many of these cream colored spots of what is probably digested cactus, and in some causes large holes in the center or at least entirely within a pad (see Roll 79, photos 1-3) such that must be caused by caterpillars. The bitten out areas of course could have these caterpillars invade such open sounds after the iguanas bite into them. There are dead (Pg 97) . . . and decomposing pads on the ground around the base of this cactus and most other Opuntias in the area – (see Roll 79, #4) – These are most certainly pads killed by the caterpillars in part which then fall to the ground. None of these I have seen so far appear to have been bitten into - in fact it seems that the iguanas (and because of no tortoise sign am certain that - the iguanas are responsible for the bites) only eat the green healthy pads. The iguanas certainly do not eat much of the cactus because each one has only a few to a dozen bites total out of all the low hanging pads which could be attached. The area has so much other vegetation, even though it is relatively dry and quite a bit drier than the area above at 1800 feet (see notes of 4 Feb) when all smaller trunked Opuntias, that the iguanas must only resort to Opuntia insularis rarely.
Roll 79 #5 – same 2.3 m tall Opuntia insularis, but in sunlight this time. There are some holes in from the sides (i.e. edges) of the tuna pads at altitudes higher than an iguana on the ground could ever reach – i. e. (Pg. 98) about 150 cm and in some cases – but from very mottled and irregular appearance of these I am certain they are not bites and are caused by 1) the disease – caterpillar I think, and 2) perhaps to some extent by finches as on S. Cruz. I worked my way further along in the same direction noting many more Opuntia insularis, most with the above described chartacteristics, the largest (height) being nearly 3 m , but most about 2 m or a bit more. See Roll 79 #6, another one 2.4 m tall. Virtually all are diseased with the caterpillar and only few have been bitten into. The only ones in which I could find bites above about 50 cm

+ off the ground were in pads in which an iguana could have easily climbed up either the Opuntia trunk itself or nearby shrubs or logs. All other deteriorations of the pads at higher altitudes are very clearly irregular and due to the caterpillar or some disease of another type. (Pg. 99)
As I moved through this area I collected a number more of the large size land iguana droppings which might 've mistaken for tortoises. Took photos 8 & 9 on Roll 79, of some beautiful, potential tortoise country – about 1190 feet – grass abundant, shady Bursera graveolens draped with Ipomoea, etc.
Then at about 1100 feet came into a beautiful, open, rather flat meadow area – it is just packed full of lush semi-green grass clumps of several species and sedges. Bursera trees and Ipomoea vines on the surrounding shrubs and trees offer abundant shade throughout this pampa and all around its edges. There are several encanadas dissecting it which must offer temporary water. Many shrubs grow all throughout it in small clumps. It is just perfect tortoise country but after wandering all through it for 1 hr I found only scads of iguanas, their trails, burrows, droppings and a few of their bones. This pampa runs for at least ½ cm up and down is about 100m wide. It is full of birds, also – doves, mocking birds, finches, yellow (Pg. 100) warblers, also, there are lots of bare spots of open soil so that if tortoises lived here I am virtually certain they could nest here; and, even if not here, they could nest in the areas around 400-800 feet which have abundant nice vegetation and also open soil sites (see notes of 3 Feb when we were climbing up). This pampa area is continuous with these areas more to the E which we passed through on 3 Feb. I simply can not believe that there was ever a tortoise population here – it is old, well vegetated, has abundant soil with no exposed lava and yet there is absolutely no tortoise sign at all. Finally this could have been where Hendrickson was, because it does offer the pampa and trees he and Cavaguero mention, but it has (Pg. 101) no pumice or anything like it, and instead a fine soft soil. The area to the W where we were on 6-8 Feb on the other hand at least has some fine cinder and scoria based areas which one might confusedly call a pumice base. 'also, there are no tree Opuntias in this pampa or even any signs of such, whereas there were some in the western area before the flood. Finally, this area does not go all the way to the coast whereas the other one does. Took photos # 10 – 16 (Roll 79) in this pampa showing various aspects of it. Returned to base camp by slightly different route but through same area; again saw no tortoise sign and noted mostly the same things as on trip down. Whole trip = 1400 to 1700 hrs. An itinerary of the trip up to this point in time follows:

3 Feb: all 5 of us climbed in one group as shown on map to an altitude of about 1370 feet where we camped for the night. Left coastal disembarkation point at 0800, arrived at camp for night at 1800. In process of climbing today examined a lot of vegetation covered area from (Pg.102). . . about 400 to 1370 feet. All potentially very fine tortoise country but absolutely no sign. Much of first 300 –400 feet of alt had very good potential nesting sites (i.e. 400 to 800 ft. actual altitude).
4th Feb : all 5 to an altitude of about 1500 feet where we made a base camp at about 0830. Left previous camp at about 0745. This base camp in open side of a small hill which is a collapsed (1/2 of it) crater. Went to top of crater and examined surrounding area with field glasses, took photos, and generally relaxed till 1000. Sent Fausto and Julio to coast at 1030 for my plant press, a fresh pineapple, and 10 gallons of H20. [Note: they returned next morning to base camp at 1100 hours] At 1130 the other 3 of us started up right hand one of 3 areas just above our base camp. D. Weber stayed in this area for about (Pg. 103) 6 hrs (1130 – 1730) collecting plants and examining the area around which he found a species of orchid (Epidendrum) J. Black and I went up through this area searching for tortoises for about 2 hrs, then on up to rim in 1 more hour from about 2800 fee; then some rest on rim and note-taking and photographing ; then we returned to main base camp in 1 hr and 20 min, in process coming down through small central vegetated area for about 45 min. No tortoise or any sign found by any of us in all this time or these places.
5 Feb J. Black, D. Weber, and I went to E crossing right hand one of 3 veg areas just above base camp, but at level of 1500 feet. D. Weber soon fell behind and stayed in this area for about 1 hr. We continued on to next hill immediately to E of our base camp where I surveyed vegetation above, to E and below (as far as I could see in all directions in general) with binoculars. Also I wrote a few notes and worked on map. All this took 2 hrs. We left camp at 0800, crossed veg area (Pg 104) . . . area searching in it for 1 hr, 2 hrs on hill and then 1 hr return about 100 m. distance to S of earlier crossing, again taking 2 hr for searching. Returned to base camp at 1200. Absolutely no tortoise sign. D. Weber continued bit more to E entering an arm of veg above hill we were on, then looped up and over to above main base camp at 500 m. altitude. He spent from approximately 1100 to 1700 doing this loop – no tortoise sign.!
6 Feb.

Sent Julio to coast to retun on afternoon of 8 Feb with 5 gallons of H20. Other 4 left for western 2 hills area at 0745 moving as described in my notes. D. Weber fell behind about ½ way there so we just finally left him in exasperation and finally reached hills at 1200, searching all area on way for tortoises. Saw absolutely no sign. Rested in small crater hole till 1430, then went toward coast till 400 feet altitude and returned to hills at 1815.
7 Feb –
8 Feb –
9 Feb –
For these 3 dates Black, Llerena, and I were together and my notes for those days give details of itinerary. Will obtain notes from D. Weber of his travels of 6-9 Feb later and add these to my map.
9 Feb – through 0930 when Black, San Miguel, and Llerena headed for coastal camp leaving me and 2.5 gallons of H20 to wait for D. Weber who is off to the W a short ways collecting plants.
It unfortunately turns out that on 6-7 Feb 1970, D. Weber went up to the rim by virtually the same route which we used; on the 7th he also went along the rim to the vegetated area on the NW side, but did not go down into it from the rim. Thus for all this time he saw the same areas we examined and he also found no tortoise sign. On the 8th he came down a bit more on the southern part than we did , ending up near the hill just to the W of our main base camp. On this descent he again saw no tortoise sign at all.
He saw large male Tropidurus at the rim on the NW vegetated side. Given these and juveniles I saw, must also be (Pg 106) . . . adult females in same areas.
In addition, in this NW vegetated area he found 9 fresh turgid land iguana eggs, all appear OK, no visible embryos so not really any development yet; all with flexible, leathery shell. Were right near the rim, 2 in an open slanted hole, 7 out in the open. On the soil at the hole's entrance. He says hole itself appeared very similar to a land iguanas living hole. Perhaps these were simply accidentally dug up by one iguanas after another had very recently deposited them. Anyway, this is further corroboration of their breeding in the rim area and successfully laying eggs. No real completed nests yet found there however. He collected 3 of the 9 eggs which we will take to CDRS museum and preserve them.
Again a nice clear hot day almost all day today; this makes 5 clear sunny days all day long, 2 with clouds most of time after midday, and 1 with clouds after midday and some (Pg. 107) rain from 1600-1800, at least on western side at 1190 feet where 3 of us were located.
10 Feb. 1970
The other 3 party members returned to the coastal camp yesterday afternoon, leaving our base camp (1400-1500 feet) at 1030 hrs. Daniel and I stayed the night at the upper base camp. This morning, both of us being convinced that this whole SW, W, and NW side of the island was not only inundated in1969 rainy season but also that a huge mass of ash was moved from the higher elevations toward the rim down over the vegetation at all elevations below, we collected some samples of this washed in ash from the right hand vegetation –covered area just above our base camp. The Thommens I have read 1520 feet, but is probably off a bit since on the previous occasions it has read abut 1500 feet at the base camp and about 1560 in the area sampled for the ash.
Anyway, the ash is of course deposited unevenly because of the rocky nature of the terrain here and probably because much of the area had some exposed lava before. Also, of course, as one ascended higher. (Pg. 108) toward the rim he might expect the ash deposits to become gradually more deep. We simply dug down through the ash at the base of some small plants until we hit what was obviously the previously upper layer of humus enriched soil before the eruption of 1968 followed by the heavy rains of 1969. We dug in 3 places to get a range of depths; one place gave a depth of 3-4 cm of ash over the previous soil top, another 4-5 cm. Each of these sites was at the base of presently standing herbaceous and shrubby vegetation (i.e. ferns, Psychotria, Tournefortia, etc.) The 3rd hole was in an open space at the base of a small Opuntia insularis in a small level area – again the depth was 4-5 cm. In the process of digging down through the ash we were able to find old, dead and semi dry small ferns within the ash layer with their roots in the (Pg. 109) humus soil below – they had obviously been covered by the washed down ash last year. Also, at about 1700 feet the other day, only a few hundred m W of here in another strip of thick lush vegetation, Daniel found a terrestrial orchid which he had to dig down more than 10 cm to free from the ash surrounding the lower parts of the leaves which were buried in it – he was still unable to get to the roots of the orchid which were below 10 cm and somewhere beneath this layer of ash. He notes that the plants which seemed to survive the inundation of ash and water were mostly strongly rooted, strong growing plants like ferns, terrestrial orchids, and small shrubby species which were able to withstand the ash covering and then grow up through it. The more easily crushed and buried plants which he things should

occur here in larger quantities then they do, must have been smothered by the ash and or washed away by the water (examples: some delicate ferns, grasses, herbs of many kinds). These plants are there now, but are just beginning to re-enter the area, probably by seeding in – their density is quite low. (Pg 110)
At 1000 we began our descent to the coast. Daniel is so fantastically slow and weak, that even while making observations and taking photographs along the way I quickly left him behind.
At about 900 feet noted some more large iguana droppings, all in one group, in an open area of old lava with some herbaceous vegetation and Jasminocerus scattered in the area. Took photos 24 and 25 of these and #s 26-27 of the general site (Roll 79). There is a strip of vegetation just E of this spot, the one running down from above to the eastern of the 2 hills which lie at about 600 feet elevation (same hills we passed just W of on our ascent of 3 Feb. 1970). This vegetation strip is only about 15 m away from the spot. There are land iguanas and their sign all over this area and have been all way down to this point.
I then continued on down to just slightly above the eastern of these 2 hills at 600 feet on old lava rubble (Pg.111) heaps which have very little vegetation. Land iguana sign all the way, but nothing of tortoises, as might be expected on this terrain. Also no tortoise sign on edge of veg strip which I was paralleling and also entering here and there for short distances.
At the eastern of these two lower hills in area of vegetation begins which runs from about 600 feet down to 400 feet elevation. Beginning just below the hill (which I had already examined on 3 Feb. 1970), I walked all the way down through this patch, generally examining it. It was full of nice large iguanas and their abundant sign but absolutely no indications of tortoises past or present. The area had no obvious ash deposit at all on the surface and is low enough in elevation that it had not be (sic) affected by the 1969 floods which were more severe above this area. The area is composed mostly of nice tall (20 feet and even more) Bursera gravelens trees scattered in rather low density but offering some nice shady areas. The canopy closure due to these trees is not much more than about 15-20%. This results in abundant open areas receiving direct light most all of the day at the herbaceous – ground level. The understory is almost entirely large (Pg. 112) . . . healthy clumps of various species of grasses. The ground also has many open patches of bare, fine, light beige, dusty, dry soil. I would estimate that the open soil makes up about 25-40% of the ground surface depending on shade, iguana activity, and varying from one small area to another. There are of course, other low growing herbs, some scattered shrubs, and an occasional largely unvegetated rocky lava covered area. However, most all of the area is either soil or soil covered by vegetation and there is very little lava present. The grass clumps are now mostly dry stems and leaves about 2-6 dm in height but even reaching to 1 m in some clumps interspersed in much lower quantity are some new green shoots in each clump; but mostly has obviously been dry lately and herbs reflect this. Bursera trees also are mostly only partly leafed – out, also undoubtedly (Pg 113) . . .
due to recent dryness. The area has an almost imperceptible gradual slope downwards and in fact most of it is virtually a level planar surface. All in all it looks like a very fine area for tortoises as did the area about at this altitude a bit to the W (see climbing notes of 3 Feb 1970). Both areas especially would appear to serve beautifully as nesting areas because of the frequent unshaded open patches of soil, the easy workability of the soil, and the adequate depth of the soil. (a few test holes with the machete showed that the soil in most green places was well over 20-30 cm deep and free of lava rock obstructions; certainly deeper than 30 cm in most places). These areas also obviously would be a fine nesting areas for a population mainly concentrated at higher altitudes in the patches of vegetation from 900-1000 feet on up to 1600-1800 feet which lie above these 3 areas and are continuous with them. The higher area could offer more lush green vegetation, periodically abundant H20 in the encanadas and at their bases and shade in abundance. However even at the level of these nesting areas there (Pg. 114) . . . would be H20 available occasionally after rains or heavy garua either at the areas or above them because the encanadas run this far down and then are scattered but fairly abundant places even away from the encandadas where water could collect in very small temporary puddles in lava rocks or on small beds of cinders. The whole area seems to offer further evidence that no real tortoise population ever existed on Fernandina in these southwestern vegetated areas.
From the end of this vegetation covered area to our coast camp everything is lava in this area. There is virtually no vegetation save for very scattered Brachycereus, Jasminocereus, and occasional minute islands of older lava with Bursera graveolens trees and some grasses and herbs. I came down to the E of the line of cinder cones where (Pg. 115) we ascended (more to the W) on 3 Feb. In this area it is possible by picking one's way to descend all the way to the coast on plate lava formations which are weirdly and interestingly shaped and sculptured.

At about 20 feet altitude just beside our coastal camp, there was a very good clear view of the vegetated areas we visited above Cape Hammond. Took a photo of this area in central part (#6) and a sequence of 3 from E to W (7,8,9) of these areas (see Roll #80)
Arrived at coastal camp at 1300 hours and spent the afternoon (after a makeshift sea bath amongst troublesome sea lion bulls and a heavy outgoing current) photographing the fantastically beautiful little lagoon area just west of the camp. The area abounds in wildlife – sea lions, and fur seals with lots of pups; penguins, old and young, and in various stages of scruffy molting; flightless cormorants sitting about drying their wings and throat panting to decrease their heat loads; pelicans sitting about looking as stupid as only a pelican can do; and Sally Lightfoot crabs grazing on algae covered rocks in the lagoons. I counted 52 penguins and about 20 cormorants in a stretch of only (Pg. 116) . . . about 100 meters of coast between the lagoon area and our campsite.
Also, John Black saw another live, large Dromicus in the camp area and I saw another of about 1 m length in the grassy areas near the small lagoons. J. B. also saw a land iguana at our campsite yesterday so from all I have seen they and the Tropidurus certainly occur all the way from the coast to the crater rim (and probably down inside the crater now again after the eruption). The Dromicus may also cover the same range but we have seen them only at our 100 foot campsite on the western side and at our coastal camp; have also seen their shed skins above our coastal campsite to an altitude of about (600?) feet in very open fresh lava covered areas with only scattered Jasminocereus, Brachycereus, grasses, and sedges. The snakes are probably (Pg 117) at least in all areas from the coast to 2000 feet on the SW and W sides I would guess. The iguanas (both Conolophus and Tropidurus) are clearly much more dense in the areas with abundant vegetation but also some open areas of bare soil and greases and light canopy cover and in meadow like areas. Their density falls off as either the vegetation becomes extremely dense and tangled at ground level or as the amount of bare open lava increases. I would suspect the same is true of the snakes but this will have to be investigated further at a later time.
* Land iguana droppings: I again noted many abundant and large iguana droppings on the way down today and collected a plastic bag full of them from various scattered sites from altitudes of 900 to 400 feet. These will be preserved as will be all those collected previously in other areas. Finally, it was a clear immensely hot day all day today from sunrise to sunset.
(Pg. 118)
11 Feb 1970 Julian and Vicente picked us up at 0700 and we went around to the W by way of Cape Douglass. At Cape Douglass we turned directly NE toward Punta Albemarle at the northern end of Isabela. Between Cape Douglass and about 1/3 of the way to P. Albemarle got a few chances to look at the NNW area of the island – not very clear because of intermittent fog and constant grey-blue haze, but could see that there did not appear to be any strips of vegetation which came from the rim to much lower than 2000 feet and only one strip seemed to even come this low; however can't really say because could never see the whole side clearly. So will have to simply look at this area more closely at a later time.
Arrived at Punta Albemarle at about 1500 and went on shore to swim a bit and take some photographs of sea lions, marine (Pg. 119) iguanas, flightless cormorants, and general vegetation. Never went further inland than 100 m from shore and of course were no tortoises or their signs in this areas at all.
Interesting thing was the Opuntia plants in and around the old U.S. radar site areas. (see Roll 82; photos 11-end, includes some of Opuntia here) Daniel Weber says that "at higher altitudes" on Volcan Wolf that they are tall and have trunks. However what is of note at Punta Albemarle is that they are low growing and completely without trunks; in addition they have large fleshy pads (some of them huge, at least 4-5 cm long by 3-4 dm.wide) with very sparse, scattered and not well developed spiny armor. It is clear that either tortoises or land iguanas if in an area with these Opuntias could easily eat them. The open question is what the Opuntia conformation is in areas on V. Wolf where there are tortoises and /or Conolophus present. One interesting note on this is that in middle Jan 1970 Daniel saw 2 tortoises, both large and one very markedly saddle-backed , the other much more dome -shaped, in an area just above Banks Bay on the W side of V. Wolf and both of these animals were (Pg. 120) . . . side by side in an area which also had these low growing , Opuntia without heavy spination!
From here we are going to James Bay tomorrow for the night and then Daniel, Fausto, and I will get off at Duncan for 3 days on Feb. 13th. As I am bloody fed-up with writing notes for awhile I am going to end this Fernandina excursion's notes for the present. Will do a summing up statement after return to CDRS. The little picky things that emerge after a week and ½ of camping with another group of people than one is habituated to is beginning to show and wear on me, I fear. Anyway, as always, once back in Academy Bay and after a general cleaning off of the ticks, and dirt everything will be roses, cream and nutmeg again.

Actually the people on the trip are a good bunch and have done virtually no bitching to amount to anything. The flesh is mortal however. (Pg. 121)

19 February 1970.

Additional notes concerning Fernandina problem and a general summing up of information to date:

I. Evidence for tortoise populations.

A. Beck's specimen from 1906; this, of course, could be explained, as an introduction as is probably the case on Jervis Island, since Beck found such paltry evidence, essentially everything he found could be ascribed to the one specimen he collected (at least in so far as his original notes are reproduced in VanDenburgh). Of course, the one animal could have been a rare survivor among the many isolated natural introduction events which must have occurred over 10's of thousands of years, especially from the Isabela populations.

The interesting aspect of his notes is the indication that for the 1st one –half of his climb upwards he give the impression that it was all rough lava, largely or perhaps completely devoid of plants and certainly not inhabitable by a tortoise population. Given that from where and how did the one he found get to the "island of old, vegetated lava" which he found 6 hours walk above Punta Mangle toward (Pg. 122) . . .the rim? Maybe this animal actually was the sole or one of the few survivors of a population whose range had been restricted by recent fresh lava flows.

B. Capt. Porter's statement about "greater or lesser abundance" in 1912 or 1813. This could be a mistake or in fact could indicate that there were really a few or one major healthy population at least somewhere on the island at that time; I simply will have to examine his journals more carefully for his statements, anchorages, areas examined by him, etc.

One thing of great importance here, is that Fernandina apparently had frequent eruptions between 1913 and 1825, i.e. just after Porter's time. (see Richards review, 19622). These if they involved the production of extensive amounts of lava on the outer slopes, could have been very important in destroying part of and restricting the areas inhabited by tortoise populations. Another interesting tidbit is that in Townsend's (1925) study of American whaling felts log books there are no records of any tortoises taken from Fernandina between 1831 and 1868. The logs indicate that no trips were even made to Narborough for tortoise hunting by any of these ships and crews; Of course the frequent volcanic activity and probable bareness of large portions of Fernandina, and lack of anchorages could have all prevented much visiting of the island by these whaling boats and other vessels in those time periods. Someday perhaps I can find pre –1813-1825 logbooks from whalers to check on visits to Fernandina. One other thing: in view of his paraphrasing, quoting and discussing Capt. Porter's travels in the archipelago in 1812 –1813, Van Denburgh (1915) makes a curious statement on page 301 concerning the Fernandina tortoise – "The early voyagers did not report the presence of tortoises on Narborough Island, so the discovery of this species was rather unexpected."

C. Hendrickson's 1964 trip – the droppings and the eaten cactus. The latter seems explainable as a combination of finches and (Pg. 124) . . . the caterpillar of Beebe guglielmi or simply finches. This of course all depends in part on the photograph published in Pacific Discovery, Sept. – Oct 1965. which shows the Opuntia - it looks like finch work and not the bites of tortoises or iguanas. The main enigma is the tortoise dropping (s) shown in the photograph. So the questions remain: are these tortoise or land iguana droppings? How large are they? Where was Hendrickson? Did he see no other sign? Etc. etc. This will simply require further correspondence.

D. Introductions to Fernandina.

1. Natural

Given the proximity to Isabela and adequate time, it is simple to see that statistically tortoises should have been introduced to Fernandina on numerous occasions by natural means. The question then becomes one of establishment and it seems rather likely that Fernandina has always has had large areas covered with stark open lava which would uninhabitable by tortoises. It really is then a question of whether they could occasionally (or even once) if it were a gravid female) land

in costal areas where vegetation came down near the sea so that they could survive long enough to get into areas with food, shad, and suitable nesting sites, and occasional standing water. In simple terms, introduction events have probably been plentiful enough in the past few 10s or 100s of thousands of years, but the problem is how many times could an animal even survive any length of time and ultimately how many of these could serve as founders for new populations. The answer is certainly damn few and perhaps virtually never. It is interesting to speculate on the fact that introductions from Isabela would of course most likely occur some where within an arc running from just W of few miles from Punta Espinosa to just W a few miles (pg. 126) of Punta Mangle (This of course depends on the currents in these areas about which I must get some information). This would perhaps fit in well with the notion of a natural and self-replacing population on the SE side above Punta Mangle prior to the volcanic activity of the latter 9/10s of the 19th century, and the possibility of Beck's male being a remnant of the latterly restricted population. (the same could be argued for any region in the arc from SE to NE with the 1906 specimen being a survivor.)

2. Artificial – i.e. By man

These are certainly possible, especially during the late 17th, all of the 18th, and first ¾'s of the 19th century with all the ships in the area then using tortoises for their staple diet. This could most easily have occurred by accident in which tortoise were lost overboard while loading and unloading or trading them between (Pg. 127) . . . vessels; or even when men-of-war were throwing tortoises over while clearing the decks for action. This might explain Beck's specimen also and even Hendrickson's droppings. But for Beck's how did the damn thing get half way up the mountain across all that lava? Or was it lava covered when the animals might have been introduced onto the island – i.e. perhaps as early as 1900 or even 1700-1750?

II. Areas covered on trip of 1-13 Feb 1970. (on Fernandina 2-11 Feb 1970)

Most of this argument is summarized and discussed in the previous notes from the trip. Basically, in all the areas we covered there were no signs of a genuine tortoise population, even one of small size, having ever existed there. To wit:

A. The areas could clearly support tortoises easily. At various places from altitudes of 400 feet or even down to the coast, on up to 2000 feet there is abundant vegetation for food and shade; at the lower altitudes of 400 – 800 or 1000 feet are areas with deep soil, shade, and food, but which contain (Pg. 128) . . . beautiful semi-open and open potential nesting sites; there are encanadas with bare lava and cinder-based holes where water would be temporarily available after rains during the rainy season of Jan – May, or , [Marginal note with arrow pointing to the word season: "Note: The area inhabitable by tortoises may have extended even higher up in altitude before the 1969 floods, perhaps to 2800 –3000 feet on the SW and or sides. "] or even at higher altitudes (e.g. 1000 –1200 to 2000 feet) during the garua season (Jun– Dec). No ponds were located but otherwise the areas seem to be beautiful potential tortoise habitat.

B. No signs of tortoise populations were found anywhere on the entire trip. The map shows the areas we covered and searched. There were no fairly fresh signs at all such as droppings, trails, nighttime or shaded burrows rasped into the soil, or evidences of tortoise foraging. Perhaps more importantly, no bones were found anywhere even though in addition to (Pg 129) examining vegetation covered areas, we were spending considerable time walking along many encanadas at various altitudes without finding any tortoise remains. Significantly, in these same encanadas we were continually discovering the larger bones of land iguanas both caught in small pockets and holes and up under old dead logs and on open cinder beds. (e.g. jaws, femurs, humeri, etc).

This lack of bones really makes me doubt that there has ever been a natural tortoise population of even small size in these areas because on all other islands which I have visited,, with the exception of Duncan, have located bones with little difficulty both in open areas, and in stream beds (i.e. Volcan Alcedo Santa Cruz). The bones of course weather and decompose

but one would expect to find at least some of the heavy solid ones like the leg bones, or perhaps carapace and plastron fragments. The case of Duncan seems hard to explain, but no one, including me has spent any time search for bones there in likely places such as stream beds, lava cracks etc. On Floreana (Pg 130). . . bones are plentiful but only down in caves. This is probably because those exposed on the surface have been decomposed and weathered away completely since the extinction of the species (in the 1840's probably). T. DeVries did find a femur of a tortoise on Barrington in the open in a stream bed area were it had apparently been washed up and uncovered by heavy rains in Mar 1969. He found it in Jun 1969. It was clearly quite old and well weathered both in sun and occasional water and wind action. It is a dense, heavy bone from a large adult and clearly of quite some age. This perhaps argues against rapid weathering of heavy hones because the tortoises on Barrington have been extinct for over 100 years. It should be notes that these areas found with bones on S. Cruz and Alcedo are from tortoises which died naturally I am certain. They are not from human killings because the areas are too isolated. The remains are all in areas where tortoises are still fairly abundant. This argument based on the negative evidence of no fresh signs (Pg. 131) . or older ones such as bones of course may be a good argument for only a relatively short time into the past, say a maximum of 50-100 years, if one assumes that exposed bones should be disintegrated within that time period and no longer recognizable. However the really important question is, if there ever were natural populations in these areas on the W or SW sides of Fernandina why are they not still in existence. The areas are old, certainly at least hundreds of years in terms of the vegetation as it now generally appears because there are large Palo Santo trees; abundant and deep soil exists in places; and what lava is exposed in various places is clearly old, worn and quite oxidized (with a deep red-brown tinge) in comparison to more fresh lava flows. The vegetation is also rather complex and in places covers the lava in a great tangled mass with abundant soil on the lava also – this surely indicates at least a couple hundred years or more of plant succession and colonization. Given all of this, if tortoises had (Pg. 132). . . ever existed here since the last fresh lava covered the area certainly hundreds of years ago if not even earlier, then there is absolutely no reason to expect that any of the events (apparent by looking at the area) since could have caused their extinction. The obvious suitability of the area for tortoises was described above, and although there are patches and streaks of fresh lava in the areas, none of it is very extensive until one gets out beyond the actual main vegetated areas.

Finally, the vegetated areas, except for long streaks running to the coast on the W, and one large and one small patch a bit further E of this streak, are all interconnected or separated by only very small short stretches of lava in a few cases. Given this interconnected set of vegetated areas on the SW side above Cape (Pg. 133) Hammond, it seems all the better as a potential area for tortoise populations because of the altitudes range of vegetation from 400 – 2000 feet, and the large areal expanse. Even with hot lava flows around this, one would expect tortoises and some vegetation to survive in some of the areas.

C. The main vegetated area above Cape Hammond on the S. West slope appears to be isolated quite well from the long thin strips of vegetation on the steep crater outer walls more toward the E (on the southern side of the island). They are thus also isolated by extensive lava from the SE side of the volcano above Punta Mangle. Thus if there ever was a natural population on the general southeastern side anywhere, the animals might not have been able to move to the W to reach the vegetated islands, or the areas above Cape Hammond.

This still however leaves the question of why animals could not have gone to or near the crater rim and then have spread around the crater rim on (Pg134) . . . the higher plateau there and thence down to other vegetated areas. Perhaps lava flows would prevent this in some locations, and the western and southwestern crater rim may have always been devoid of shade and only covered by very sparse vegetation as it is now. This however is hard to assess because these areas from the rim down to 2800- 3000 feet on the W and SW sides are now covered by deep ash from the 1968 eruption and were also certainly strongly affected by the 1969 heavy rains and resultant flooding. If these areas were always dry, windblown and lacking really shady vegetation then this would have prevented tortoises both from living there or using these as dispersion corridors. I asked Roger Perry what these areas near the rim

were like before the 1968 eruption but (Pg. 135) he had never walked over the SW or western plateau near the rim on his previous climbs. He did walk a short ways into the area on the SW side above C. Hammond before the eruption but only remembers the vegetation as being very sparse, dry and without trees for shade. Unless the ash in 1968 killed off all the plant life in these areas of the rim plateau and then the flood washed away all the dead trunks of trees and stems of shrubs, all of which I doubt strongly. Then I suspect the area was only very sparsely vegetation with herbs, grasses sedges, and very low-growing small shrubs which offered no shade abundant enough to tortoises before the 1968 eruption. In this regard, it is interesting to note Beck's description of the rim plateau on the SE above P. Mangle as being beautiful grass and cactus covered tortoise country. Tortoise also could clearly live on the NW rim and plateau area where there is (Pg. 136). . . plenty of vegetation and shade (and land iguanas in tremendous abundance!). Whether tortoises could cross from the SW vegetated areas to the western long strip which runs to the coast remains unclear. They certainly could now, given a few cloudy days, cross the ash covered areas at 1600-1800 feet where the walking is easy but the plants only scattered herbs. The same holds true for the lower altitudes of about 1000 –1100 feet where much of the crossing between vegetated areas is old worn lava or cinder beds and some ash. The problem is that these areas were probably harder to traverse when they were made up of more bare and exposed lava before the 1968 eruption (see aerial photos). In sum, the SW and W vegetation strips above Cape Hammond are isolated enough (Pg. 137) now and probably were so for a long period into the past such that tortoise populations which may have become established on the NE, E or SE sides of the island may not have been able to disperse to these more isolated areas. As of this time I simply don't know what the situation was before on the rim and nearby plateau area on the SW and W sides or what the situation is on the N, E and SE sides at the rim and below it to 2000 feet altitude or so.

III. Additional evidences and comments.

A. Opuntia insularis – see notes from trip. Also, finches which seem to be the species eating the Opuntia and causing the small to large semicircular areas cut out of the cactus pads are probably the following (on Fernandina in specific): Geospiza fortis; Geospiza fuliginosa.

Also maybe G. difficilis and G. magnirostris are also doing the same thing but am not sure of this. Anyway it is very likely that at least these 4 species are involved , perhaps different ones at different altitudes, in attacking the cactus. (Pg.138).

The caterpillar which causes the eaten out areas in the Opuntia pads is of the Pyralidae moth species Beebea gugliclmi Schaus. There is a brief paper on it by F. X. Williams (1930, Beebea gugliclmi Schaus, a pryalid moth borer of the Opuntia cactus in the Galapagos Islands. Pan. Pacific Entomologists, vol VII, no. 1. , pp. 1-4, based on his data and observations from the Calif. Academy (1905-06) Expedition. He discusses the larvae, pupae, cocoon, etc. From the paper and a discussion with T. DeVries, it appears that the exuded material I was seeing near small holes or along the borders of holes in the centers of the cactus is the droppings of the larvae which hatches within the pad and feeds there inside. The yellow exudate is fresh dropping material, the black more dried up being a later stage after the droppings have dried and weathered (Pg. 139) and are of greater age. The paper doesn't really indicate, but DeVries thinks that the caterpillar only eats within the pad and does not actually work along the edges of a cut in the pad, thus creating the serrated, cut edges I have seen on pads on Fernandina, Duncan, and S.. Cruz. He also doubts that the moth lays the eggs in open border wounds of the cactus pads (as might be caused by iguana or tortoise bites or finch activity). Instead he thinks the female lays the eggs somewhere within the cactus pad, away from the border itself. I frankly can't evaluate these comments because my observations are not complete. However, nothing I have seen contradicts these notions. DeVries and I agree that the serrated edges of pads and holes often seen within pads are certainly largely caused by finches eating into open and or weakened areas of the cactus pads, where the caterpillars have been active. My observations of finches and caterpillar activity on Fernandina and S. Cruz support these ideas. (Pg. 140).

Also it has yet to be demonstrated but I suspect that finches often are able to simply attack and open up a pad in areas where the spines are few and scattered (e.g. as on virtually all pads in the Fernandina Opuntia).
Finches also can clearly work (see notes) on an area where a tortoise or land iguana has taken a bite out of a cactus. Some of my notes and photographs from the trip show cactus pads in which finches have almost certainly started eating into a pad in an area where a land iguana took a bite from a low hanging pad.
I also have photos of area (see notes) where land iguana bites from low hanging Opuntia pads are obvious and also of areas where finches have attacked areas weakened by caterpillar activity. (Pg. 141) This all is evidence indicating that it is damned difficult to definitely locate and identify Opuntia pads with cuts out of them and definitely claim this activity was caused by tortoises (see Hendrickson's only published photograph (Pacific Discovery 1965) the serrated edges look definitely like the results of finch feeding, perhaps after caterpillar feeding had taken place inside the pad already. The other significant problem involving Opuntia on Fernandina is the tendency to form the tree type of growth pattern. My detailed notes on this when other vegetation is more sparse and not so abundant, the land iguanas appear to occasionally eat cactus (Opuntia) pads ranging from quite low branches and to also eat fallen pads on the rather (relatively) sparsely spine –covered pads of very young Opuntia. In areas with lush abundant vegetation of other types, the land iguanas seem to leave the Opuntia entirely alone and one virtually can not find a young Opuntia with a (Pg. 142) . . . bite out of its pad. So from what I have seen to date of Opuntia on 'Fernandina I would argue that 1) the tendency to form trees is present but not nearly so strong as on islands with tortoise populations of abundance or previous abundance such as S. Cruz, V. Alcedo, and Duncan. 2) Correspondingly the young plant's pad and low hanging pads on the trees are not densely and heavily armored as on islands like S. Cruz and Duncan where I have made careful observations; land iguanas take bites out of both types of pads on Fernandina and if tortoises were there they could easily also eat them; and 3) the tendency toward the tree growth form. on Fernandina can probably be adequately explained by the constant but fairly low selective pressure exerted by the land iguanas alone; tortoises do not need (Pg. 143) to be thrown into this evolutionary argument. Interestingly enough, we saw Opuntia all the way from 500 feet to about 2800-3000 feet elevation on the SW side above Cape Hammond. I did not make counts or take measures in all locations, but in general the Opuntia showed 3 significant trends. As the altitude changed:

1. Generally as we ascended they became more abundant in total numbers of individuals; this is correlated with increase in lushness of other types of plants; i.e. the iguanas have increasingly greater amounts of other types of food as one ascends.
2. Generally the plants were less tall above, 2 m and less at 1500-1800 feet for example and taller and with thicker bark in the dryer regions below – e.g. 3 m at 1100 feet, and 3 m+ at 550 feet. All these areas had heavy land iguana populations.
3. Generally, there were less and less young plants as one went further down in altitude from the lush, well-vegetated, more moist areas to the dry more (Pg. 144). . . open vegetated zones. All these things seem to correlate well with the land iguana populations' need for moisture and food which the Opuntia provides in the lower drier zones. In these areas the plants are more tree-like, taller, with heavier bark, and young plants are few and in some areas non-existent. As one ascends and the veg becomes more lush, the iguana feeding pressure decreases and the plants are shorter, the bark less heavy, and the presence of young ones much more noticeable. These same trends continued as one went from the SW side to more westerly, drier conditions on the western vegetation strips – again the trees were bigger, taller, and with heavier bark and the young plants were few and far between and often had bites removed from them in the more western (Pg. 145) vegetated zones.

B. More references of importance.
    1. Williams. F.X. 1930 Beebea guglielimi Schaus, a pyralia moth borer of the Opuntia cactus in the Galapagos Islands. The Pan Pacific Entomologist, 7: 1-4.

2. Simkin. T. and K. Howard. 1968. The 1968 collapse of Fernandina Calder, Galapagos Islands. Printed (mimeo) by Smithsonian Inst. Center for Study of Short – Lived Phenomena. 15 pp. 7 figures. ; contains some interesting comments on ash production, lava, lithic lappilli, etc. Also good references.
3. Richards, A. F. 1962. Catalog of the active volcanoes of the Archipelago de Colon., Isla San Felix, and Islas Juan Fernandez. Intern. Assoc. Vulcanology, 50 pp. Review of activity on all volcanoes incl. Fernandina (See next page; good reference lists)
4. Cox. A. G. , G. B. Dalyrymple. 1966. Paleomagnetism and potassium-argon ages of some volcanic rocks form the Galapagos Islands. Nature 209: 776-777.

Check for Fernandina dates. (Pg. 146).

5. Mc Birney, A. R. and H. Williams. 1968. Volcanic rocks of the Galapagos Archipelago. Geol. Soc. America. Sp. Paper 101, 135 pp.; check for Fernandina age dates.

Correction of reference #3
Richards, A. F. 1962. Catalgoue of the active volcanoes of the world including sofatara fields. Part XIV Archipelago de Colon, Isla San Ferlix, and Isla Juan Fernandez, Int. Assoc. Of Vulcanology, c/o Prof. Ing. F. Panta, Instituto di Geologia Applicadta, Fac. Di Ingenenaria Via Endossiana, 18-Roma (Italy)
One eruption (1961) in particular –SE side above P. Mangle (Leveque)
6. Frazer, C. M. 1943 General Account of the scientific work of the Valero III in the eastern Pacific, 1931 –1941. Univ. S. Calif. Press, Allan Hancock Pacific Expeditions, vol 1, no. 2, part 2 , pp 49-258. A bit of information about lava flows on E, SE, and S sides of Fernandina.

7. Morrell, Capt. Benjamin. See for details (including, some air and H20 temperatures of terrific eruption on E side of Fernandina in 1825.
8. Matthews. See for details of another large eruption on Fernandina's E side in 1846. Many other references in Richards 1962 review!

[Next pages are blank until Pg 153]
Roll 80 cont.
#6-9 cont – taken from 20 ft altitude near disembarkation point.
#10-end – coastal area at disembarkaction Pt. Cape Hammond; sea lions, fur seals, marine iguanas, penguins, flightless cormorants, a fantastic green pool there, sally lightfoot crabs, cacti and much more.
Roll 81 – 10 Feb. 1970; HSE
Same as last 2/3 of roll 80
Roll 82 – 11 Feb. 1970 KX
1-10 camp on Fernandina at coast Cape Hammond; cleaning up and getting ready to go on board Bronzewing; also some of getting into dinghy and loading equipment. A few of a fur seal female and her pup.
11-end: Punta Albermarle, Volcan Wolf, Isla Isabela: sea lions, coastal scenery, Opuntia right at and near sea coast, flightless cormorants, marine iguanas.
Roll 83 – 11 Feb. 1970; KII
1-6 location same as last 2/3's of Roll #82 – all flightless cormorants.
For rest of this roll see Duncan notebook #1. (#s 7 – end).
(Pg 154)
Roll 79 cont. KII
8-9 Trees, grass, Ipomoea area – ll40 feet, WNW of main base camp. See pp. 99-100 for details.
10-16 – grassy pampa with surrounding shade trees, etc. 1100 feet WNW of main base camp See pp. 99-101 for details
17 – land erosion , 1450 feet, WNW of main base camp – actually coming down off hill where map is.
18-19 – hill where main base camp is located in late afternoon sun.
20-23 sunset at base ca. 1500 feet.
24-25 – Land iguana droppings of size similar to small tortoises (60-70 cm c. l.) at 900 feet on SW side Fernandina, day of descent.

26-27 – general scenery around area above where droppings found - 900 ft. elevation
28-end – descent from 600 ft to coast. – Brachycereus and beautiful plate lava formations.
Roll 80 – 10 Feb. 1970
1-5 Brachycereus and lava on descent (cont. of above roll)
6-9 – sequential shots (7,8,9,) of SSW western slopes of Fernandina showing green area we searched; all but very western arm where Hendrickson was are shown here.
(Pg 155 – unnumbered)
Roll 72 1-2 Feb. 1970 KX

Roll 73: 3-4 Feb. 1970 KII

Last 16 photos
Fur seal pup and mother – nursing at landing site.
Land iguanas on ascent up Fernandina – SW side. One up in Ipomoea eating
2 photos of Julio San Miguel and Fausto Llerena in early morning making breakfast.
Roll 74: 4 Feb. 1970 KII
1-4 Sunrise and camp at 1370 feet altitude
5-8 Steep slope of Fernandina on SW side – very lush and green - tortoises?; from 1400 ft. Also one of the lowland – one ascent route and general surrounding area.
9: Jasminocereus sclerocarpus; 1400 ft. SW side Fernandina.
10-11: land iguanas 1500 ft.
12-13 D. Weber collecting plants, 1500 ft.
14-15: main base camp – 1500 ft. at base of a hill
16: D. Weber coming down hill through Ipomoea after collecting plants.
17-19: Galapagos hawk – 1650 feet.
20 Land Iguana – 1650 feet
21: encanada from above 1600 feet.
(Pg 156 - unnumbered)
22-34: various things seen on ascent to rim of Fernandina on SW side. Several of young (<2yrs. old) Galapagos hawks; several of ash and cinders and soil covered areas with fine covering of this beautiful orange – yellow moss which is ,1-2 cm in height. Other aspects of terrain and veg on ascent.
35-36 – crater of Fernandina from SW side of rim – shown eastern half of crater with lake in bottom and smoke from sulfur fumeroles on SE side of caldera.
Roll 75 4-5 Feb. 1970 KX
1-5: Fernandina caldera including a rainbow and a sequence of shots from E to W.
6-11: various things on descent; including some red lava, old and quite oxidized and forged as bubbles. J. Black and scenery below including mist during a brief rain; also him with moss covered areas and green areas below on SW side. Also chontilla (a fern); patches at an altitude of 1840 feet.
12-13 Opuntia insularis – stand of young specimens with none taller than 2-2.5 feet.
14-19 SW slope above camp with vegetation (top of photo (land) about 2500 ft) and rainbow.
20-22 – Sunset from campsite at 1500 ft.
23- end – 2 adult hawks on hill above campsite at 1500 ft.
(Pg. 157 unnumbered)
Roll 76 – 5-7 Feb. 1970 KX
1-3 – large Solanum at 1500 ft. – same one occurs all way to rim on SW side above Cape Hammond.
4-5 – Photos of higher vegetated areas (overlapping) from most easterly hill on my map of SW side of the island. Includes easternmost arm of veg which is connected with those above our campsite.
6-7 – sunset from camp on 5 Feb. /70
8-9 – J. Black chopping through veg at 1700 feet on way W from camp.
10-12 – Cactus (Opuntia insularis) in green meadow-like area on left hand of 3 vegetated areas just above camp. – This is the western or drier edge of this zone. Also (blotches?) of caterpillar on the Opuntia. Red leaved plant is . . . .
13 – D. Weber – same cactus and pampita or meadow around it – same as 2 previous photos. F. Llerena also in photo.
14– from pampita to hill below and coast – J. Black in foreground.
15 – J. Black & F. Llerena crossing same pampita

16 – Cerro Azul from same pampita.
17-20- Land iguanas at more or less 1700 – 1800 feet on way W just before descending to two western hills where Hendrickson was prob located in 1964.
21-23 Land iguanas at 520 feet in area of vegetation and large encanada below two hills where Hendrickson probably was in 1964.
(Pg. 158 unnumbered)
24-25 Fungus on dead shrub at about 500 feet, same area as previous 2 photos.
26-27: Land iguana droppings in same area as previous 5 photos – very fresh and made by a medium – large male.
28-30 Photos of encanada showing size, presumed destruction by water, dead P. Santos, etc. 430 – 500 ft. alt.
31 – Same but at about 700 feet alt.
32 – Same but at 800 feet alt.
All these 5 photos of the encanada and surrounding plants were taken looking toward 2 hills where I presume Hendrickson's camp was probably located in 1964. J. Black and F. Llerena are in most of the photos.
33-end: Ipomoea flowers in very early morning before sunrise.
Roll 77 7-8 Feb. 1970 KII
#'s 1-4 - Land iguana droppings in 2 hills area; see pp. 62-64 for details.
#'s 7-15 & 19-20 - Opuntia insularis – 2 hills area; interesting aspects of effects of flood in this area – see pp. 64-66 for details.
#'s 16-18 – General terrain in 2 hills area where Opuntia photos taken; affects of H20 –
#'s 21-22, 24 – Side of hill (eastern one), (Pg 159 unnumbered) . . . . same area, showing destruction of trees even here by H20 See pp. 64-65 for details.
#23 – effect of H20 flood on Jasminocereus; see p. 65.
Details of photo #1-24 on this roll are on pages 62-65 of this volume
25-28 – Sunsets from camp by 2 hills in western area of the crater.
29 – Ipomoea in early morning – same area as above 4 photos; near camp.
30-31 Denser vegetation on WSW side of hill at our camp – somewhat protected from H20's force.
32 – Western side of hill above our camp – also protected from full force of H20
33-35 – from 2 hills looking upward – note veg and encanada
36 - From 2 hills looking down – note veg and encanada.
Roll 78 KII 8-9 Feb. 1970
1 – J. Black and F. Llerena climbing up at 2200 feet on western side of Fernandina above the 2 hills where we camped for the previous 2 days.
2– Young (1yr or less) Galapagos hawk at 3400 feet in barren area on western side of Fernandina – above 2 hills camp.
3-4 Two hills area (Hendrickson and Co.) from above at alts of 3400 feet.
5– Barren area at 3400 feet looking upwards – F. Llerrena in foreground; shows action of H20; almost no plants here at all – a few clumps of sedges is about all.
(Pg. 160 unnumbered)
6-10 – Various shots with and without J. Black and F. Llerrena hiking - main thing to note is erosion and lack of plants through this area- 3500-400 feet on western side
11 – Rock fall on E side of Fernandina's crater; taken from rim on western side.
12-15 – Land iguanas near rim on NW side of Fernandina crater.
16-21 – Fernandina crater – all taken from NW side on rim.
22 –30 – Descent on SW side from about 3500 - 2500 feet – various photos of vegetation from "moss only" area; to moss with some few herbs (e.g. Taraxacum; ferns, grasses,) mostly 1-2 dm high herbs. Cerro Azul in background of some photos; also one of iguana skeleton showing profusion of moss around the enriched (organically) area.
31-32 – Land iguanas, 1450 feet, just below base camp.
33-35 Opuntia insularis at 1200 feet. See pp. 95-96 for details
Roll # 79; 9-10 Feb. 1970 KII
1-7 Opuntia insularis, about 1200 feet. See pp. 95-97 for details (cont. on Pg. 152)
End of notebook.

Isla Fernandina Notebook #2
Other Animals
Field Notebook of Craig MacFarland
September 1974

(Pg 1)
13 Sep 1974 – 0600 – Leave Academy Bay on Beagle III enroute to Fernandina; dropped two wardens (A. Villa and A. Calapucho) on Pinzon E side enroute- they are going to measure young tortoises and check for nests. Night at Villamil Stopped to see Arnaldo Tupiza and his son but they were at Corazon Verde or tortoise area nearby to E of Santo Tomas.
14 Sep 1974 - Continuing; dropped A. de la Bastida and 2 wardens (B. Sanchez, M. Salas) at San Pedro, 2 wardens (C. Diaz, M. Robalino) at Caleta Iguana (to Las Tablas). Both groups to protecdt G. e. vicina nests and hunt dogs, cats, and pigs. To P. Espinosa, Fernandina for night leaving Pat and Jerry Wellington and Gil DeRoy (Jerry there for marine survey study work for 2 weeks).

(Pg 2)
15 Sep 1974 – Around N side of Fernandina and to long strip of vegetation which comes all way to coast from rim, or at least nearly the rim, on WSW side or flank. Here, with some considerable effort we (me, Henning and Anne Adgerson, Guy Coppois, Orlando Romero) were able to get out at a little sheltered spot –see map enclosed. It is one of the few spots where it is every possible to approach shore in an outboard bot (noticeably used by cormorants and penguins to the exclusion of rougher areas to either side. Certainly only possible in very calm period with little swell and at low tide. Ad it was it was possible only because we had one man on shore with rope of the panga, forming a line to pass gun and things to higher ground, and 2 crew in boat using oars to keep panga off of the rocks while another man passed gear to those on shore. Checked cormorants at sites where we landed. In two clumps of 5 nests each about 10 m between two sites; all 10 nest now occupied by nesting pairs (none banded):

Nest #	Condition
	courting and building nest
	courting; saw no building yet
	¾ grown chick
	2/3 grown chick
	3 eggs
	2 eggs
	3 eggs
	3 eggs
	2 young just hatched, no down, (no evidence of a 3rd egg)
	½ grown chick

(Pg 4) Plus 2 other adults with fledged chick which has left nest and which occasionally swims. However, the adults still seem to be feeding it at shore about 25 m away from nesting areas. Therefore, a total of 22 adults, 1 fledged chick and the other details as above.

Approx. 200 m to S, in another inlet, less protected one, found 7 more adults, none banded; 2 nesting in only obvious nesting site, have 3 eggs. Call this nest # 11 will check these nests for changes before I leave and therefore am leaving the nest page blank for that purpose.
Fur Seals– counted 15 along 100 m of coast – 4 adult males, 2 sub-adult males, 2 pups (juveniles actually), 7 adult (Pg 5) females. No recently borne pups or females with obviously nursing pups seen. Don't know if the two juveniles are still with females or not (did not see them with females, but females may be off fishing as juvs in rocks sleeping! Thiss count rough – could be more animals in rocks and hidden areas.
Sea lions – 3-4 adult females in the area and one young one with one of the females. No sandyk beach or any beach here.
Cormorants: (see pg. 42, 21 Sep notes)
18 Sep '74 – Nest #1 – built – one egg now
Nest #2 – saw attempted copulation ather courtship before and after 1130-12:00 hr.
19 Sep '74 – all same, save that noticed that one adult near nest #5 was ringed – checked No. Z28047. Turned out not to be one of nesting adults.
21 Sep '74 – At 0615 survey two sites – besides 20 at nest sists at landing, counted another 13 near water's edge at nearby resting place; at site 100 m away only saw the one nesting pair, no others. Total = 35 [Marginal Note: Total: 34 adults, 1 recently fledged]

Pg 6 – 16 Sep'74 – Noted 8 adult penguins at landing site, none banded; no obvious nests or fledgling anywhere.
Yellow crowned night heron at landing place this morning early and late yesterday afternoon.
Yesterday afternoon and today we each made three trips to two craters at plus or minus 340 m altitude, directly above landing place, and between which the vegetation strip runs. Very easy walking on the whole for ½ km N of here along coast one hits a dry stream bed which then runs all the way up to the craters and well beyond. It is the same encanada and same two craters I visited in Feb 1970 (see (Pg 7) . . . notebook No. 1 – Fernandina). Henning, Orlando and I took about 60 lbs per trip, Guy about 50, Anne about 40 and it took about 1 hr 3o min to 2 hr each time with two 10 min rest stops enroute.
Enroute saw 5 cleaning symbiosis sessions in progress, all between plus or minus 20-120 m elevation, and all but two this morning between 0800-0900.
Mockingbird – land iguana: saw 3 instances, all on stream bed just at edge near vegetation; in all 3 iguanas were fully raised in upward push-up position. One mocking bird in two cases, 2 in the other, were pecking in axillae, along side, and around neck skin folks and on upper legs. All 3 land iguanas were large males. Mockingbirds mainly on ground, but also hopped on dorsal surface of back and tail (Pg 8) . . . of iguana on occasion. Did not see initiation of sequences or probably normal termination as we scared land iguanas in each case, they moved and mockers flew away. One of these yesterday p.m.; others this morning.
Land iguana – G. fuliginosa: two clear cases seen both in progress; one this a.m., the other this p.m. Iguanas in each case, both adult males, fully raised, immobile. In one case one adult males, two adult female G. fuliginosa cleaning and pecking in same areas as mockers, especially

on upper legs and in axillae. In others case only one adult females G. fuliginosa. Initiation not seen; both cases interrupted by us – iguanas moved and finches left.
(Pg. 9) 17 Sep '74
Went up to "green" crater directly up encanada from our base camp in between the two craters. The former is at approximately 630-640 m (on top) and the latter at 340 m according to Henning's Thommens pocket altimeter. He put in two quadrates here - see details at end of trip notes.
Main observation, here on upper side of crater, on "hillsides" above here toward rim and on alluvial fan on upper side of the southern of the two craters at 340 m, is that re-vegetation is continuing steadily apparently but not all that rapidly. I took a few photos on roll 1 to illustrate that truly base ash is now not evident anywhere up to about moe or less 900 m elevation (i.e. as high as I can clearly see) – it looks as if from more or less 1000 m and upwards there still may be little or no vegetation at all on this western outer flank. The ash has continued to (Pg 10) . . . be weathered and eroded by rainfall/runoff, and much more bare lava seems evident again, here and there, from 300 – 600 m elevation.
The vegetation now covering the ash consists mainly of herbs (Salvia, Alternanthera, small ferns sedges, (Cyperus), grasses, etc.) and very scattered shrubs (Tournefortia, Waltheria, etc.), species composition varying with altitude. But the cover is generally either continuous or at least 50-75% in most places, with bare ash the exception rather than the rule.
The whole aspect of this side of the mountain (W flank), from the Beagle's deck 2 days ago, looked as if the ash cover had been considerably eroded, especially in non-vegetated areas.
Orland Romero went to coast and back and says he saw several cases of both mockingbirds and "small finches" cleaning fully raised land iguanas. (Pg. 11)
18 Sep '74
Toward coat to study land iguana- bird cleaning symbiosis. Cloudy until more or less 1030 hrs; land iguanas coming out of burrows between 0730-0900, lying flat on soil with body oriented more or less perpendicular to sun's scattered rays coming through clouds.
Then active for approximately 40-60 min and all into shade by 1030-1200 hrs. Saw none entering burrows, bu instead saw over 20 individuals seeking shade under dense shrubs – e.g. Waltheria, Croton, Ipomoea alba – covered low Bursera trees. Saw no instances of cleaning symbioses, but probably not surprising due to short activity period. Went to coast camp from 1200-1300 to write notes and check cormorants (see Pg 5)
Up to first crater (Pg 12) . . . along encanada above coast my path was simply the dry stream bed which is narrow all along here (1-10m) with vegetation (quite green, most species flowering) along both banks, and to the interior areas beyond. From this crater upwards, had to vary my path from the stream bed where it was narrow enough to walking about 15-20 m inside of vegetated areas to S of the stream bed when the latter was wider than the 1-10 m allowable; it forms a huge outwash alluvial plain here and there making it impossible to count iguanas on both sides - therefore in these areas I went into vegetated areas. In total, distance within veg areas, away from the dry stream bed totaled approximately 1/3 of this second half of the overall (Pg 13) . . transect. The transect in total was about 7-8 km I would estimate, half below the first crater, the other half between it and the "two-craters" campsite.
Counts:
1st half of transect: 22 land iguanas, of which: 8 adult males, 7 adult females, 3 subadult males?, 4 subadult females ??. [totals of 11 and 11 for males and females respectively]

2nd half of transect: 26 land iguanas of which: 9 adult males, 8 adult females, 5 subadult males??, 4 subadult females??. [totals of 14 and 12 for males and females respectively]
Saw no juvenile or hatchlings anywhere and on animals that I would estimate to be less than 30-35 cm snout-vent length. All were largish to quite large and all with more or less adult type of coloration. Am not too positive on sexing of subadults.
Almost all the animals were resting in the shade during the ensus (1300-1430) period, save for (Pg 14) . . .four which I saw feeding there all returned to shade with 5-10 min after I spotted them – i.e. probably shuttling. Looked in a couple dozen burrows – no iguanas – thus during this season am certain they do not enter burrows for escape from mid-day heat- only at night and to escape predators.
Four I saw feeding were eating Ipomoea alba leaves (3 cases) which is particularly lush and flowering now. It forms huge mats of green leaves, the vines climbing on both shrubs and other herbs and over open ground. The other animal was eating Rhynchosia minima leaves and stems.
Walked around upper base of the southern of the two craters at 350 m near camp. Many land (Pg 15) . . . iguanas. They became active again between 1500-1800 when went into holes (burrows) for the night. Noted the following plants being eaten or that individual plants show clear signs of grazing in this area:
Ipmoea alba – being eaten – leaves and stems but mostly leaves.
Froelichia nidcaulis lanigera- heavily grazed – leaves and stems
Commelina diffusa- being eaten – leaves and stems
Rhynchosia minima- being eaten – leaves and stems and flowers
Alternantherea filifolia filifolia- being eaten – leaves, stems, and flowers
Caught a males, 52 cm snout-vent and collected ticks – and lots of lavarl tick crawling all over him, but found only few attached, mainly in neck skin folds,and axillae and inner joints between thigh/calf. Henning saw two males fighting – head butting into side of other by one, followed by chase, at about 220 m alt. Probably territorial defense. Guy saw two males (Pg 16) . . . performing head butting and lateral presentations displays near camp, but no direct contact.
19 Sep 1974
0800-1030 hrs – enroute to coast with Henning and Guy. Cllected land iguana droppings from Henning's quadrats #'s 4-8, and he and Guy will collect from quadrats #'s 1-3 (above campsite at 2 craters) on their way to rim in 2 days. They will also collect droppings when possible from quadrats Henning installs on rim and at others sites during the coming weeks. We will then examine these for defecated food items, using his collections and quadrat plant lists as reference materials simply to obtain qualitative (Pg 17) . . . idea of land iguana food items at varying altitudes on this W flank vegetation strip. For now we know that land iguanas are common all along the strip right from the coast to the least 650 m altitude, and Orland who has been to rim twice in past two days, going straight up from our two-craters campsites, says that wherever there is seen a little vegetation, all way to the rim, there are also land iguanas and lava lizards.
I saw no cleaning symbioses instances, but saw few iguanas du to collecting taking my time and attention. Henning saw one instance at about 300 m altitude of a Geospiza (either dificilis or fuliginosa, he is not certain), cleaning a fully-raised female land iguana with back arched and motionless. He came upon it in progress. (Pg 18)
Only one finch cleaning in axillae, along mid-dorsal line (hopping along back) and in skin folks of underside of the neck. Ended when bird left and iguana relaxed some 10-30 seconds later.
On return saw following instances of feeding by land iguanas:
2 adult females – Ipomoea alba – leaves

2 adult males – Ipomoea alba – leaves
1 adult males – 1.5 m off of ground in a Croton scouleri- probably forma macraci= one with long thin lanceolate leaves – 2.5 3 m high shrub= eating leaves.
Also noted some Waltheria ovata leaves, lots of Alternantherea filifolia filifolia stems and leaves, some Rhynchosia minima leaves, and one case of Cyperus ligularis leaves in 4 dropping examined in dry zone (80 m altitude). In several (3) droppings examined (Pg. 19) at coast found mostly unidentifiable twigs and leaf fodder, but could clearly distinquish Cacabus miersii fruits and leaves in each dropping, and also what appeared to be Physalis pubescens fruits. Saw clear evidence of grazing by land iguanas on following plants.

1) Cacabus miersiik- right at coast; mny plants grazed.
2) Alternantherea f. filifolia – heavily grazed in dry zone and in transition zone – everywhere I've seen it up to 350-400 m it is grazed a lot.
3) Froelichia nidcaulis lanigera – same as A. filifolia – heavily grazed everywhere seen, up to 350 m alt.
4) Rhynchosia minima –
5) Ipomoea alba – Both extensively grazed

Have noted especially heavy pop desity of Platyspiza crassirostris finches in (Pg 20) . . . in zone from about 150-300 m altitude. It is possible to "pish" call 20-30 birds of this species at a time, to one tree or bush within 30-40 seconds. They seem to be everywhere in this zone and we (Henning and I) have noted tem feeding on the following plants.
Lycopersicon chessmanii – feeding on fruits once in awhile fruits, very abundant.
Pisonia floribunda – feeding heavily on buds (flowers, and fruits absent).
Solanum erianthum – feeding more or less heavily on fruits which are extremely abundant.
Tournefortia rufo-sericea – saw feeding on fruits at 500-600 m altitude where fruiting shrubs common now.
Darwinothamnus lancifolius – eating flowers of both types (bright green and blue green)
(Pg 21) . . . heavily, both of which are quite common in dry and transition zones.
Alternathera f. filifolia – eating abundant flowering heads.
This is definitely the commonest finch by far throughout the zone from 150-300 m altitude. Other finches noted and their relative abundances and locations are indicated below = however note that these are gross impressions only and not based on accurate surveys, counts, or censuses:
G. magnirostris – fairly abundant in dry zone from coast up to more or less 80-100 m elevation. Not seen above there.
G. fortis – fairly abundant in same areas as G. magnirostris; perhaps extends up to 150-175 m alt. in transition zone.), is abundant from coastline all way up (Pg. 22) . . . to 150-200 m elevation. (Most abundant finch up to 100-150 m, where _____ becomes most abundant). Have seen scattered individuals all way to 340-350 m at two craters base camp. Also, perhaps range extends higher in elevation. Do not know.
G. difficilis – notable numbers at 350m elev and above, but think I am seeing rare to occasional individuals all way down to coast. Certainly more common than G. fuliginosa at 250-300 m elevation and higher – in fact most common finch from more or less 300 m elevation upwards.
C. psittacula
C. parvulus
C. pallidus
(Pg. 23)

Other birds noted:
Yellow warblers here and there from approx.. 75m elevation upwards to at least 400 m elevation – perhaps higher? Not common anywhere.
Vermilion flycatchers – scattered individuals seen from more or less 250 m elevation and upward to as high as I went (650m elevation); not common anywhere.
Myiarchus flycatcher – more common than vermilion, but still not many seen. Seen here and there from about 100 m elevation on up to as high as I went (650m). Most seen around 300-400 m elevation.
Mockingbirds – very common all way from coast to as high as I went (650 m). Especially abundant from approx.. 50 m to 400 m elevation.
Doves – very common from near coast to as high as I went, but very abundant (groups of 3-4 up to 10-15) at elevations of 250-450 m.
Barn owl – one seen at two craters camp (340 m alt.) each night from 16-19 Sep when I was there.
Hawks – juveniles and adults both seen commonly at all altitudes. Guy counted 18 in air near him at 630 m other day.
(Pg 24)
Land iguanas : On way to coast this morning saw two of smallest animals I've ever seen – both about 23-25 cm snout-vent length, definitely smaller than any other land iguanas I've seen here or on S Plazas. Both were a non-descript brownish-yellowish, fairly dark. [Marginal note: not spotted at all.] Both ran to holes and hid,very quietly moved and rapidly. Both seen about 120 m alt. about 0900. Both appeared to be basking in open, but only saw them for a few seconds. Unlike full-sized adults and sub-adults they ran to holes without stopping and entered them.
On return caught an adult female, 48 cm snout-vent length, and checked for ticks. What appears to be Amblyomma nymphs and a few adults found, attached in axillae, in folds of skin on sides and bottom of neck and on (Pg 25) . . . shoulder blades. Had one (large engorged tick on lower jaw, hidden by upper jaw when mouth closed. Also on calf/thigh inner joints. Only saw one attached tick in open area on body surface – one non-engorged adult on lower rear side in front of rear axilla. Ticks preserved. Also, small larval ticks crawling all over surface of the animals.
Snakes: Henning saw one Dromicus (striped) at approximately 15 m elevation on 16 Sep '74. I have seen 3 more of same species, all medium to large in size in this same area approximately 200-350 m distance inland; all three seen before 0800 or after 1600 and all active. Saw the 3, one each on following dates 15 Sep '74; 16 Sep '74; 29 Sep '74. Adsersens and Guy say they saw about ½ dozen of same species at Cape Hammond in late June – gave impression that they were very common. Henning also saw one Dromicus (spotted) in encanada wall (only front 20 cm sticking out of a hole) at 270 m elevation on 18 Sep '74.
Lava Lizards – very abundant from coast to highest I've been (650 m). (Pg 26)
20 Sep 1974
Examinng land iguanas for ticks, all animals near two craters camp at 340 m – in fact, all in area where made observations this morning of symbiosis (see notes below). Now 1415 hrs.
Adult female – 44 cm snout-vent length, has larvae, nymphs and small adults (males); most not engorged. A few engorged – distributed almost exclusively in the skin folds of those areas which are most hidden from "cleaner" birds – i.e. sides of and especially lower neck, shoulders, axillae, front sides at "elbows and knees", in cloacal opening. The heaviest concentration of ticks are in the first two and the last area. Only engorged female tick found was in cloacal opening, well hidden. All the more exposed areas, ie. sides of body,

(Pg 27) . . . dorsal body and neck surface, most of leg surface areas, ventral body areas, all surfaces of tail, were completely free of attached ticks of all sizes. There are numerous larval ticks walking around on these and all other body surfaces, but none attached except in more protected areas.
Adult male 43 cm snout-vent length; distributions and density of ticks by size classes on various parts of his body exactly as in the previous animal. As in previous one; 1) detached ticks in various hidden areas, were not dense anywhere, only scattered; 2) large engorged females (2) were found, only well-hidden inside cloacal opening.
Adult male – 44 cm snout-vent length, distribution of ticks by size classes on various body parts exactly as in the previous two animals and in those two examined on 18 and 19 Sep. Main difference is that this animal has approximately (Pg 28) . . . 3-4 x the density of larval, nymphal, and unengorged, small adult ticks attached in the hidden areas. Also, had 5 engorged adult ticks (females) inside cloacal opening. It is clear from examining these five animals that the finches and mocking birds are keeping the land iguanas well cleaned of ticks in all the open, exposed areas of the skin and even reasonably well cleaned in the more hidden areas. Engorge females are only able to develop in really non-exposed areas such as the cloacal opening and inside lower lip where ticks are completely hidden.
Henning noted today that land iguanas are apparently also grazing extensively on Sonchus and Conyza judging from the condition of most plants he has seen.
Did a complete census of (Pg. 29) this area near camp and southern most of the two craters to get an idea of land iguana density. Surveyed an area of 100 m x 75 m lying just above and t N a bit of the base of the southern crater and running over to the point where the two encanandas join above the craters. The area cuts across the open cinder-sand covered alluvial outwash dry rive bed and includes large areas covered by grasses and Cyperus, by Ipomoea alba, and scattered shrubs of Waltheria, Cordia leucophlyctis and Tournefortia and Croton scouleri. Did census between 1000-1030 hrs just as land iguanas were ending grazing activity of the morning and beginning to seek shade under the shrubs. Count: total of 17, 15 in area, 2 right on border which should be excluded.
(Pg 30) All were adult or nearly adult animals. A total of 6 males, 9 females in the “quadrat”, 1 male and 1 female on the border. Very high density!
Also took data on activity periods from 0715 to 1030 hrs and made observations on cleaning symbioses. Following notes are expanded version of shorthand notes taken earlier in temporary notebook:

A. <u>Activity periods and feeding</u>.
Sun up over rim of crate at 0700; six iguanas I watched all out of burrows between 0715-0730, taking up positions flat on soil right beside burrow entrances. Where slope permits, lie flat on it so that body is perpendicular to sun’s rays.
(Pg 31) All these became active between 0825-0840; began moving about and feeding; followed serveal (3) of them= moving aourn in Ipomoea alba mats on ground and covering low shrubs and grasses. Eating leaves, but especially concentrating on flowers. One females I watched, moved through a huge Ipomoea alba patch from 0845-1005 eating mostly flowers (see photos) and leave/stems on occasion. All 6 animals entered shade under dense shrubs or Ipomoea covered vegetation between 0945-1015 and became inactive. Stayed here until about 1500-1530 when becme actie again and sstart feeding in same area on same plant. There are other plants in the area which they are feeding on, judging from grazed condition, e.g. Alternanthereea f. filifolia, Rhynchosia

minima, Froelichia n. lanigera, Waltheria ovata, but did not see them doing so today. I. alba is (Pg. 32) very lush, green and heavily flowering and thus may be concentrating on them here. Left area at 1630, but from observations here on the 17th and 18th and near coast on 19th and today it is obvious that animals stay out basking in sunlight, lying flat on ground from 1630-1700 up until sun sets at 1800. Probably heating up for early evening hours in burrow.

Thus at this time of year daily activity pattern is composed of:

Basking: 2- 2 ½ hrs

Feeding and locomoting: 2-3 hrs

Resting in shade: 5 ½ - 6 hrs

They occasionally feed while resting in shade during 1000-1500 period, but not often. (Pg 33) Feeding on Ipomoea alba flowers very interesting how ones (some) simply eaten with one bite. Higher ones "knocked" down with front foot and then gulped down.

B. Cleaning symbioses: saw 8 instances between 0830-1000, as follows:

1. Large male land iguana basking on 20 degree slope at 0830; single mockingbird approached from side on ground, walking and hopping when was a few inches away, iguana turned head slightly toward mocker, the rose up into fully arched, fully raised cat like posture, tail curved in an arch. Held posture noticeably while "mocker" proceeded to first circle round him on ground and then walk along tail and dorsum of back up to head. "Mocker" picked and probed in all 4 axillae, and in skin folds on underside of neck and on sides of neck and on shoulder. "Mocker" (Pg 34) . . . also appeared to inspect head, around eyes, and in nostrils, and all along sides and top of body, but did not peck or probe at any of those areas. Once mocker went partly under animal and turned head sideways, appearing to inspect belly and then chest area, but not pecking / probing seen. Once mocker appeared to peck at cloacal opening. Unable to get photos because of time and distance. Observed all with field glasses. Entire sequence lasted approximately 90 seconds, from birds approach until it left. Iguana settled down about 10-15 seconds after bird departed; then continued basking in same flat position as before. No other birds participated; saw no other (Pg. 35) . . . finches or mockers in the immediate vicinity of this area.
2. Large male iguana walking along approaching an I. alba patch. Mocker flew and landed at side of head, about 10 cm away. Iguana immediately assumed fully-raised, arched posture and mocker proceeded to clean it exactly as in previous case, walking around body and along dorsal surface. Saw it peck a lot into axillae, under and sides of neck, on shoulders at cloaca, and a few times (4-5) along body sides and on dorsal surface of tail. In this sequence mocker fid not walk on hae of iguana nor appear to inspect nostrils or eyes. Mocker left after about 60-70 seconds, and iguana relaxed from motionless posture approx. 20-25 seconds after mocker left. (Pg. 36) Continued on to I. alba and began eating flowers. No other mocking birds or finches nearby and none joined in cleaning.
3. Land iguana: (large female) walking in open cinder-sand of dry river bed. Geospiza difficilis males flew and landed beside right front leg, 5-10 cm away. Land iguana immediately assumed posture; finch immediately flew onto back by shoulder and finch hopped down back and along top of tail, pecking 2-3 times at body ando ce on tail. Finch then carefully searched in axillae, around cloaca, in joints of "elbows" and "knees" (front surfaces, under (Pg 37) . . . and sides of neck and on shoulders. Spent

most time in those areas, only quickly inspecting sides and ventral surface of body while passing from front to rear axillae areas. Hopped up onto head and appeared to check around corners of mouth and around eyes, then returned to front axillae and lower neck. Bird finally left after approx. 120 seconds, and iguana relaxed after another 15-20 seconds and continued walking along. No other finches or mockingbirds involved in cleaning and none nearby. This finch flew out of shrubs about 20 m away to begin the cleaning sequence.

4. Same female land iguana continued on walking another 15 m when a G. fuliginosa female flew to it and then a cleaning session just almost exactly as described (Pg. 38) . . . under 3) occurred. Same sequences of behaviors on part of both species. (Conolophus and Geospiza ful.) as in previous case, except that this finch did not hop around at all on head, and only quickly along back and tail. Spent almost all of the 60-70 seconds of cleaning in the hidden areas (axillae, elbows, knees, neck, shoulders, cloacal area). Finch finally flew away; iguana relaxed from fully-raised motionless posture and continued walking on, after approx. 10-15 seconds after finch departed. No other finches or mockingbirds nearby or involved. (Pg. 39)
5. And 6. Almost exactly as in case #3 above. Each sequence involved one G. difficilis (both females or subadults) and two different large male land iguanas. In both cases land iguanas assumed arched – tail and back, fully-raised posture within a few seconds of the flying approach to within a few cm of the iguana's anterior end by the finch. Finches mainly cleaned in hidden areas, but also pecked a few times on dorsal body and tail surface. Head cleaned and inspected in one case, not in the other. Did not time either, but lasted approx. 60-90 seconds each, and finches left voluntarily, followed by iguanas relaxing and continuing previous activities (feeding in these 2 cases, on I. alba).
6. Included in 5 above.
7. As in previous cases, but a male G. difficilis approached walking female land iguana from rear (Pg 40) . . . and landed near rear leg. Iguana did not appear to notice it and continued walking. Finch then hopped onto body at pelvic girdle area and moved two hops forward and pecked into rear axilla. Iguana then assumed posture and cleaning sequence followed as in other cases. Lasted about 50-60 seconds, terminating when finch flew away and iguana then relaxed from posture and went on walking after another 15-20 seconds.
8. Sequences in progress. A single female or subadult G. fuliginosa seen cleaning a large female iguana in a fully-raised, motionless position. I scared iguana by approaching too close and (Pg 41) . . . it moved; finch flew and sequence ended. But 20 seconds plus or minus I saw was as in other cases and it was definitely a G. fuliginosa.

Some interesting points:

a. Sure for No. 1 above, saw no cleanings or attempted ones, or even approaches to basking or shade-resting land iguanas; almost all cases occurred with actively locomoting or feeding animals.
b. Finches and mockingbirds definitely concentrate cleaning (pecking and probing) time in those same more inaccessible areas where ticks are most abundant on the land iguanas. These areas (especially axillae) are definitely more exposed in stretched-out, fully-raised animals, as is the entire ventral surface.

21 Sep '74
Returned to coast at 1800 hrs yesterday evening. This morning (Pg 42) . . . at 0615 surveyed two areas where cormorants nest and roost. Total of 34 adults and the one recently fledge animal =35.
At 0700 checked nests – changes in conditions were:
Nest #1 – 2 eggs now
Nest #6 – 3 eggs now
Nest #8 – one of 3 eggs starting to hatch.
Nest #2 – continuing to build - about 1/2 constructed judging from other nests.

Saw 8 penguins at landing site this a.m. The went to sea by 0630-0645 and did not return by time Beagle III came for me (0900).
Lava lizards: males here at coast seem a bit larger than those in vegetated areas more incland, and (Pg 43) . . . both sexes are very dark charcoal grey (almost black) all over body, here at coast. Those inland are much lighter and have the normal T. albemarlensis coloration pattern. These dark grey- blackish lizards at coast are living on bare lave right at coast with sno vegetation present. They appear to feed mainly on flies and other insects which they snap up by moving around very near and on and over the bodies of marine iguanas, sea lions, and fur seals. They also "hand around" cormorant nests and regurgitated food and feces of these same 4 species where they also are able to catch the abundant flies and other insects available. The especially spend time around and on the heads of marine iguanas, fur seals (Pg 44) . . . and sea lions where flies are abundant.
Hawks – Lava lizards: Yesterday and day before saw two cases of adult hawks preying upon lava lizards:

1) Adult hawk flew over our 340 m alt base camp at approx.. noon carrying a large male lave lizard in one foot.
2) Saw an adult hawk drop down and grab a large male lava lizard with one foot and then bite its neck with the beak – at about 200 m elevation.

End of notebook.

Other Animals
Field notebook of Craig MacFarland

(Pg. 1)
12 Oct 1969 – Spent the day watching rails- First, the following concerns a nest which is probably that of Laterallus spilonotus but could be Nesocrex.
The nest with 5 eggs and a female was first found just beside the trail (Caseta – Zone 3) about 300 m below Caseta Pond #1 by O. Chappy on 23 Sep 1969 or thereabouts (he forgets the exact date but this is approximately correct).
Then on 9 Oct 1969 Julio San Miguel told us he had seen this nest on that day but that no young were yet present.
On 10 Oct 1969 Jan visited the nest with Julio at 1000 hrs and found one hatched chick which was lying immobile in the nest. The chick was covered with black down. The female was present but moved off about 1-1.5 m into some tall grass and remained there moving about from time to time while the people were in the area. No wanting to disturb her on the nest any more they left quickly with getting a better look at things.
I quizzed O. Chappy and Jan independently about the identity of the ♀ and both describe as being black or at least very dark in color with a rather bright red eye. This at first made me think it was a Nesocrex because Oswaldo knows that there are 2 rail species of similar size and that Laterallyus spilonotus has a (Pg. 2) deep brown back and small white spots on the back and rear upper surface. He was able to describe this species and the "pachay negro" (=Nesocrex) as separate species without any coaching from me. He thinks that this female and nest are Nesocrex.
However Jan and I have since seen a number of Laterallus and have found that some adults have only very faint or virtually invisible white spots and that the brown area on the back can be so dark as to blend in almost imperceptibly with the dark gray of the body. Even animals with a clear brown area with white spots can appear all dark if the light is just right and when they are moving along the grown under the vegetation (even at normal speeds) used in searching for food) these markings are very hard to see. As a result, Jan is unwilling to say that the ♀ was not a Laterrallus and especially since she only saw (Pg. 3) it flitting about under the thick grass we think it could have in fact been that species. On 12 Oct 1969 (at 0900) Jan and I returned to the nest and found that only one egg remained and that fragments of from 1-several were lying beneath the nest on the ground. The female was nowhere in sight and there were no chicks present.
We took photographs of the nest and one egg by bending back some of the vegetation (Roll #21) and then recovered the nest. We returned this afternoon and re-checked the nest (1300 hrs) but no ♀ still and the nest was just as we had left it. The egg looks exactly like those of the Laterallus spilonotus nest I saw last year (see Book #1) and seems to be of a similar size. It is a pale off-white or light cream in color with small flecks and blotches of a dark red- brown scattered over the surface. All this suggests that 3 more of the eggs hatched since the morning of 10 Oct and that the 4 young and the ♀(plus ♂probably) have left. There is absolutely no disturbance in the area and no sign that any young were killed or eggs destroyed. The nest is entirely intact also.
The nest is constructed of a mass of the common grass in the area plus a thin-leaved sedge, in about equal proportions. The strands of plant material are simply bent into a ¾ circular form, making sort of a cup which is turned up on its side but is more solid below

on the ground, being a bit open at the top. This (Pg. 4) is all built down in and under the general grass and sedge cover in the area which is 1-2 dm tall. This latter living plant material forms a very effective cover over the nest and all around it so that the nest is virtually impossible to see from any angle – indeed it was discovered (as mine of last year) only be seeing the ♀ flee the nest when approached. Note that the plant material which makes up the nest proper is also alive. Anyway we have good photos of the nest and area so that it can be described mover fully.
Although well hidden, the nest was certainly in such an area that it is very likely that tortoises may crush one once in awhile.
Secondly we discovered a family of rail in a low area surrounded by manzanillos just 75 m W of the big pond (Caseta #1). The area has a little colleted water in one small hole and another low area with mud in it. The group of birds was foraging in (Pg. 5) 3 clumps of vegetation which stood about 0.5 m high and surrounded these 2 little low spots. The clumps were about 1 m in diameter and mover or less circular to square in shape and were composed almost entirely of Plant #1.
This was definitely Laterallus spilonotus and the group consisted of 2 adults, (indistinguishable, but presumably 1 ♂ and 1 ♀) and 3 very recently hatched chicks. The chicks were covered completely with fuzzy black down and locomoted in a very stumbling bumbling manner with the stubby little wings held out at their sides. These chicks were so tiny that they looked just a few days old at most and as if they well could have just come out of the Laterallus sized eggs I have seen.
Jan got some photos of the adults with and without the chicks and one of me holding a chick in my palm - Roll #21.
Since could not sex the adults, will call them #1 (probably ♀) and #2 (thus probably the ♂). We watched them forage in this area for about 1.5 hr. The primary technique was that #2 would go off in search of food in other clumps (away from the one in which #1 and the chicks were located) for 3-5 minutes at a time (Pg. 6) but never going further than about 6 m in a straight line; #1 and the chicks would remain more or les in about the same spot where #2 left them, most sort of standing there, but with #1 foraging and a little now then in the very immediate area. #2 would then return, usually with a food morsel and literally give this to #1 who in turn would either hold it in her beak down near the ground for the chicks or sometimes even drop it on the ground for them – the chicks then would pick the item to pieces, most of which they appeared to get down their gullets. Once I saw the adult #1, eat the time after letting the chicks peck at it only a small while, but this was the exception I think.
At times while #2 was gone, the other adult would find an item and catch it and put in on the (Pg. 7) ground for the chicks to devour.
Occasionally it appeared that #2 returned without a food item after a particularly lengthy (508 min) absence and simply checked on the presence of the group and then would take off again after simply approaching the group and looking them over.
Sometimes while #2 was gone the other adult and chicks would wander off, away from where he had left them, up to 0.5–1 m at times. On these occasions he still returned to the position where they were last left and immediately upon not discovering them he would make a single or occasionally 2-3 sharp, short clucking noises which the ♀ immediately answered with the same sound. He then immediately found them by what appeared to be this auditory location mechanism. His behavior was interesting in that he

seemed to have a very good sense of direction, being able to wander off a number of meters, taking circuitous routes through 2 or more of the vegetation lumps yet always returning right to the last spot where the family had been when he left. This latter position changed frequently also, so he was not simply zeroing in on one known spots. Sometimes when he approached the ♀ and chicks he would give one of the clucking sounds anyway even though they were in full view and vice versa. The ♀ would likewise (Pg. 8) answer – this , however, did not occur every time, except when the group had wandered off.

When #2 returned and gave the food item to #1 the chicks would immediately begin a cheeping racket as they crowded around to be fed.

Also, occasionally a chick would wander off a decimeter or 2 away from the♀ and while doing so she would appear to let the young one go without missing it, but finally would give a little clucking sound which they chick would answer with a peep and then the chick would turn around and rejoin the others and the ♀. On the whole, however, the chicks stayed very close around #1 at almost all times - when #1 was moving quickly through the brush they trailed along single file close behind, stumbling along and crashing into grass (Pg. 9) blades and other small bits of vegetation. They are very uncoordinated looking but genuinely precocious.

In all we estimated that the male was averaging about 1 food time for the group about every 4 min during the hour and a half. We saw 3 of the items in specific. -1 spider, 1 Lepidopteran larvae, 1 moth. We never saw him eat any of the morsels which he brought the group, but, of course, he could have been feeding while off on forays.

I only saw the ♀ provide 2 items definitely – one caught on ground and one by jumping onto a twig. However this is no statistical sample as could not see her clearly most of the time.

All the animals spend virtually all the time under some vegetative cover, coming into the open only briefly and then frantically (frenetically?). This also provides shade for they were doing much of this while the solar input was quite strong (1100-1230). The ♂ was particularly cautious and never stayed in the open long. Once for about 15 min the ♀ and chicks were at the edge of the vegetation on a little cleared area of very low grass (1 cm) in the sun. During this time the chicks were crowding around underneath here and up under her slightly spread wings. Thus surely offered some protection from the sun, but they were also (Pg. 10) seen doing this often while in full shade when the group of 4 were stopped some place and it thus may simply be a reaction which keeps the group close together.

We wondered if the adults ever reversed roles, but on only one occasion did the returning animal (#2) clearly feed the young and the other take off in search of food – however, even this time the ♀, #1 only foraged about 2-3 dm away and then returned quickly, apparently without a food item – the ♂, #2 quickly took off again, foraging, just after she returned to the chicks. However, we did not see all the cases of his returning and thus do not know if more exchanges took place – saw at least 1 dozen cases in which no exchange occurred. Finally, the animals do no t seem prone to fly at all (Pg. 11) even when disturbed at least not when they have chicks. When I caught the one young one, the adults kicked up a fuss by clucking but rapidly moved off – the ♂ going away rapidly in one direction and the ♀ leading the 3 other chicks off at about a 30˚ direction to his departure. After quickly photographing the chick we placed it on the ground abut 2-3 dm

from the ♀ and 2 chicks at which time it cheeped and she clucked and then it headed straight for the other chicks and the ♀. The ♂ had by this time come back near the others and in the resulting confusion I think (and hope) the captured chick went away with him and the ♀ then followed with the other 2. At no time did either adult attempt to fly. We made all these observations from only 2 m away without binoculars and the animals seem very relaxed as long as one does not move rapidly or talk above normal sound levels.
14 Oct 1969 – Re-checked nest of 12 Oct nest – no ♀ and nest exactly as before. Therefore collected the egg for the CDRS collection. It measures about 2.9 cm long xx 2.2 cm wide. (Pg. 12)
18 Oct 1969 – Counted about 35 Galapagos pintail ducks and 15 gallinules on the large pond below the Caseta this evening.
On 5 Sep 1969 there were 55 ducks and about the same number of gallinules. Also, tonight there was a little green heron feeding along the bank of the pond and out into the water about 20 m also. On 5 Sep 1969 saw a great blue heron feeding in the center of this pond at dusk- have photos of this.

[Rest of notebook blank]

Ticks and Mite collections from Reptiles in Galapagos, other than Geochelone elephantopus (tortoises). Some accounts in tortoise notebooks, but most within this volume.

Field notebook of Craig MacFarland
(Pg. 1)

18 August 1971 – Isla Santa Cruz, Darwin Station.
Going to examine Tropidurus albemarlensis near CDRS today and collect ticks and mites from them. All the following animals were caught on grounds of Charles Darwin Research Station, Academy Bay, Isla Santa Cruz and carefully examined for ectoparasites. All collections from each lizard placed in a single bottle of 70% ethanol and kept separate.
Lizards examined and results:
Every lizard examined had the same 2 types of ectoparasites, both probably mites:

1) an oval-shaped, medium grey colored one.
2) Small oblong-shaped, bright red-orange to orange colored ones.

The former were scattered all over the body from the forelegs to the first 1/3 +/- of the tail; they lie neatly up under the scales so that they are often not visible or only slightly visible from directly above. They were most common on the main trunk of the animals, especially along the sides and central trunk, but also occurred dorsally. Some few were found on the neck and forelegs of each (Pg. 2) . . . lizard; they were again relatively common on the rear legs and on the tail on all sides.
The latter were scattered all over the body, from the neck and the first 1/3 of the tail; on some individuals they occurred in dense clumps of 5-10 on the sides of the neck; otherwise they were under the scales in 1's to 3's but mostly singly or in 2's all over the body. Only rarely were the two types of parasites found side by side under the same scute. The red-orange ones were clearly attached; the oval, grey ones were either unattached or only slightly so and could be moved out from under a scutes simply by pushing them lightly with a pair of forceps (one prong).
Mites collected from following individuals (both types except where indicated):

♀ adult	6.9 cm snout-vent length
♂ adult	8.3 cm
♂ adult	7.87 cm
♀ adult	6.9 cm
♀ adult	6.87 cm
Juvenile	5.0 cm – oval grey type only.
Subadult +/-	5.74 cm – oval grey type only.

Both juvenile and subadult had red-orange type also.
(Pg. 3)
I also examined the following lizards, all of which also had the same 2 mite species, but did not collect parasites; distribution of mites on these as in above individuals.

5 ♂ adults	snout-vent lengths of 7.81, 7.72, 8.30, 8.40, 8.62 cm
2 ♀ adults	snout-vent lengths of 6.71 and 6.72 cm.
1 subadult	snout-vent length of 5.90 cm.
1 juvenile	snout-vent length of 4.87 cm.

Interesting that only rarely noted either parasite on long, thin rear 2/3's of tail of lizards – they do occur there but in very reduced numbers – perhaps associated with habit of tail excision by these lizards.
Some individual lizards had more of the parasites than others but same distribution noted on all of them. Occasionally adult ♂♂ and ♀♀ had more than smaller lizards but one of juveniles also was heavily infested. Largest specimens of both parasites on adult ♂♂ and ♀♀ (lizards).
(Pg. 4)
19 August 1971.
Examining Amblyrhynchus cristatus for ectoparasites today. All caught on grounds of CDRS near shore, Academy Bay, Isla Santa Cruz. Collections from each iguana kept separately in 70% ethanol in small bottles.
Found 3 types of ectoparasites on all iguanas examined – their rough descriptions and distributions:

1) small bright red-orange to paler orange – same size and rough appearance as those of same color from Tropidurus albemarlensis here. Scattered over body in general but only occasional except in certain areas. These areas of density – axillae and around it, forearm, shoulder, neck on sides and forward onto head; they occur occasionally around eyes, in rear leg axillae; along sites of trunk; almost never on tail and none seen on ventral surfaces. Down in between points of scutes, attached to skin but easily pried loose. (Pg.5)
2) small darkish black-red species of tick – probably Ornithodorus; attached in between points of cutes very strongly; impossible to extract by simply pulling with tweezers with damaging them severely; easiest method is to dig them out of skin from site of attachment point. Seen exclusively on 1) sides and dorso-laterally on neck, also 2) ventro-laterally on neck; on shoulder and dorsally a bit from it on front [of shoulder]. Saw none on venter, rear or foreleg axillae, tail, around eyes, dorsum much back of foreleg area. Well embedded and certainly not easy prey for finches except when moving freely around on lizards (uncommon to see this).
3) Black ticks of all sizes from very tiny to large swollen adults – undoubtedly Amblyomma. Scattered virtually all over body but commonest in following areas:
    a) Shoulder and skin above it.
    b) Sides and dorsolaterally and ventrolaterally (Pg. 6) . . . on neck.
    c) Between dorsal spiny scutes at their bases.
    d) Axillae forward and aft and surround skin.
    e) Inner sides of upper legs, i.e. facing axillae.
    f) Between toes on fore and rear feet- at very bases.
    g) Ventral surfaces, mainly just before cloaca but all over it.

    By far commonest areas are: a, b, d and f.

Could see no ticks or mites in nostrils, but difficult to see. Some additionally interesting observations about these ticks: Those on areas a and b, almost exclusively very black and very tiniest stages (larval) , mostly unengorged ones. Some of these tiny ones are engorged but not commonly in these areas. These tiniest ones also occur scattered over rest of body and in areas c, d, e, and f where a higher percentage of them are engorged,

although most are still unengorged. Larger ones, and especially engorged ones are more restricted - almost all of them occur in areas c, d, e, f, and rear of ventral surface near cloaca. Saw virtually no engorged (Pg. 7) . . . large ones in more open areas of body surface where other 2 tick species and small larval Amblyomma occur. Some of unengorged larger ones occur scattered over open body surfaces but not many of them – they are also more prominent in more hidden areas.
This is of great interest because Peter Kramer and I have both noted Geospiza fuliginosa cleaning ticks from the marine iguanas on coast near and E of CDRS dining room recently, i.e. exactly area where examined iguanas today. These distributions of ticks as to size and engorgement area not absolute but are proportionally what one would expect where finch grooming is common.
I still need to make more detailed observations on this behavioral mutualism of the finches and marine iguanas to determine if marine iguanas respond to finches at all. (Pg. 8)
Iguanas examined – did not successfully collect all 3 ectoparasites from all of them but each had all 3 types as described and distributed as noted above. Amblyomma type from all.

Sex	Snout-vent length (to nearest 0.5 cm)
♀?	28
♂	38
♀?	26.5
♂	39.5
♀?	29
♂	35

Collections of ticks and mites made by Dagmar Werner from marine iguanas on Hood Island, 21-22 August 1971. She carefully examined 6 live Amblyrhynchus cristatus v., checking all over bodies, in other nostrils, and around and just inside anal, or rather, cloacal opening. She noted the same 3 types described in my notes above from Santa Cruz marine iguanas. I questioned her closely without prejudicing her and found that the 3 ticks/mite species were distributed virtually exactly (according to engorgement and size also) as on Santa Cruz specimens of the iguanas. She especially noted (Pg. 9) . . . that swollen, engorged medium to large Amblyomma were all in well hidden areas such as

1) ventral surface far in rear just in front of tail/trunk juncture
2) in between toes
3) in skin folds of "knee", i.e. juncture of upper and lower parts of legs,
4) to a lesser extent in axillae.

In some of the animals examined she could find not ticks or mites (obvious ones anyway) inside nostrils or inside cloacal opening. However, some had them in these places (see below) and those from nostrils look as if they may be a new species (or perhaps Ornithodorus adults?). She has never spent much time at any one sitting in all her some 60 days plus on Hood watching groups of marine iguanas to see if Geospiza fuliginosa or mocking birds clean them regularly. In fact she has never witnessed this activity at all, nor has Mike Harris, but both admit that they have not really sat and waited to see if the behavior occurred ever - thus one can not conclude much about (Pg. 10) . . . its frequency

on Hood. In late July, 1971, I spent several hours on 2 different days at Punta Suarez photographing marine iguanas and working among them and along shores where they occur and I also never saw the behavior; in fact I never even saw a G. fuliginosa light at coast, but only back from it in more brushy areas; thus perhaps the behavior is not as common on Hood as perhaps at Academy Bay (Santa Cruz) and at Punta Espinosa (Fernandina), although the actual frequency of it has never really been determined in either of the latter 2 sites.

The collections she made were all at Punta Suarez, on 21 and 22 August 1971, and there are 2 collection bottles per iguana in 3 cases, and 1 bottle per iguana in the 3 other cases. The details of these collections are as follows:

(Pg. 11)

	Date	snout-vent & sex	Collections	Special Comments
	21 Aug 1971	~35 cm, ♂ prob.	1 bottle	Ticks and mites from skin folds of axillae of forelegs
	21 Aug. 1971	35-40 cm, ♂	2 bottles	1) from axillae of forelegs and folds of skin on sides of neck 2) other bottle with 1 tick from just inside nostril.
	21 Aug. 1971	~ 30 cm; ♀	2 bottles	1) 1 tick from nostril – just inside 2) mites & ticks from neck, shoulder region & around anal opening (1 large Amblyomma)
	22 Aug. 1971	36 cm; ♂	2 bottles	1) 1 tick from just inside nostril 2) mites & ticks from skin folds of neck; large engorged ones from ?
	22 Aug. 1971	33 cm; ♀	1 bottle	Ticks & mites from dorsal shoulder & anterior back; three huge ones from front “knee” joint.
22 Aug 1971	22 Aug. 1971	25 cm; ♀ prob.	1 bottle	Mites and ticks from neck and arms; large one from posterior belly.

(Pg. 12)
1 Sept. 1971. R. Bradley Jacobs, Pease Corps volunteer studying Pterodroma and working at CDRS collected ticks and mites from Tropidurus delanonis and Amblyrhynchus cristatus on Hood Island at Punta Suarez in a different area than where Dagmar Werner collected. He found same 3 species on marine iguana as Dagmar noted and his description of their distributions by type or species, size class, and degree of engorgement agreed with hers (independent, they had not discussed it). He also found same two types of mites on lava lizards as I noted on Santa Cruz with similar distributions on the lizards. Also, on 1 of the lizards he found 1 tick on dorsal midline of a ♂ attached at base of an upright scales (spiny scale of crest) – perhaps an Ornithodorus larvae.
His collections were as follows: note that he did not look in anus or nostrils of either species.
Tropidurus delanonsis – from 3 adult ♀♀ and 1 adult ♂ - each collection in a separate bottle.

Amblyrhynchus cristatus - from 8 individuals, each collection in a separate bottle. Size as follows: (sex not determined).
1 – 18 inches
1 – 10
1 – 30
1 – 12
1 – 12
1 – 12
1 – 36
1 – 20
(Sizes are snout to tail tip).

He also caught and examined 10 snakes (Dromicus hoodensis) at Punta Suarez and carefully examined them for ectoparasites (not possible to look into nostrils except at very edges) but found none on any of them. Snakes varied in size from small to medium-large ones.

Dagmar Werner collected ticks and mites from marine iguanas and lava lizards on James Island, at Buccaneer Bay on 4-5 Sept. 1971.
Amblyrhynchus cristatus – collected from 3 live individuals.

Date	Sex and size
5 Sept 1971	♀; 22 cm snout-vent
5 Sept 1971	♀ prob.; 20.5 cm
5 Sept 1971	♂; 25 cm

Could find no ectoparasites in cloacal or nostril openings. They appeared to have same types of ectoparasites, 1 tick, 1 mite as those on (Pg. 14) . . . Santa Cruz and Hood. She saw none of Ornithodorus type on them.

Tropidurus albemarlensis – collected from 4 live individuals.

4 Sept. 1971 ♂; 9.2 cm snout-vent. No mites; ticks from back and between toes – probably Ornithodorus and Amblyomma.
4 Sept. 1971 young ♀; 5.7 cm snout-vent. 1 or 2 mites from back.
4 Sept. 1971 ♀; 6.7 cm snout-vent. Ticks from back.
4 Sept. 1971 ♀; 6.5 cm snout-vent. Mites from back and hind leg.

Tropidurus had only red mites, distributed mainly on neck, axillae and shoulder region and a species of tick under the scales, especially on the back, between toes, etc. She could not find any of oval–shaped anterior-posteriorly shortened mites as found on Hood and Santa Cruz lava lizards. The tick species remain to be identified.

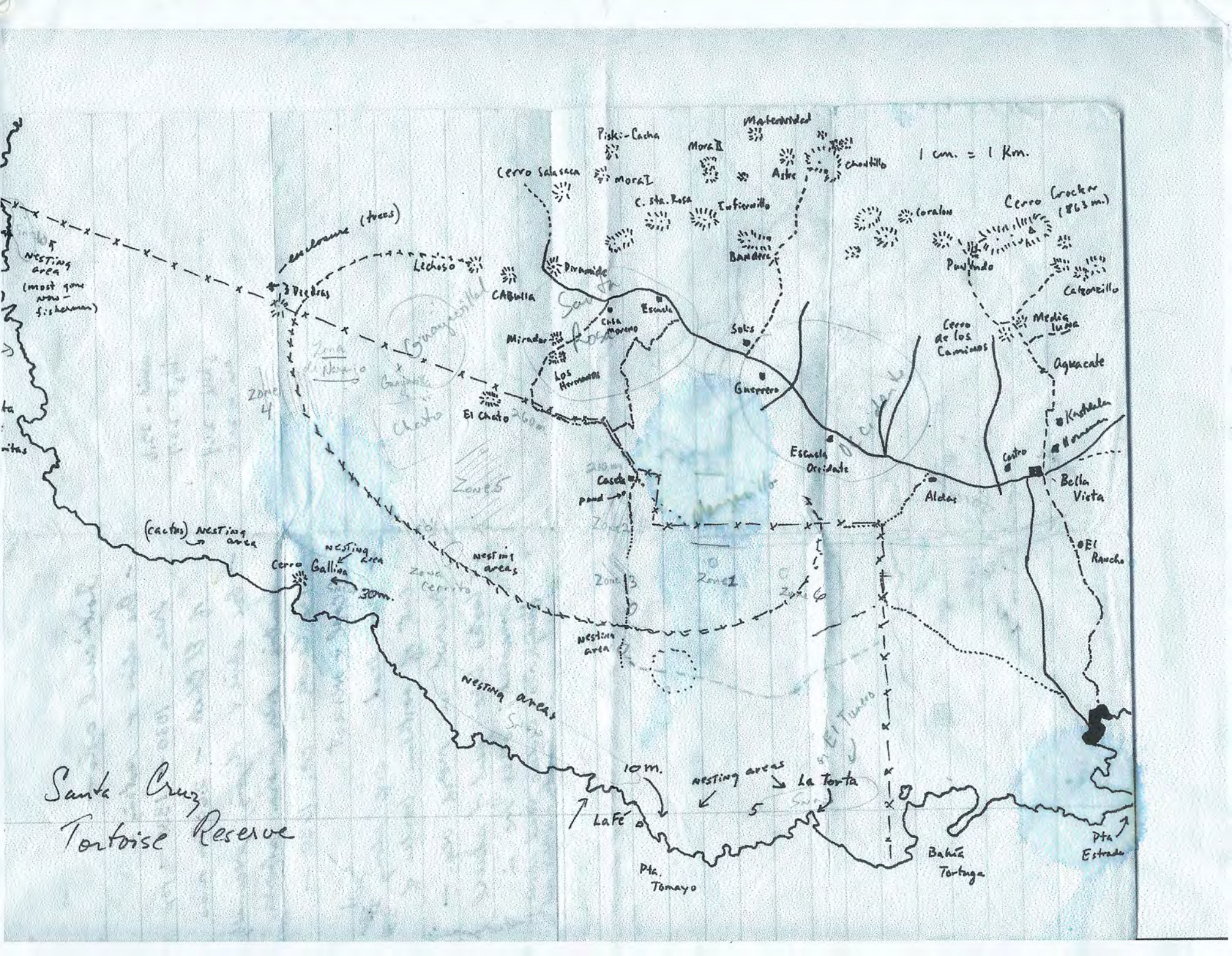
Marine iguanas – she could not find any of small brownish-reddish Ornithodorus larvae on the marine iguanas at all. Seemed to be ticks of Amblyomma type and tiny red mites only on them. She found one inside cloacal opening and none in nostrils but admits the (Pg. 15) . . . latter were hard to examine carefully. Red mites were not present in large numbers and were distributed mainly on neck, shoulder, and front axillae. Amblyomma types: larger and engorged medium to large ones found only between toes. In knee joints, in hidden parts of axillae and on belly just in front of vent. Smaller and inconspicuous ones on neck, shoulder, axillae, dorsum and more generally distributed. She saw no finches or mocking birds cleaning marine iguanas but she was not in the area long and iguanas were extremely dispersed, almost rare in fact. Found only some dozen along 500 meters of shoreline.

I collected ticks and mites from 1 land iguana and 3 marine iguanas on the N side of Volcan Wolf. The marine iguanas were out on a point at W end of Bahia Roca (Piedra) Blanca, i.e. a small half-rectangular bay just W of old U.S. Radar sites near Punta Albemarle., Isabela. I examined 6 iguanas and collected mites and ticks from 3 of them. All had the same 3 types of species as on Santa Cruz, Hood, and James Island individuals: 2 ticks (Amblyomma and Ornithodorus) and 1 type of tiny red mites. The distribution of these 3 types, including according to size and state of engorgement, was essentially (Pg. 16) . . . the same as I noted for Santa Cruz collections; main exception being that they had far less of the Amblyomma type, especially engorged and large ones, than on Santa Cruz marine iguanas. The larger and more engorged ones occurred only in the most hidden areas. This suggests that Geospiza fuliginosa or even other Geopsizids and or mocking birds are cleaning the iguanas here. Although we saw none of this activity actually happening, probably mainly because we were only out on coast about 1 hour in all, there were abundant G. fuliginosa (saw ~15-20) and about 6-8 mockingbirds along the 100 m stretch of coast where these iguanas and some 15-20 more marine iguanas were living.
Marine iguanas examined: all on 11 Sept 1971.

1) ♂; 52 cm snout-vent; ticks and mites collected.
2) ?; 34 cm; ticks and mites collected.
3) ?; 32 cm; ticks and mites collected.
4) ♂; 49.5 cm; no ticks and mites collected.
5) ♂; 54 cm; no ticks and mites collected.
6) ?; 28 cm; no ticks and mites collected.

(Pg. 17)
On Sep 1971 caught a 49 cm snout-vent ♀ Conolophus subcristatus and collected ticks – for description of this see Volume12 of Volcan Wolf/Volcan Darwin notes. Very abundant ticks.

End of notebook.


Santa Cruz
Tortoise Reserve
1 cm. = 1 Km.
Maternidad
Piski-Cacha
Mora II
Mora I
Cerro Salasaca
Asbe
Cerro Crocker (863 m.)
C. sta. Rosa
Coralon
Bandera
Pavinado
Lechoso
Piramide
CABulla
Escuela
Casa moreno
Mirador
Los Hermanos
Solis
Guerrero
Cerro de los Caminos
Media luna
Aguacate
Caramillo
El Chato
Escuela Orrichate
Centro
Bella Vista
Aldas
El Rancho
Cascada
pond
(cactus) nesting area
nesting area
Cerro Gallina
30m.
nesting areas
nesting area
nesting areas
10m.
nesting areas
La Torta
La Fé
Pta. Tomayo
Bahía Tortuga
Pta Estrada
3 Piedras
enclosure (trees)
NESTING area (most gone now - fisherman)
Zone 4
Zone 5
Zone 2
Zone 3
Zone 1
Zone 6