

3 of 3 FFS



U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Fisheries Center Honolulu Laboratory
2570 Dole St. • Honolulu, Hawaii 96822-2396

September 30, 1988 F/SWC2:GHB

MEMORANDUM FOR: William G. Gilmartin
FROM: George H. Balazs
SUBJECT: Cooperative NMFS/FWS tagging study of green turtles at French Frigate Shoals

As we discussed, I am providing you with a written summary of information gathered from my "debriefing sessions" with personnel returning from turtle-related fieldwork at French Frigate Shoals (FFS). The objectives of these interviews were (1) to determine if pertinent research goals, as outlined in the draft recovery plan, had been achieved in concordance with the on-site training I provided; and (2) to identify and better understand personnel problems impeding the harmonious accomplishment of those research goals. Briefly, my findings are as follows. We can discuss them in greater detail at your convenience.

(1) Census and tag recovery data for turtles nesting at East Island were successfully obtained for 101 consecutive nights. I have recently edited this information and made it available to Jerry Wetherall for use in our population model for East Island. This represents the 16th year that data have been systematically collected at East Island to ascertain population trends. It is also the first year that FWS personnel have taken an active involvement in the work.

(2) The nest productivity study initiated by FWS this year was expanded from Tern Island to also include East and Whale-Skate following my departure from FFS. This expansion caused significantly greater pressure on the turtles (and other wildlife), as well as on personnel who were, in my opinion, asked to extend themselves beyond reasonable psychological and physical limits. This expanded study contrasted with the instructions I had given while at FFS. Furthermore, the fact that this expansion had occurred was not made known to me until late in the study period. This is in spite of the fact that I was in regular radio contact with Tern Island to answer any questions and ensure the project was staying on track.

(3) The campsite that was established on Whale-Skate in late May, with my instructions to monitor turtles not more than 2-3 nights a week, ended up being almost continuously staffed throughout the study period. This expanded effort resulted in increased pressure on turtles and other wildlife, as well as on personnel. Personnel stress was also exacerbated by inadequacies of the Whale-Skate camp (i.e., no cooking facilities, no refrigerator, inadequate conditions for daytime sleeping).



(4) Communication and coordination among personnel at FFS was less than adequate. This resulted in part from personnel receiving modified instructions after my departure, and their uncertainty as to who had ultimate authority over research methodology. Although I made it absolutely clear during training that I held such responsibility, it is easy to understand personnel's uncertainty because (a) FWS policy stipulates that the Refuge Manager holds the highest authority on the FFS refuge; (b) some personnel were directly employed by FWS, while others were employed or were formal volunteers for NMFS; (c) FWS stated it had its "own" turtle research project, separate from the cooperative NMFS-FWS effort I had been sent up to institute; and (d) the assigned on-site FWS turtle-study coordinator that I had trained (Holly Feifeld) decided to terminate her employment and leave FFS during the early portion of the study.

(5) A more comprehensive process of screening was needed for all personnel in order to determine individual strengths and weaknesses prior to being assigned to FFS for the isolated stressful nighttime work with turtles. This applies equally to both FWS and NMFS personnel, volunteer and full-time employees alike. For the future, two basic elements are proposed: (a) A physical examination at the Employee Health Clinic similar to the annual scuba certification health exam; and (b) a screening/evaluation session with a clinical psychologist or psychiatrist, which may possibly also be available at the Employee Health Clinic.

(6) The excavation of nests by FWS personnel to determine productivity has been taking place sooner than is advisable. Live healthy hatchlings have been excavated that would otherwise have emerged on their own in a natural unaltered manner. A verbal message has been relayed to FWS asking that at least 3 days be allowed to pass after the initial emergence of hatchlings prior to excavation. The routine penning of hatchlings at the nest site is also an unwarranted practice that has apparently been recently instituted by FWS as part of their nest productivity study.

The most important point to consider in all of the above may be one of "research philosophy" on threatened and endangered species. Is research that expands to become increasingly more intense, intrusive, and/or comprehensive a desirable effort highly correlated to more rapid recovery and successful management of a species? Is "more" always "better" when it comes to endangered species research? I would argue that it is most definitely not, and that a point of rapidly diminishing "research returns" can be quickly reached. Beyond that optimum-yield inflection point there is the very real likelihood of causing more harm than the "good" (worth of data) that is accomplished. Unwarranted adverse impacts to the species and

its habitat can result, as well as work overload to personnel causing excessive stress, burnout and greater chance of physical injury.

The challenge here is to convey these reasonable ideas to FWS in such a way as to not discourage their fledgling participation in the seasonal monitoring effort. I wouldn't want the engine to stall again after taking so long to get started.

cc: J. Wetherall

VOLUNTEER INFORMATION PACKET

Aloha! We welcome your interest in Tern Island and the Hawaiian Islands National Wildlife Refuge! To make your stay as enjoyable as possible, please read the information contained in this packet. This packet is designed to help you prepare for your stay on Tern Island. It does not cover everything, so please feel free to ask questions.

Tern is a 37 acre island located in French Frigate Shoals, a unit of the Hawaiian Islands National Wildlife Refuge. French Frigate Shoals is located approximately 500 miles NW of Honolulu, a little less than half the distance between the main Hawaiian Islands and Midway. Tern Island was a Coast Guard LORAN (Long RANG Navigation) facility until 1979. The U.S. Fish and Wildlife Service (USFWS) has been managing the Tern Island field station since 1979. The Island consists of large barracks, a number of outer buildings, a 3000' runway, coral/sand beaches, and areas comprised of shrub, grass, and forb cover. Tern Island is visited year round by a number of researchers, volunteers, and administrators. At the present time there are two permanent USFWS employees stationed on the Island.

In late 1987, the USFWS converted the entire power system at Tern Island from diesel generated power (110 V. AC) to solar power (12 V. DC). It is important to keep this in mind when planning your stay on Tern. Some specific considerations will be covered under separate sections of this text.

BEFORE REPORTING TO HONOLULU:

~~If at all possible, check with the USFWS Honolulu office several days before your scheduled flight to see if there have been any last minute changes in the flight date. At this time you should also reconfirm your room arrangements.~~

~~The flight schedule is often changed for a number of reasons, so it is a good idea to have an open return ticket for your flight back to the mainland.~~

BEFORE REPORTING TO TERN ISLAND:

It is very important to determine when you received your last tetanus booster and get one if necessary. ~~It is also a good idea to leave some cash in the Honolulu office in case you need some personal items picked up for you while you are on Tern.~~

WHAT TO BRING:

The key phrase here is, "Travel Light". There are load restrictions on the planes that service Tern Island. Be sure and check with the Honolulu office to find out what the current weight limitations are. The USFWS will provide most of what you will need, other than personal items. This includes bedding, first aid and medical supplies (other than personal prescription medications), sunscreen, raingear, work gloves, food, cookware, dishes, eating utensils, binoculars, spotting scopes, office supplies, toilet paper, soap for washing clothes and dishes, and reference books (including bird books). In addition, there is a small library of "popular" literature - novels, westerns, science fiction, classics, etc. Bring a few reading type books along, ~~but keep in mind that books will eat up a lot of your weight allowance.~~

The following list of personal items will help with planning what to bring, but it is far from complete:

Snorkeling gear	2 pair sunglasses
Extra prescription glasses/contacts	Hats
Contact solution to last thru stay	Camera/film/polarizing filter / camera battery
Stamps/envelopes/cards/stationery	Bathroom items/toiletries
2 pair sandals w/hard, thick soles	Prescription medicine
2 pair old sneakers	Reading lights (batter power)
Clothes to last 2 weeks between wash	Music...radio/tape player, etc.
Watch and alarm clock (windup or batt.)	Batteries for everything
Alcoholic beverages	Fishing Gear
Towels, washcloths	FAVORITE "snacks"
	For turning - boots
	* tick repellent (NIMES supplied)

Remember, all personal electrical devices must be self-powered (battery or solar); because there is limited receptacle access to the Tern Island solar supply system.

Bring old clothes and expect them to be well worn, stained and smelly when you leave (occupational hazards such as bird whitewash, sweat, gas and oil). It is a good idea to bring some long-sleeved shirts and long pants. It can get cold on the flight up to Tern, plus it can get rather cool during the winter months.

WORK:

~~Please refer to the volunteer position description for specific duties. In general, your work will be varied. You will primarily assist the refuge managers and biologists stationed on Tern Island. You will assist with on-going biological studies on seabirds, sea turtles and monk seals. You will also assist with general maintenance and operational activities. You may also assist on projects on other islands as needed. There are also opportunities for personal interest research projects at the discretion of the refuge managers. We tend to work some long days as conditions warrant, but we make up for it in recreation time.~~

ACCOMMODATIONS:

You will be staying in one wing of the former Coast Guard barracks. Your room will be furnished with one single bed, a dresser, desk and chair. There is a community bathroom in this wing with toilets and a shower. There is no bathtub. Please remember to clean your room, the hallway, and the bathroom before you leave.

Kitchen

There is one large community kitchen with a large and varied assortment of cooking implements and utensils. There is one gas range with an oven, and several small refrigerators and freezers. Space for storage of fresh food items is limited.

Laundry

There is one washing machine in the barracks. It runs on 110V. AC and will be available for use on weekends. At this time we will be operating the old generators for maintenance purposes. Please plan accordingly. There is a clothesline in the courtyard for drying your wash. Please remember to wash your bedding and towels before leaving.

Recreation

The following items are usually available for use:

Ping Pong Table	Library
Precor 720 Exercise Machine	Pool Table
Weight Bench and Weights (old)	VCR & Movies

There are countless other opportunities for recreational activities. The runway is a good jogging surface. There are excellent opportunities for photography (please check with the Honolulu office on the current regulations regarding disposition of photographs taken on National Wildlife Refuges). We also do a lot of snorkeling. If you have any hobbies, plan on bringing adequate supplies.

PROVISION OF SUPPLIES/OUTSIDE COMMUNICATIONS:

Flights are scheduled as needed. On average, they will occur every 6 weeks. The flights will be your main source of fresh food and mail, as well as supplies required for work. In addition, we occasionally are able to arrange deliveries through fishing, research, and Coast Guard vessels.

Name
USFWS - Tern Island
P.O. Box 50167
Honolulu, HI 96850

We contact the Honolulu office 3 times a week via radio. We can contact them at other times as well. The Honolulu office can relay messages to you and from you. Friends and relatives can leave phone messages for you at the office. The phone number for the Honolulu office is (808) 541-1201.

OTHER CONSIDERATIONS:

~~Please make sure that you understand your Volunteer Service Agreement and have read the Volunteer Position Description. If you have any questions on these or on any points brought up in this packet, please try to get them cleared up before you leave Honolulu.~~

One last point. One of our biggest "battles" on Tern Island involves fighting corrosion brought on by ocean salt spray. It is the number one cause of mechanical breakdown, and we spend many hours either repairing corrosion damage or trying to prevent it. This point is brought up to further assist you in planning what to bring to Tern. Think twice about bringing any equipment that is sensitive to the marine environment and be prepared to take proper care of those items you decide to bring. We can provide some assistance in the form of a "dry room" (dehumidified, airtight storage area) and plastic bags for wrapping gear.

That's it! Hopefully we have answered more questions than we've created. Please feel free to ask any questions that you may have. We expect that your stay on Tern Island will be a memorable one. It is a great opportunity to work in and experience a unique ecosystem; an opportunity few people will ever have. There are many challenges to working in this environment, both physical and social. You will be working under field camp conditions to a large extent, and will work with a diverse group of people. **If** you are mentally and physically prepared for the experience, it should be a great one.

Ph. I. 21c
4/24/88

COMMENTS ON TURTLE SEASON, FRENCH FRIGATE SHOALS, 1988

ACCOMPLISHMENTS AND JOB SATISFACTION

I felt that this summer was a highly productive summer in terms of amount of data collected and intensity of scientific effort devoted to the green sea turtle. It was exciting to feel a part of a team effort in the gathering of data. Personally, my favorite part was the application and recovery of tags. It is fascinating to speculate as to the whereabouts of turtles during the internesting interval and the tagging program is slowly removing the cloak of mystery from this speculation. Also, it is a good feeling knowing that one's work is helping to save an endangered species from extinction. After all, how can one save a species without understanding it first? In short, the sea turtle is a fascinating species to work with and I am truly fortunate to have the opportunity to work with this animal.

FRUSTRATIONS AND PROBLEMS

While this section is longer than the ACCOMPLISHMENTS AND JOB SATISFACTION section, this is not to imply that I was disappointed with this summer's field season, but rather, it is the problems that tend to be remembered and perhaps exaggerated, especially in a remote environment like FFS. Also, the simple act of be able to go to FFS is often satisfaction enough!

1) It would have been nice to speak to someone from NMFS more often. At times it was frustrating passing messages through FWS, wondering if the message was passed OK. After all, the original meaning of a message becomes distorted as a function of the number of messengers through which the message passes. In addition, I think perhaps FWS didn't mind passing some messages but after a while, began to tire of it. Finally, and most importantly, even though no messages of importance might have needed to be passed, just a short chat with the parent agency every two weeks or so would have boosted morale.

2) For me personally, I arrived at FFS this summer not knowing if I'd be doing seal or turtle work. It would have been nice to get this cleared up before I left this summer.

3) Again, for me personally, although I enjoyed working with turtles, I found it very difficult at first to work at night. This was probably due to my first impression that I was to stay up with the turtles as long as there was

some kind of nesting activity. Not until a month and a half after I arrived was I told of the method in which turtle people were originally trained by NMFS. This helped a great deal in my ability to perform the nighttime work, as I then began to work in the NMFS style. This difference in techniques and instructions was a source of great confusion.

4) While realizing that conditions at FFS are far from luxury, the camp at Whale-Skate was still primitive, even by FFS standards. To ask people to spend at least four full days without the means of cooling or heating foods was a bit much, I felt. Fresh foods became an impossibility there and warm, canned food did nothing to improve morale. Also, the tent at Whale-Skate was really only useful for protecting equipment, rather than people, since the nylon tent became blazing hot during the day and made any attempt at sleeping inside it futile. I understand that originally, the camp at Whale-Skate was only to be occupied on a temporary basis, but when the decision to occupy it full-time was made, then the upgrading of the camp to a "full-time" camp should have also been made at that time.

5) Communication was at times poor. Sometimes, it felt as if each person was acting under a different set of instructions, which in fact, they might have been!

RECOMMENDATIONS

- 1) Get NMFS radio in to operational status.
- 2) A short description of the nature of turtle work should be distributed to all turtle people PRIOR to departure for FFS. This would not necessarily be a training manual, but rather, something to give people an idea of what is expected of them, etc. This could also be a springboard for ideas and questions to be discussed before the volunteer departs.
- 3) If plans are made for the full-time occupation of Whale-Skate Island, then the camp should be modeled after the East Island camp, especially in regards to the equipment that will be needed.
- 4) Although only briefly mentioned under (5) in the above section, improved communication is perhaps the most important recommendation. Both agencies (FWS and NMFS) and all people concerned should be familiar with what is expected of themselves and others as well as each agency's goals and expectations. In addition, both agencies should strive to have similar instructions given to all turtle people. This will accomplish two goals: improved efficiency of work and the maintenance of high morale.

September 6, 1988

Dear George,

Hello! Thank you so much for your very informative letter. Sounds as though you'll have to take the family to Japan someday - you must have really enjoyed seeing the country! I appreciate your abstract. I hope I can always get updates from you in your turtle research. I feel as though I really want to keep updated with your research and their status since I learned so much at East Island and had an opportunity to "be there"!

In regards to Sea Life Park, unfortunately there are many things that go unsaid by "higher-ups" - for what benefit I'm not sure. But I do appreciate your confidence(?) in me.

I am enclosing the copy of the FWS Volunteer Info Packet. I hope that NAFS will take it and revise it for future volunteers. I also received information from a friend at FWS, Craig Rowland (a former UH student). He even had a video so I was able to "see" Tern Island before my arrival. Also Marilyn ~~or~~ Major filled me in with a lot of information so I was more prepared. I was trying to find the list of supplies and notes I had written when speaking with Marilyn, but was unable to find it.

George, I hope this is helpful for you and future volunteers!

Oh yes - and enclosed you'll find a slide from your departure from East Island with all your gear. You can have the slide, I had a print made of it for myself.

I think my experience up at Fr. Frigate will always be with me - and I plan on trying to do it again next summer, if possible! If you ever need assistance with turtle necropsy/autopsies, PLEASE do contact me - I'd love to help out!!

P.S. Guess I'll be seeing you at SIP for the turtle lecture!!

Sincerely,
Glynnis

1561 Wilhelmina Rise
Honolulu, Hawaii 96816
July 15, 1988

George Balazs
National Marine Fisheries Service
Honolulu Laboratory, Southwest Fisheries Center
2570 Dole Street
Honolulu, Hawaii 96822

Dear George,

My sincerest apologies for not turning this evaluation in as agreed. I came back to work with more things to get done than I expected and deadlines had to be met. I am finally sending this off to you and hope it is not too late. I have given you my honest account of my experience at French Frigate Shoals.

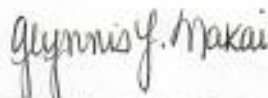
Thank you George, for recommending me to Bill for turtle research. I really enjoyed my 4-5 weeks up there and hope to be up there again in the future! It was such a valuable experience for me. I needed to get back into the research area of Zoology and to evaluate my future goals. Believe me, the experience has certainly accomplished that! It opened my eyes to many things about what I would like to accomplish myself and basically answer the question, "What do I want to do when I grow up?"

The Sea Turtle work was great! I am still awed by the abilities of such a clumsy-appearing animal -- they are so intricate and their nesting behaviors so detailed...definitely not clumsy at all! My interest in sea turtles has really grown and will always keep up to date with new research.

I was sad that I could not stay up there to see the hatchlings emerge and finish up the season. But perhaps next time I will have that opportunity! I plan to continue on with school to receive my masters degree in either Wildlife Management or Ecology, mainly in the area of Endangered Species, which has always been my interest.

I want to thank you once again for the opportunity that I will remember always! Again, my apologies for not mailing this a month ago!

Mahalo,



Glynnis L. Nakai

Enclosure

cc: Bill Gilmartin
Stewart Fefer

Glynnis L. Nakai
NMFS Volunteer at French Frigate Shoals
May 10 - June 14, 1988

1. JOB SATISFACTION/FEELING OF ACCOMPLISHMENTS:

My volunteer work experience at French Frigate Shoals was WONDERFUL! The reasons for volunteering in the first place are many: to actively get involved in the research of an endangered species (Green sea turtles); to do that research in their natural environment; and a personal feeling of accomplishment by living on my own in a remote environment. I really feel a sense of accomplishment from this volunteer experience. Being in the field was the most stimulating feeling and I thoroughly enjoyed my stay at French Frigate. The researchers at French Frigate were all very friendly and helpful and I felt we got along very well. This experience has opened my eyes to what I really want to get into, in a broad sense, and has given me the push that was necessary to motivate me to continue on with school for my masters degree. It's hard to put into words, but the four/five weeks at French Frigate were very worthwhile and special to have been given the opportunity to experience such a unique environment!

In my eyes, the Green sea turtle research is essential for the future of this species and the methods of collecting data are such that it does not critically impede upon the species natural behaviors. Although the schedule of working at nighttime can be hectic at times, it is very adaptable (and actually much cooler). I learned so much from "turtling" on East and Whale-Skate Islands just from watching this species and I think it will always amaze me! As far as job satisfaction, I was satisfied and feel that it is very worthwhile in order to learn more about their natural history and population dynamics.

2. FRUSTRATIONS/PROBLEMS EXPERIENCED:

I was very ecstatic about being up at French Frigate Shoals and there were very few frustrations. I think one major problem was the NMFS boat situation; I felt that new motors should have been purchased instead of always trying to fix the old ones only to have something else break down. It seems that as remote as the shoals are, the safety of the researchers would come first. Why take chances? Eventually when it did run on a regular basis, I felt uncomfortable riding island to island in it, thinking it may go out anytime. Another problem I saw was with staffing. I realize that it's difficult to obtain as many volunteers as possible, but I think each potential volunteer should be thoroughly screened. For example with one volunteer that went up to Laysan and evidently it was not what he expected and he returned to Honolulu earlier than expected, leaving limited staffing at Laysan. Another such volunteer was sent to French Frigate to do research on the turtles and it ended up she was afraid of anything and can't even stay on the islands by herself, which staffing each of the islands a problem. By screening potential volunteers, occurrences such as these would not happen...or not happen as often. But I do realize your needs for volunteers!

One last comment is in regards to food. There is a lot of canned food that is in the pantry that no one wanted to eat because the cans were just covered with rust. Personally, I feel that foods such as vegetables (potatoes, carrots) that can last a length of time are more liked than canned and are probably healthier.

All in all, though, I didn't feel frustrated and the problems didn't seem so great. I think my only frustration is that I couldn't stay at French Frigate Shoals to see the turtle season end!

3. RECOMMENDATIONS FOR IMPROVEMENTS:

The only recommendations that I have were pointed out in #2 of this evaluation: planning better for outboard motors for the next season, screening potential volunteers more thoroughly and...less canned food -- especially if no one is going to eat it (more fresher food).

One other recommendation that I feel is very important is in the way of prepping volunteers for their stay at the different islands. I was fortunate enough to know an employee from the Fish and Wildlife Service, so I received a copy of their information that they give to their volunteers. This information covered items such as expectations, conditions when living on the island(s), what to bring, etc. I found this very helpful in my physical and mental planning. From the National Marine Fisheries Service, I received nothing like this. The volunteers that came up to Tern Island at the beginning of June did not even know what research they were working on. If you could just write up, or even copy from FWS with their permission, information about their stay on the island(s) and what to expect, what to bring, etc. it would prepare them better so there is less confusion.

That is all in regards to recommendations. All in all, while I was at French Frigate Shoals the research on the Green Sea Turtles went smoothly and the scheduling was good with the four of us (Vanessa, Holly, Sheila and myself). I feel that the full coverage of Whale-Skate is very essential for the complete nesting data, as well as East Island. It seemed as though there were just as many turtles nesting on Whale Skate as East Island. I hope that in the next few nesting seasons the staffing will be sufficient so that yearly data can be collected for all islands (Tern, East and Whale-Skate).

There was concern by one staff about the method used to collect data on turtle nestings. Personally I feel that it is the most sufficient method to collect data and that it can be done with minimal disturbance to the turtles themselves as well as other inhabitants (monk seals and seabirds). It is just the way each of us goes about "turtling" at night and being conscious and alert to where animals are resting and where you aim the flashlight. Perhaps in the future, feelings such as this would be alleviated if the person is well prepped for what the research involves and how to best go about it.

In summary, I thoroughly enjoyed the unique experience of performing research on the Green Sea Turtles at French Frigate Shoals. It was a very valuable and worthwhile experience. The staff at Tern Island were all very helpful and willing to teach and involve me in their research.

I would like to thank George Balazs for his recommendation and Bill Gilmartin for accepting me as a volunteer! I hope you will keep me in mind for future research at the Northwest Hawaiian Islands Refuge -- I'd definitely do it all over again!

Glynnis Nakai

Glynnis Nakai
July 5, 1988

every part
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less
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October 11, 1988

F/SWC2:GHB

Mr. Tim Clark
5399 Edgewater Drive
Ewa Beach, HI 96706

Identical ltrs to: Phil Dye (Phil) and Sheila
Moriarity (Sheila) of 884 Miller Ave., Cupertino,
CA 95014; and Glynnis L. Nakai (Glynnis), 1561
Wilhelmina Rise, Honolulu, HI 96816

Dear Tim,

I want to take this opportunity to formally thank you for the fine job you did this past summer working with nesting green turtles, Chelonia mydas, at French Frigate Shoals. The data you helped to collect as part of our research team contributed substantially to census and tag resightings for the 1988 breeding season. We are most appreciative of your voluntary contribution of time and talent. I hope that circumstances will allow you to be involved in this research again during coming years, possibly on a salaried basis.

Best wishes for all your future endeavors.

Sincerely,

George H. Balazs
Zoologist and Leader, Hawaiian
Sea Turtle Recovery Team



October 5, 1988

F/SNC2:GBB

Mr. Phil Dye
884 Miller Avenue
Cupertino, CA 95014

Dear Phil,

I want to take this opportunity to formally thank you for the fine job you did this past summer working with nesting green turtles, *Chelonia mydas*, at French Frigate Shoals. The data you helped to collect as part of our research team contributed substantially to census and tag resightings for the 1988 breeding season. We are most appreciative of your voluntary contribution of time and talent. I hope that circumstances will allow you to be involved in this research again during coming years, possibly on a salaried basis.

Best wishes for all your future endeavors.

Sincerely,

George H. Balazs
Ecologist and Leader, Hawaiian
Sea Turtle Recovery Team

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bc: Balazs
HL

Balazs



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2570 Dole St. • Honolulu, Hawaii 96822-2396

October 11, 1988

F/SWC2:GHB

Mr. Richard A. Bauer
1924 McKinley Street
Honolulu, HI 96822

Dear Dick,

I want to take this opportunity to formally thank you for the fine job you did this past summer working with nesting green turtles, Chelonia mydas, at French Frigate Shoals. The data you helped to collect as part of our research team contributed substantially to census and tag resightings for the 1988 breeding season. We are most appreciative of your voluntary contribution of time and talent. I hope that circumstances will allow you to be involved in this research again during coming years.

Best wishes for all your future endeavors.

Sincerely,

George H. Balazs
Zoologist and Leader, Hawaiian
Sea Turtle Recovery Team





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Southwest Fisheries Center Honolulu Laboratory
2570 Dole St. • Honolulu, Hawaii 96822-2396

October 11, 1988

F/SWC2:GHB

Ms. Vanessa Gauger
1924 McKinley Street
Honolulu, HI 96822

Dear Vanessa,

I want to take this opportunity to formally thank you for the fine job you did this past summer working with nesting green turtles, Chelonia mydas, at French Frigate Shoals. The data you helped to collect as part of our research team contributed substantially to census and tag resightings for the 1988 breeding season. We are most appreciative of your contribution of time and talent. I hope that circumstances will allow you to be involved in this research again during coming years.

Best wishes for all your future endeavors.

Sincerely,

George H. Balazs
Zoologist and Leader, Hawaiian
Sea Turtle Recovery Team



November 15, 1988 F/SWC2:GHB

Ms. Melissa Jacobs
2116 Lime Street, Apt. 203
Honolulu, HI 96822

Dear Melissa,

I want to take this opportunity to formally thank you for the fine job you did this past summer working with nesting green turtles, Chelonia mydas, at French Frigate Shoals. The data you helped to collect as part of our research team contributed substantially to census and tag resightings for the 1988 breeding season. We are most appreciative of your voluntary contribution of time and talent.

Best wishes for all your future endeavors.

Sincerely,

George H. Balazs
Zoologist and Leader, Hawaiian
Sea Turtle Recovery Team

GHB:ey
cc: Balazs
HL

November 7, 1988 P/SNC2:GHB

Ms. Mimi Brown
c/o 3317 N.E. 59th Ave.
Portland, OR 97213

Dear Mimi,

I want to take this opportunity to formally thank you for the fine job you did this past summer working with nesting green turtles, Chelonia mydas, at French Frigate Shoals. The data you helped to collect as part of our research team contributed substantially to census and tag resightings for the 1988 breeding season. We are most appreciative of your voluntary contribution of time and talent. I hope that circumstances will allow you to be involved in this research again during coming years.

Best wishes for all your future endeavors.

Sincerely,

George H. Balazs
Zoologist and Leader, Hawaiian
Sea Turtle Recovery Team

GHB:ey
cc: Balazs ✓
HL



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NATIONAL MARINE FISHERIES SERVICE
Southwest Fisheries Center Honolulu Laboratory
2570 Dole St. • Honolulu, Hawaii 96822-2396

December 10, 1986

F/SWC2:GHB

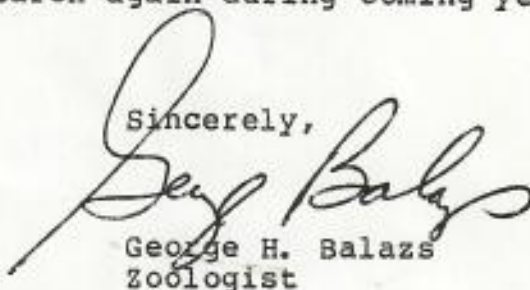
Dr. Marilyn B. Major
Associate Professor
Department of Nursing
2528 The Mall
University of Hawaii
Honolulu, HI 96822

Dear Marilyn,

I want to take this opportunity to formally thank you for the fine job you did this past summer working on nesting green turtles at French Frigate Shoals. The data you collected following my departure in late June contributed substantially to our census and tag resighting records for the 1986 breeding season. We are most appreciative of your voluntary contribution of time and talent. I hope that circumstances will allow you to be involved in this research again during coming years.

Best regards,

Sincerely,



George H. Balazs
Zoologist



P. 1
VANESSA GAUGER
1924 Mc KINLEY ST.
HONOLULU, HI 96822

10-23-88

Dear George,

Please excuse the delay, but here at last is my commentary on turtle work last summer at French Frigate Shoals.

I found the work to be very interesting and enjoyable. I appreciated the opportunity to observe turtle nesting behavior at such close range, and for such an extensive period. I also liked knowing that the data we collected would prove valuable in calculating population estimates of the species.

I found many advantages to working nights: it was much cooler, I didn't have to worry about getting sunburned, and I improved my knowledge of the constellations greatly!

However, as you know from conversations with all of the turtle workers, all did not go smoothly last summer. I have a number of suggestions that may help to alleviate some of the problems we encountered, so that future field seasons can benefit from our experiences.

One thing that really disturbed me was the practice of digging up hatched nests within days of their hatching. If thirty to fifty live hatchlings were "rescued" from many such nests, that seems to indicate to me that these nests hadn't completed their hatching yet. I think that these nests should be allowed to complete their natural hatching sequence, even if its spread over more than one night, rather than holding hatchlings in a bucket and artificially releasing them. (Waiting a longer period, perhaps four or five days, seems like a better idea to me). I also don't agree with the practice of "helping" a nest to hatch by digging up the first few hatchlings as they rest half-emerged from the sand. I find it irresponsible to interfere with the natural hatching process out of impatience or because of a proprietary attitude.

I think that a more thorough interviewing of prospective volunteers is in order, including a thorough description of the field camp situation, and of the duties to be performed. People should be informed before their arrival at Tern Island about what their expected duties will be; there were several cases of volunteers not finding out until they got off the plane whether they would be working with seals or turtles. If advertised in the right places, there should be no problem finding volunteers who would be capable and happy to do the work.

I think that it would help to have something on Tern in writing detailing the duties expected of turtle workers. If any additional duties are later added to the list, they should first be cleared with you by radio. That would eliminate some of the confusion of having "two bosses", and would make it clear (especially to newcomers) which duties are part of the job. I think that if the refuge manager has additional duties he would like the turtle workers to perform, for his personal research interest, that the status of these additional duties should be made clear to the workers. I believe that many people would not object to helping out with these additional duties, if they have the time, but they should not be required to do so if they are

already feeling overworked. The discontinuation of any of the duties which you specified as part of the job should also be checked first with you by radio. (Here I'm referring to when we discontinued the baskers' count ; I'm still unsure where the order to do so arose).

General policies about the number of nights per week worked, and the length of stay on East and Whaleskate, could also be worked out prior to the start of the season. It's good to maintain flexibility about these things, but a policy would give workers something to compare their schedule with, to insure that they're not being asked to work too much. It would be nice to have something on Tern stating what you expect of workers, in case there are discrepancies between that and what the refuge manager expects.

Policies about the intensity of coverage per night should also be worked out. I can understand having a different set of rules for Tern as opposed to East and Whaleskate, but it could get confusing. For example, it should be specified how often walks should be done, when it is appropriate to go back and check on certain turtles in between the regular two-hour intervals, etc. For instance, on Tern the turtle workers were expected to check, on a turtle up digging, every 15 minutes, in order to verify the exact site of egg-laying. Although this wasn't possible on the other islands, it was necessary to do walks much more frequently than every two-hours, in order to obtain the nest-site and turtle identification data that the refuge manager deemed necessary.

Also, having something in writing detailing in which stages during nesting it is appropriate to paint, tag, and measure the turtles would be useful. I know that you went over this with us during the training period, but it seemed to be something that people tended to forget in the excitement of the moment. This would also be useful information for people who arrive in the middle of the season, and thus have to do without the benefit of your training session.

It would be nice to have all of the turtle workers trained by you personally, but if this isn't possible, provisions need to be made to insure that everyone gets proper training. I encountered resistance on this point last summer, when I tried to request that either I got to train newcomers, or at least I got to go out with them to check up on their techniques.

Hands-on experience I find very valuable in the training process. I would recommend that, when training, you first demonstrate the procedures, and then provide guidance while the person tries it alone. It might also help to give newcomers a few days experience just walking around the island at night, to get them used to the sights and sounds, before starting intensive training. I think that some people were too overwhelmed with the newness of the situation to remember all of the details of the training you provided last summer. It could also be good to have kind of a 'quality control' program : send a more experienced person out for a night with a newcomer, after the newcomer has been working for a week or two.

As far as the paperwork goes, it would be nice if there were forms to enter the night's data onto, so that it could be entered

directly onto the computer weekly. The lists of 'newly tagged' and 'recovered' turtles became rather cumbersome and confusing, especially when dealing with a turtle tagged that season, but whose paint had worn off. It also became confusing when adding a new tag (or newly read tag) to the list for a turtle previously recovered that season. If the data could be entered regularly and kept up to date, a printout of the latest tag information could be sent out to each island each week or so.

The notebook method of taking field notes could also use some improvement. I'm not sure what method would work best, but I have some suggestions to try. When using the small field notebook, I found it useful to only record data on about three turtles per page, and to delineate an empty space after the first entry for each turtle, to save room for future entries that night for this same turtle. (A diagram would help, so I'll include one.) This way, it's easier to keep track of the progress of each turtle, because several sightings can be recorded together on the same page, rather than continuously flipping back and forth pages. I found it useful to record: the exact time of sighting, the location, the specific activity (i.e. medium egg-pit, etc.), the tag reading(s), the paint number, and what was "missing" for this turtle (i.e. needs left tag). Future entries for this turtle would include an update of time and activity, and possibly location. When the turtle returned to the water, I drew a single slash through the entry, to signify that this turtle was gone.

As it may be hard for some people to remember just what needs to be recorded for each turtle, a pre-printed form may be handy instead of a field notebook. A small clipboard could be used to hold the forms, preferably one of the metal kind of clipboards which has a cover. Water-proofed paper could also be used. The form could have room for 4 to 6 turtles per page, and could have lines to fill in, and boxes to check. This would expedite taking field notes, and would make it easier to decipher other people's notes as well, since they would be somewhat standardized. A quick check of the form would show you what data you still need to collect for that turtle. (I'll include an example). A variation on this theme would be to still use pre-printed forms, but to just have one turtle per form. The forms could then be shuffled, as the turtles move around, so that they are in the same order in which the turtles are in as you walk down the beach.

A vest, similar to a fishing vest (with lots of pockets) turned out to be the most convenient way of carrying the equipment. I found it useful to carry extra flashlight batteries; I also carried a spare paint can nozzle, which I kept in the film canister along with the spare spring for the banding pliers. The nozzles pop off easily, so when I used up a paint can that had a good nozzle, I kept the nozzle. I used these spare nozzles to replace clogged nozzles with, and to replace nozzles that fell off and got lost in the sand. The other items carried in the vest included notebook, pens, flashlight, pliers, tags, rag, gloves, raincoat, paint, wire-cutters, red flags etc. (More on the flags later). The advantages of using the vest are that it doesn't tire

your arms out, everything is handy, and you don't have to put anything down (to find later in the dark).

It became necessary to carry two different series of index cards on the walks each night. The first was the "Missing Data" card : this included the paint number, plus whether the right tag, left tag, or carapace length needed to be read. When doing the paperwork each morning, it was necessary to go through this card and scratch out the missing data which you acquired that night, which was thus no longer missing.

The second set of index cards were the "Band Numbers" cards. These cards included each painted number, in order, and the corresponding band numbers that were then read or applied. I found it useful to record first left tags, then right tags : this made it easier to find a particular tag number while scanning the cards. (For example, if only the right tag had been read, I would leave a blank on the left side, and record the right tag on the right). It was important to update these cards after each night's work as well. We found that a large index card, folded in thirds, worked well. It was necessary to refer to band readings on the "Band Numbers" cards each time a turtle's carapace number was repainted, to ascertain that the carapace number had been read correctly. It was surprising how many times you could misread a number otherwise ! Sometimes a turtle had been previously painted, but the paint had all worn off, and she was then mistakenly given a brand new carapace number. If this happens, I found that it was best to let her retain the new number, and not try to repaint her with her original number later on. It makes it hard to keep track of the paperwork if the carapace number is switching back and forth; besides, repainting a smaller number over the remnants of a bigger number (for example, 48 over 102) is hard to do legibly.

I found that using red plastic flags, on wire stakes, was useful in keeping track of turtles' whereabouts. This is especially handy if the exact marking of nest locations is required. I would put one of these flags, marked with the turtle carapace number (if known) near a digging female. If, for example, I flagged a turtle that was digging an egg chamber, when I came back and checked on that pit again, I could tell whether it had been a false dig (egg chamber not filled in) or whether she had probably laid (egg chamber covered over). I also found the flags useful to mark the location of females who needed paint or tags, and I would check back on these females on my return trip. The flags were good overnight markers for the nesting success study: the distance and compass direction from the flag to the eggs was recorded, and the carapace number was written on the flag. The flags were then replaced by more permanent stakes the following day.

I found that special footwear was not needed for the work: my tennis shoes or high-topped tennis shoes worked just fine. None of us were able to straddle the turtle to read tags, and other positions seemed to keep the feet out of danger. My hands were more likely to get injured than my feet, but a pair of cotton gloves worked well to protect them.

Well, that's about all I have for now. If I think of something

P.S

else, I'll be sure to let you know. By the way, I want you to know that we all appreciated the reprints and books which you sent up to Tern for us to read. I think everyone learned a lot from them. Thanks for thinking of us!

Sincerely,

Vanessa Gauger

Vanessa Gauger

P.S. -

I ALMOST FORGOT TO MENTION ABOUT PAINT!
THE SPRAY PAINT PROVED TO BE A PROBLEM, SINCE IT OFTEN
WORE OFF DURING THE INTER-NESTING PERIOD, WE THUS HAD
TO CHECK TAGS DURING EACH NESTING ATTEMPT.

AS DISCUSSED WITH YOU IN YOUR OFFICE, PERHAPS
SOME KIND OF EPOXY WOULD LAST THROUGHOUT THE
SEASON ... POSSIBLY EPOXYING ON AN IDENTIFICATION
NUMBER WOULD WORK. I BELIEVE THERE ARE ALSO
PAINTS WITH EPOXY IN THEM, WHICH WE COULD TRY.

11 December 1988

Dear George,

I appreciate the Thank You letter and am honored to have participated in the project.

Enclosed is a list form summarizing my feelings of accomplishment, frustration and recommendation for future turtle work.

My turtle poster hangs on my wall and I am enjoying it!

Thank You for the opportunity to work with Chelonia mydas at FFS July-August 1988.

Sincerely,

Mike Brown

Successes / Accomplishments

- 1) Learning to carefully mark, tag Chelonia mydas.
- 2) Directing "stray" hatchlings to the water.
- 3) Digging nests for those ♀♀ whose back flippers were too short to dig a deep enough egg pit.
- 4) Becoming aware of Chelonia patterns of behavior; i.e. haul-out, serious digging, resting, non serious digging.

Learning the times at night they seemed most active compared to times when there were few turtles hauled-up.

Learning the best times to tag and paint which caused the least disturbance to the turtle.

- 5) Enjoying the solitude of being the only person on an island and the awareness that brings.

FRUSTRATIONS

- 1) The intensive / frequent turtle walks which seemed to gather no more "real" data than walks every two hours.
- 2) I was trained by Vanessa and was instructed to place flags by every digging turtle which required immediate identity of the turtle even if it had just hauled up. At this stage the turtle would often return to the water. This, I believe, defeats our purpose.
- 3) Turtle watch activity on Tern often resulted in digging up more than the expected number of potentially "trapped" hatchlings. I wonder if this →

procedure didn't interrupt "imprinting."

4) There were a lot of tags not clamped properly,

Recommendations

- 1) When training the volunteers to tag, actually allow them hands on experience, then check their work.
- 2) Minimize futile walks, being thorough on each walk, focusing on identity, tag, resight instead of whether they lay or not. Minimizes the use of high beam flashlights!
- 3) Overall, the project was well run although the Whale Skate camp could have used more cooking supplies.
- 4) I believe ~~the on the whole~~ that the data gathered is a good thing and that probably not too much harm was done in the realm of seal / turtle disturbance but would not reach this level annually.

~~Plaque~~
~~letter~~

7 June 88

Dear George -

Hi. I have some bad news for you, & I really hope we can still be friends after I tell you...

I can't stick it out here all summer. There are a lot of reasons - I'll try to explain some of them - it's important to me that you know I'm not a "flake" - & this wasn't an easy decision to make.

* I'm unhappy with the work - although I fully appreciate how important it is for the conservation of turtles in the long run. ~~the~~ I don't like harrassing them, as well as disturbing all the birds & the seals all night long. It won't be the way I want to interact with wildlife, for me, it's no good. Also, the burn-out is far worse than I expected. Physically, the hours are incredibly draining, & mentally, as well, the concentrated time alone is stressful at this particular point in my life. (Not to mention the ticks - my feet are a mess.)

Maybe these are things I should or could have anticipated before the fact - but I guess there are some things you gotta learn the hard way. I didn't expect this at all.

Finally, being away from Jeff is very difficult - the timing of my "return to Tern", & his departure, was just rotten. It became finalized at the last minute, & there was nothing we could do about it. I think if I was enjoying what I'm doing, that wouldn't be such a problem. But given the way I feel about the job, Jeff & I being apart just makes matters worse.

I'm not trying to codge your sympathy, but I respect your opinion of me, & I know I'm letting you down, so at least I owe you an explanation.

BUT - I'm not going to leave until there's a replacement lined up for me - we're working on that now. And, I'm giving the →



work my very best effort, so please don't worry about that. I'm 100% "here" - & you can rely on that. It's just that I'll be a lot better off if we can find someone to take my place. I think that if I stay all summer just because I said I would, and my heart's not in it, ultimately the quality of my work will suffer, and that's no good for anyone.

So, like I said, I hope we're still friends, & that you'll still talk to me on the radio.

I know you said phone-patches would be granted on the basis of "good behavior," which this obviously isn't - but I think you'll understand that Jeff & I need to talk on the 12th - not just to chat. I really appreciate your doing that for me / us. I'll talk to you then....

Thanks....

- (hang-dog) Holly



9/4/88

Aloha George,
Sorry this evaluation took so long but things got quite hectic here and it was my fault for not writing it in Haukaui! But here it is and I hope it is helpful for you.

Accomplishments and Successes

This was the first field work experience of my life and I absolutely loved it. The work with the green sea turtle was challenging because it was done at night and required you to be alone. It was also challenging to try to disturb the animal life as little as possible which at times was quite difficult. It wasn't until I trained Mimi Brown that I began to feel proud of the way I handled turtle work. I was open to her suggestions but on the whole felt that the style I developed was ~~good~~ thoughtful of the animals welfare and enabled me to collect accurate data with the least amount of disturbance.

Due to changes in personnel there were several changes in the work schedule but I felt

that it was flexible and adapted well to the changes that were made.

Problems and Frustrations

The turtles that rested on East island had an additional hazard to deal with and that was the condition of the island due to the remnants of the buildings which are no longer present. The turtles get caught in the wire and some would literally strangle themselves if we weren't there to untangle them. There is also an excessive amount of broken glass leftover from beer bottles carelessly thrown in the sand.

The condition of East island was a frustration at how callous human beings can be towards the environment and the living organisms that inhabit these places.

although the work is to help the turtle it is a fallacy to think that our presence is not disturbing the turtles. One frustration I had was that there was a difference of opinion as to how the work should be done. Instead of a random sample it became almost a race to tag every turtle that rested on Tern, East and Whaler

skate islands. Since we worked alone I was able to choose my own work methods although it was evident in the data collection that my coverage was less than others. At times I felt pressure to tag more turtles per night but I believed that constant coverage was too disturbing to the animals and also had a negative affect on my attitude.

Another problem has to do with food. There ~~was~~ an overabundance of canned foods from NMFS that are musting in the store rooms on Tern Island. Many of these foods are unnecessary like: bamboo shoots, olives and water chestnuts which are hardly used and yet during my stay few cans of these very same items were sent to Tern Island. I think that the inventory needs to be improved because there are too many starving people in the world to waste food.

Recommendations for Improvement

I think the actual training for turtle work should be more intense; meaning longer in duration. I realize that our

training period was shortened due to the boat situation. I think it would be helpful to the person being trained to be able to tag turtles with the trainer to assist them. During my first week alone on East Island I was not successful at tagging and it was very frustrating and I think that if I had more of an opportunity to tag turtles with supervision that I would have been more successful.

On the whole my experience was very positive and I am thankful that I had the opportunity to experience life on Tern Island.

Aloha,
Shula Moriarty

NEW ADDRESS: 884 Miller Ave.
Cupertino, Ca

95014

P.S. This is Phil's new address too.

INDIVIDUAL
WILL
CAPABILITIES
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BUT ACK THAT
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Aloha,
Shula Moriarty

NEW ADDRESS: 884 Miller Ave.
Cupertino, Ca
95014

P.S. This is Phil's new address too.

December 30, 1988

TO: JAW

FROM: GHB

SUBJECT: My 12/22/88 meeting with FWS personnel to discuss results of 1988 tagging/monitoring at FFS, and to formulate plans for the 1989 nesting season research.

The subject meeting lasted for nearly 3 hours and proved to be very worthwhile. I reviewed as best possible the voluminous data obtained during the 1988 effort. Most of this info has already been given to you, or is now attached with this memo.

In my view, the main success of this meeting was making Stewart Fefer and Ken McDermond more fully aware of what we are trying to accomplish each year at FFS, and especially the importance of monitoring East, for as many consecutive nights as feasible, as an "index" of the population.

There are plans for us to meet again about mid-January to finalize arrangements for the 1989 season. However, before this can take place we need your input on certain matters. One key point is, based on what we know to date (including results from 1988 work), just how important do you feel it might be to saturation monitor Whale-Skate Island again? As you have read from my previous memos to WGG, looking at the "big picture" (ie concerns for disturbing wildlife on this narrow islet, etc.), I'm inclined to leave this site alone and focus everything on East (and Tern if FWS personnel are available). However I have an open enough mind on the

subject to alter my opinion, if you come up with a significant reason why it should be done. Basically, the question is "Is it crucial to gauging recovery, or would it just be good to have more data for this site?"

If your time will permit, the ideal situation would be for you to attend the January meeting and provide input. But of course we need to discuss the options together first. Please lets talk about this more at your earliest convience.

Happy New Year! (and note that my "talents" on wordstar are coming along)

We have completed our report on the statewide status of 42 rare coastal plants, four endangered waterbirds and four marine turtles for DOFAW & Hawaii CZM Program. Copies of this report are available for review at the HHP office. Field work has been completed on the Ahihi-Kinau, West Maui and Hono O Napali NARs as part of our on-going inventory of the state Natural Area Reserves System.

ENDANGERED SPECIES

Recovery Plan Development
Spring - Summer 1988
John Engbring 541-2749
U.S. Fish and Wildlife Service

There are two new starts for recovery plans in 1988, the Mauna Kea Silversword (Argyroxiphium sandwicense) Recovery Plan and the Oahu Tree Snails (Achatinella spp.) Recovery Plan. The endangered Mauna Kea Silversword is restricted to a few small populations on the upper elevations of Mauna Kea on the Big Island. Grazing by feral ungulates has been implicated as the major factor in the decline of this species.

All Oahu tree snails in the genus Achatinella, about 40-45 recognized species, are listed as endangered. These snails were once abundant in the native forests of Oahu, but are now rare and restricted to upper elevations. Introduced predators and the loss of habitat are believed to be major causes for the decline.

Both recovery plans are being prepared by contract and are expected to be in final form in 1989.

DUNE ECOSYSTEM PRESERVATION

Establishment of Mo'omomi Preserve

May 1988

Audrey Newman 537-4508
The Nature Conservancy of Hawaii (TNCH)

In May, TNCH acquired 900 acres on the north coast of West Molokai, creating Mo'omomi Preserve. One of the state's last intact coastal dune ecosystems, it contains five rare plant species and nesting sites for the green turtle. The Laysan albatross is trying to recolonize the area. Fossilized bones of over 40 bird species have been found in the lithified dunes.

Management activities will concentrate on controlling vehicle access and assessing the impacts of axis deer, humans, and alien plants on the native vegetation. The preserve will contain a nature trail and other activities for public use and education.

NORTHWEST HAWAIIAN ISLANDS

Midway Atoll National Wildlife Refuge

April 1988

Craig Rowland 541-1201
U.S. Fish and Wildlife Service

Midway Atoll National Wildlife Refuge was established on April 22, 1988 and is managed by a cooperative agreement between the U.S. Fish and Wildlife Service and the U.S. Navy. Temporary Biologist Breck Tyler, along with Animal Damage Controllers Jim Murphy and Tim Ohashi, have begun a rat trapping study to determine the extent of the rat population and control methods to be used in wildlife areas on Midway.

NORTHWEST HAWAIIAN ISLANDS
Hawaii Islands NWR Survey Trip
June - July 1988
Craig Rowland 541-1201
U.S. Fish and Wildlife Service

Biologists Ken McDermond and Craig Rowland, along with botanist Derral Herbst, were joined by Bishop Museum botanist Wayne Takeuchi for a survey trip of the Northwestern Hawaiian Islands. The field party spent five weeks working their way from Nihoa Island to Midway Atoll with transportation provided by the fishing vessel FERESA.

Information was gathered on the distribution of a number of candidate endangered plant species and selected seabird species in order to better monitor their populations. Counts of Hawaiian monk seals and green sea turtles were conducted on Nihoa and Necker Islands. The field party also erected 400 feet of drift fence in an effort to stabilize shifting sand on the east side of Laysan Island.

GREEN SEA TURTLE

Nesting and Hatching Studies at
Tern Island
1986-1988
Ken Niethammer, Jeff Holm,
Craig Rowland, Tern Island
Staff 541-1201
U.S. Fish and Wildlife Service

During 1986, the U.S. Fish and Wildlife Service in cooperation with the National Marine Fisheries Service began to monitor Hawaiian green sea turtle (*Chelonia mydas*) nesting activity on Tern Island, French Frigate Shoals. The objectives of this study are to monitor nesting and hatching phenologies, hatching success, and

avian and crab predation of hatchlings.

Green sea turtles nested on Tern Island between May 25 and Oct. 20, 1987. Eighty-two percent of the nesting occurred during the months of June, July, and August. Nine different turtles were observed nesting on Tern Island; one individual was observed nesting four times, while three others were observed nesting twice. No adult turtles were observed entrapped on Tern Island.

Forty-eight of the 50 nests located produced hatchlings; the first hatchling emerged on July 29 and the last on December 26. 81% of the nests hatched during August, September, and October.

The mean incubation period for the 34 nests with lay and hatch dates known was 63.0 days with a range of 54 to 85 days.

The mean clutch size was 86.7 eggs, with a range of 36 to 115 eggs. Individual nest success ranged from zero to 100% hatch. Two of the 50 nests failed to produce any hatchlings. When excavated, the eggs from these two nests showed no signs of embryo development. Of the 4,161 eggs found in 1987, 75.5% (3,137) produced viable hatchlings that succeeded in reaching the sea. Of these, 482 hatchlings required assistance, as they were trapped in their nests or were not fully developed (yolk sac still extended). Most obstructions were large pieces of coral; however, six hatchlings in one nest were trapped under a piece of copper wire. A total of 1,024 eggs (24.6% of the eggs) failed to produce viable hatchlings.

The 1988 study will begin in May and will continue as conducted in 1986 and 1987,

with the addition of an effort to tag or read existing tags of all nesting females. The study will also be expanded to include East Island as well as Tern Island.

HAWAIIAN MONK SEAL

Kure Headstart Project
March - June 1988
John R. Henderson 943-1225
NOAA, NMFS, Honolulu Laboratory

A total of 8 Hawaiian monk seal pups have been born at Kure, the highest total since births dipped to a low of one in 1986. Four of the pups are female, three male, and one of unknown sex is still nursing. One of the male pups died shortly after birth, having been abandoned by its mother who had incurred serious back wounds. The four weaned female pups are being maintained in the protective headstart enclosure and will be released in September. Particularly noteworthy is that female seals which themselves went through the headstart program are now contributing significantly to births. Four of this year's births were to females head-started in 1981 and 1982.

The increase in births and the fact that the program is well into its "second generation", with relatively high numbers of immature females soon to reach reproductive age, bodes well for the eventual recovery of the Kure population.

HONO O NA PALI NATURAL AREA RESERVE SURVEY

May 1988
Samuel M. Gon III 537-4508
The Nature Conservancy of
Hawai'i

Samuel Gon III, Steven Perlman (The Nature Conservancy of Hawai'i) and Michael Buck (State DLNR) conducted an ecological survey of the Hono O Na Pali NAR, Kaua'i from 9-20 May. The purpose of the survey was to document the status of rare and endangered species and natural communities in the reserve, and to obtain information for development of a management plan for the reserve.

On the nights of 18 and 19 May, while camping in a remote bog on the edge of Wainiha Valley at ca 4,050 feet elevation, 'ua'u or Hawaiian Dark-rumped Petrels (Pterodroma phaeopygia sandwichensis) were heard returning to nest sites in the darkness after 2015 hours, presumably on the upper cliffs of Wainiha and in adjacent steep slopes in the Hono O Na Pali NAR. We estimate that five - 10 birds were heard for approximately two hours both nights. This constitutes the first known nest site location for the Kaua'i population of 'ua'u.

WEDGE-TAILED SHEARWATER

Artificial Nesting Structures
June 1988
Thomas Kaiakapu 548-8850
DLNR - Division of Forestry and
Wildlife

Back in mid-March of this year, the Oahu District implemented a project to install 82 artificial nesting structures designed for ground-nesting seabirds at a Wedge-tailed Shearwater (Puffinus pacificus) colony at

Black Point, Kahala, Oahu. The project was a joint undertaking on a private estate to redirect the nesting of shearwaters from an established site to newly constructed nest structures.

Within the past few years, the property owners had experienced an increasing number of shearwaters nesting under their home. The increase in noise and smell have become an unbearable problem for them.

We recommended that before the nesting season started, the area around the house be screened off. In the mean time, we installed nesting structures in an area that had limited use by shearwaters. The structures were of eight-inch PVC pipes cut in 24 inch lengths, then cut straight down the middle to form a concave appearance and placed in various positions to determine the difference in their acceptability by U'au kani. A few shearwaters had already been observed utilizing the structures in early May.

BRISTLE-THIGHED CURLEW

Status and Demography of the Bristle-thighed Curlew

April - May 1988

Roland Redmond, Jeff Marks, David Evans, Craig Rowland
541-1201

U.S. Fish and Wildlife Service,
Montana Cooperative Wildlife
Research Unit

Little is known about the status of the Bristle-thighed Curlew population. Color-banding of Bristle-thighed Curlews is being conducted on Laysan Island, Christmas Island, and the Tuomoto Islands in an effort to determine the following: 1) status of the population, 2) geographic extent of breeding and staging

grounds, 3) demographics of wintering, staging, and breeding components of the population, and 4) potential threats to the population.

The colorbanding work will also help determine the turnover rate of Bristle-thighed Curlews heading North to their breeding grounds in Alaska.

The Fish and Wildlife Service is conducting this research in order to make sound management decisions on matters that may affect the Bristle-thighed Curlew population.

ENDANGERED WATERBIRDS

Monitoring Program

January - April, 1988

Paul Chang 541-1201

U.S. Fish and Wildlife Service

University of Massachusetts

On April 19, the hundredth nest was located on Ki'i Unit of James Campbell National Wildlife Refuge. This year, nest searching began on January 5 and will continue through August 5, 1988. As of April 28, 16 stilt nests have been found. A nest fate breakdown of the first 100 nest follows:

HM - Hawaiian Moorhen

HC - Hawaiian Coot

FW - Fulvous Whistler

HD - Hawaiian Duck

SP	# Nests Found	Successful Hatch	Predator Unknown
HM	27	16	3
HC	34	20	1
FW	4	1	
HD	35	18	

September 27, 1988 F/SNC2:GHB

Mr. Stewart Fefer
U.S. Fish and Wildlife Service
P.O. Box 50167
Honolulu, HI 96850

Dear Stewart,

Enclosed for your files are edited summaries of the turtle census data collected at French Frigate Shoals this past summer. Also included is a preliminary bar graph showing the number of new turtles recorded nesting each night on East Island for the 101-day study period. All of this information has been provided to Dr. Jerry Wetherall for incorporation into the population model discussed in our draft recovery plans. I will be sending you copies of additional data as it becomes edited and analyzed.

The turtle tags and applicators for use at Rose Island are here in my office ready to be picked up. Or, if you prefer, I can mail them to you.

Best regards.

Sincerely,

George H. Balazs
Zoologist

GHB:ey

cc: Gilmartin
Balazs ✓
HL

January 7, 1990

To: Tern Island Files

From: Tern Island Staff

Kenneth Niethammer

SUMMARY OF 1986, 1987, 1988, and 1989 GREEN TURTLE
STUDIES AT TERN ISLAND, FRENCH FRIGATE SHOALS

During 1986, the U.S. Fish and Wildlife Service in cooperation with the National Marine Fisheries Service began to monitor green turtle (*Chelonia mydas*) nesting activity at Tern Island, French Frigate Shoals. The general objectives of this multi-year study are: to monitor nesting and hatching phenologies, hatching success, nest locations on Tern Island, and avian and ghost crab predation on hatchlings.

The Tern Island facilities are staffed year-round by FWS employees and volunteers. This year-round presence makes studies of seasonal nesting and hatching phenologies more practical than at other locations (i.e. East Island) where the logistics of operating 8 or 9 month field camps become formidable. Another major consideration in conducting turtle research on Tern Island is related to the condition of the seawall. The Tern Island seawalls will need to be replaced, removed, or left to continue rusting away. Information on green turtle use of Tern Island (nesting and hatching phenologies, location of nests, numbers of turtles nesting on Tern Island, numbers of hatchlings produced, etc.) will be an important consideration in making a decision on the fate of the seawalls.

This document contains a summary of 1986, 1987, and 1988 nesting and hatching phenologies and hatching success data. Copies of the 1986 and 1987 raw data can be found in the "Summary of 1986 and 1987 green sea turtle nesting and hatching success studies at Tern Island", a copy of the 1988 raw data can be found in the "Summary of 1986, 1987, and 1988 green turtle studies at Tern Island, French Frigate Shoals". This document also contains a summary and copies of the 1989 green turtle study data which cover nesting and hatching phenologies, nesting female tag identifications, hatching success, and great frigatebird (*Fregata minor*) predation of turtle hatchlings.

STUDY AREA

Tern Island (Lat. 23° 52' N, Long. 166° 17' W) is found on the northwestern rim of French Frigate Shoals (FFS), about 500 miles west-northwest of Honolulu, Hawaii. During World War II, the Navy enlarged the original 11 acre islet into a 57 acre island that could accommodate aircraft. From 1952 to 1979, the U.S. Coast Guard operated a LORAN transmitting station at Tern Island.

Since 1979, the U.S. Fish and Wildlife Service has occupied Tern Island for the purposes of managing the Hawaiian Islands National Wildlife Refuge, performing research, and assisting other agencies in research projects.

About 3000 ft. of Tern Island's south-facing shoreline provides easy access and good substrate for nesting green turtles. Most of the remaining shoreline consists of exposed seawall or coral rubble beaches. The exposed seawall prohibits access to the island while coral rubble beaches do not provide optimum nesting substrate.

METHODS

Research techniques used during 1986, 1987, and 1988 to determine nest locations and hatching success were similar. See the "Summary of 1986, 1987, and 1988 green sea turtle nesting and hatching success studies at Tern Island" report for a more detailed account of methods used in those years. The following methods were used during the 1989 nesting season.

To locate nests and monitor hatching: morning patrols of Tern Island beaches were conducted between 28 April (first nest laid) and 27 December (last nest hatched). In addition, night patrols (about one hour after sunset) were conducted during the nesting season. The objective of these evening patrols was to identify any nesting females encountered. To eliminate as much disturbance as possible to the Hawaiian monk seal (Monachus schauinslandi) and seabird populations, these patrols were limited to the beach zones (at night, most seals "haul out" and are in the interior, vegetated zone of the island). Turtle observers entered the interior vegetated zone only when following tracks of turtles coming ashore.

Nest Locations

Locations of nests were determined by either observing the turtle nesting or by observing the physical characteristics of the turtle's diggings. Usually, a successful nesting attempt can be differentiated from "false pits" by the distinctive evidence of back-filling or covering of the nest. Also, after completing a nest the turtle will normally return directly to the ocean. If a researcher was relatively confident that a female's effort resulted in a nest (eggs seen or all the appropriate signs were present) the nest site was marked with a numbered stake placed about 150 cm (5 feet) inland of the nest. If the researcher was unsure if there was a nest, the site was given a M-series number meaning that all the signs of a successful nesting were not present. These M-series nests (maybe nests) were not marked with a stake. However, locations of both nests marked with stakes and the M-series nests were recorded on appropriate maps and data forms.

Nesting Female Identification

In 1989, because of personnel constraints, no extensive effort was undertaken to identify nesting females. Identifications were limited to turtles encountered on the twice daily beach patrols (night and early morning). An effort was made to read any existing tags on each turtle encountered. If the turtle was not tagged, tags were applied. A curved carapace length and any distinguishing physical characteristics were recorded for each turtle. After a turtle had been identified, a temporary 1989 study letter or number was spray painted on the carapace. This painted identification expedited re-identification of this turtle on subsequent visits to Tern Island, reducing both disturbance to the turtle and effort required by the researcher. Identification, tagging, and/or any other activity that would disturb the turtle was not performed while the turtle was excavating a nest or laying eggs. These activities were accomplished either before nesting or after egg laying.

Tags were applied to either the primary sites (proximal locations on the front flippers) or secondary sites (further out on the front flippers). We tried to ensure that at least two well applied tags were on each turtle. Tags were provided by National Marine Fisheries Service.

Hatching Success

Hatchling emergence was monitored by observing each nest site starting about 50 days after eggs were laid. Almost all "hatching" nests can be detected on the day the hatchlings emerge by watching for pre- and post- emergent pit formations and tracks of hatchlings. If a nest had not "hatched" within about 100 days, the nest was excavated and contents analyzed.

Five days after "hatching", nests were excavated to determine clutch size and hatching success. We determined the number of successfully emerged hatchlings by counting hatched egg shells. The remainder of the nest's contents were categorized as follows: bad eggs (infertile and/or rotten), dead embryos (1/4, 1/2, and 3/4 developed), dead fully developed hatchlings, and live hatchlings trapped in the nest. Any trapped hatchlings were released that night. After analysis, all nest materials were returned to the excavated pit and buried. For the 1989 season, the "trapped in the nest" category should be further defined as the number of hatchlings that remained in the nest five days after hatching.

The hatching of 2 nests were missed, so only the date the eggs were laid was known for these nests. The mean incubation length of the 1989 nests was used to estimate the hatch date for these nests. Although this does not give us an exact hatch date it is probably accurate enough to include these two nests in the

hatching phenology summary where hatchings were tallied by the month.

Great Frigatebird Predation On Turtle Hatchlings

During September 1988, the diet of 150 great frigatebirds (GRFR) (50 nestling, 50 juvenile, and 50 adults) was checked during peak turtle hatchling emergence to determine whether GRFRs are a major predator of hatchlings at French Frigate Shoals. This September, stomach contents of 50 nestling GRFRs were analyzed to augment last year's data set. Stomach contents were obtained by inducing regurgitation by pumping salt water into the GRFR's stomachs.

RESULTS AND DISCUSSION

Nesting and Hatching Phenologies

During 1989, green turtles nested between 28 April and 28 September and nests hatched between 19 July and 27 December (Figure 1.). For comparison to previous years, Figures 2, 3, and 4 show the nesting and hatching phenologies of 1988, 1987, and 1986, respectively. Tables 1, 2, 3, and 4 show a monthly breakdown of nesting and hatching activity on Tern Island during 1989, 1988, 1987, and 1986, respectively. Lay and hatch dates of individual nest can be found in Appendix A.

Nest Locations

In 1989, 103 nests were located on Tern Island. All but eight of these nests were located on the south-facing shoreline. The exceptions were seven nests on Shell Beach and one nest on Crab Beach (Figure 5). In 1988, three nests were found on the northeast beach (Figure 6); this year that beach area was not large enough to accommodate nesting turtles. During 1987 and 1986, all nests were located on the south-facing shoreline of Tern Island (Figures 6 and 7, respectively). More detailed locations for the 1989 nests can be found in Appendix B.

Identification of Nesting Turtles

During 1986 and 1987, identification of nesting turtles was limited to those encountered during twice nightly beach patrols. In 1988, the number of beach patrols were increased in order to try to identify as many of the nesting turtles as possible. Two confirmed nesters were identified in 1986, nine in 1987, and 24 in 1988 (Table 5). An additional 10 turtles were observed digging on Tern Island during the 1988 season, but nests were not confirmed for these turtles (Table 5). In 1988, even with the increased effort, we failed to identify nesting females at 16 of the 88 nests (18.2%). Most likely, these 16 nests were laid by females that were identified on other nesting excursions so the

total number of turtles using Tern Island in 1988 is probably quite accurate.

In 1989, we again could not afford the personpower required to identify all nesting turtles. Identification was limited to turtles encountered on twice daily beach patrols (one about an hour after sunset and one in the early morning). However, we still managed to identify 42 female turtles digging on Tern Island (Figure 5). Eight of these turtles were also encountered on East Island during the nesting season.

Number of Nests/Turtle

Because we could not attempt to identify females for all nests during the 1989 season, no estimate of the number of nests per nesting female could be made.

Nesting Activity On Tern Island

Each of the last four years have shown a marked increase in nests: 23 in 1986, 48 in 1987, 88 in 1988, and 103 in 1989. During the last two seasons, green turtle nesting and hatching activity on Tern Island seems to be a good indicator of activity throughout French Frigate Shoals. The first nest on Tern Island occurred about the same time nesting activity was observed on East and Whaleskate Islands. Nesting activity seemed to end at about the same time on all islands: late September or early October. It will be interesting to compare seasonal changes in turtle nesting phenology to changes in avian nesting phenologies to see if there are any correlations.

Nesting Turtles Trapped By Man-made Obstructions

During 1989, three nesting females that came ashore either at Shell or Crab Beaches were not able to get back to the ocean because of the northern seawall. On the morning of 12 June, a female turtle was found crawling along the middle of the runway. This turtle had come ashore at Crab Beach and probably could not get back to sea because of the seawall in that area. Two nesting female turtles were found trapped or potentially trapped in July 1989. The first was found on 7 July trapped behind the seawall between Crab and Shell beaches. The second also became separated from the sea by the seawall between Crab and Shell beaches on 22 July. It ended up on the runway. All of these turtles were assisted back to the ocean.

In 1988, one nesting female became entrapped between the two seawalls just east of the boat-shed. This turtle was quickly located and released and it subsequently nested. No turtles became entrapped in 1987; however, in 1986, Tern Island personnel found and released four adult female turtles that had become entrapped while attempting to nest.

Incubation Periods

Incubation periods (days to hatchling emergence at the surface) were calculated for all nests which had both lay and "hatching" dates. Mean incubation periods for 1989, 1988, 1987, and 1986 were 70.5, 63.2, 63.0 and 67.6, respectively (Table 6). During the four years of Tern Island work, the minimum and maximum incubation periods have been 53 and 97 days, respectively. Before the 1989 Tern Island data, the longest incubation period recorded at French Frigate Shoals was 88 days. In 1989, we had three nests that exceeded that length (91, 94, and 97 days). Each of these three nests were located on the crest of the beach (the point where the beach begins to slope down to the sea) areas that are periodically exposed to high tides. The mean incubation for 1989 was seven days longer than that of 1988 or 1987. The 1989 season seemed to be much wetter than the previous year and upon comparing rainfall totals for June through October (14.7, 7.8, 8.5, and 12.0 inches for 1989, 1988, 1987, and 1986, respectively) we found that 1989 had about twice as much rainfall than either 1987 or 1988. The 1986 season was a wet year and the mean incubation length was again elevated 67.6 days.

The wide range of incubation periods (53 to 97 days) cannot be explained by genetic differences in nesting females, as the incubation periods of nests laid by the same female in the same year show a similar wide range of values. For example, in 1988, one female laid nests that hatched at 56, 61, 63, 66, and 76 days. Another possible factor is nest site characteristics. In 1988, when incubation periods of nests within 10 meters of the beach crest (point where the beach starts sloping to the sea) were compared to incubation periods of nests greater than 10 meters from the beach crest, we found significant differences (at $p=0.07$ level, TTest) in mean incubation lengths: 64.7 (SD=5.73, $n=57$ nests) and 58.7 (SD=3.90, $n=19$ nests) days, respectively. This is a gross comparison as many factors are probably involved: moisture and organic contents of nesting substrate, elevation above sea level, if the nest site is in a shaded area, nest chamber depth, and etc.

Clutch Size

In 1989, we found a mean clutch size of 89.0 eggs with a range of 44 to 127 eggs (Table 8). Respective mean clutch sizes for 1988, 1987, and 1986 were 96.8, 85.6, and 86.7 (Tables 9, 10, and 11, respectively). The minimum and maximum numbers of eggs in a clutch for these three previous years were 36 and 146.

Hatching Success

Nest success data for individual nests can be found in Appendix A for the 1989 nests. Data for individual nests from 1988, 1987,

and 1986 can be found in the previous years' reports. A summary of hatching success parameters for the four years of work at Tern Island can be found in Table 7. Tables 8, 9, 10, and 11 contain individual year summaries for 1989, 1988, 1987, and 1986, respectively.

During 1989, 101 of the 103 nests produced hatchlings (Table 8). Individual nest success ranged from 0 to 100%. The percent of eggs that hatched (defined as the number of eggs that produce hatchlings that made it out of the nest alive) has ranged from 75.4 to 84.8, during the previous three years (Table 7). This year's 81.9% hatch is similar to the previous years' values. A total of 7,514 hatchlings entered the ocean from Tern Island this season; making the total for the last four years 18,924.

In 1989, none of the "trapped" hatchlings were trapped by any man-made debris. The percent of hatchlings found trapped (still in the nest upon excavation) was 10.9, 10.8, 6.5, and 2.4 for 1986, 1987, 1988, and 1989, respectively (Table 7). Nests were excavated the day after hatchling emergence in 1986 and 1987, excavated two to three days after hatchling emergence in 1988, and were excavated five days after emergence in 1989. This decline in numbers of hatchling "trapped" within the nest over the last four years probably indicates that some of the small groups encountered when excavating nests one, two, or three days after emergence could have made it out on their own given more time. In their struggles to free themselves are these "trapped" hatchlings expending energy needed for their survival at sea? Does each additional day spent in the nest diminish their chances of survival? How many days after the original "hatch" should the nest be excavated? Should we attempt to free the trapped hatchlings or is this natural selection?

The percent of bad eggs (rotten or infertile) has remained relatively constant during the last three years: 12.2 to 15.2% (Table 7.)

Great Frigatebird Predation of Turtle Hatchlings

September was chosen because it was the peak month for hatchlings emergence (Table 1 and Figure 1). Another 39.6% of the nests had already hatched in July and August so turtle hatchling densities in and around French Frigate Shoals was most likely at its highest levels during September. Data from these nestling GRFRs will be added to data from the 150 great frigatebirds sampled in 1988 (see the 1988 summary for that data) and hopefully, we will get this in publishable shape in early 1990. In 1989, identifiable foods (squid and fish) were found in 34 of the 50 GRFR nestlings sampled. No evidence of turtle hatchlings were observed in any of the samples.

Often, "wrong way" turtle hatchlings are observed on the Tern Island runway in the daytime. No seabirds have been observed trying to take these hatchlings, even though thousands of birds

are overhead. Ruddy turnstones (Arenaria interpres) have been observed feeding on dead turtle hatchlings; however, none have been observed pursuing live hatchlings.

COMMENTS

Continued monitoring of green turtle nesting on Tern Island will allow us to delve deeper into the breeding biology of this species. In addition to developing better databases for the topics already discussed, we can also examine topics such as: clutch size in subsequent nests from the same female (does it remain fairly constant?), hatching success of subsequent nests from the same female, hatching success of nests laid early in the season compared to ones laid in mid-season or at the end of the season, relay intervals within a season, re-nesting cycles, etc.

Table 1. Nesting and hatching phenology of Green turtles at Tern Island, French Frigate Shoals, 1989.

Activity	Month												Total
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec				
Nesting	1(0.9) ¹	15(14.6)	33(32.0)	35(34.0)	15(14.6)	4(3.9)	-	-	-	-	-	-	103
Hatching	-	-	-	9(8.9)	31(30.7)	33(32.7)	24(23.8)	1(1.0)	3(3.0)	101			

¹Number of nests (% of total nests).

Table 2. Nesting and hatching phenology of green sea turtles at Tern Island, French Frigate Shoals, 1988.

Activity	Month												Total
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec				
Nesting	2(2.3) ¹	10(11.4)	26(29.5)	34(38.6)	13(14.8)	2(2.3)	1(1.1)	-	-	-	-	-	88
Hatching	-	-	-	13(15.3)	24(28.2)	35(41.2)	11(12.9)	1(1.2)	1(1.2)	1(1.2)	1(1.2)	1(1.2)	85

¹Number of nests (% of total nests).

Table 3. Nesting and hatching phenology of green sea turtles at Tern Island, French Frigate Shoals, 1987.

Activity	MONTH							Total Number Of Nests	
	May	Jun	Jul	Aug	Sep	Oct	Nov		Dec
Nesting	1(2) ¹	8(16)	18(36)	15(30)	6(12)	2(4)			50
Hatching			1(2)	8(17)	17(35)	14(29)	6(13)	2(4)	48

¹Number of Nests (% of Total Nests)

Table 4 . Nesting and hatching phenology of green sea turtles at Tern Island, French Frigate Shoals, 1986.

Activity	MONTH							Total Number Of Nests	
	May	Jun	Jul	Aug	Sep	Oct	Nov		Dec
Nesting		8(35) ¹	7(30)	6(26)	2(9)				23
Hatching				6(26)	9(39)	6(26)	2(9)		23

¹Number of Nests (% of Total Nests) .

Table 5. Green turtles identified on Tern Island, French Frigate Shoals during the 1986-89 nesting seasons. Tag numbers followed by a R or L denote tags in the primary tag site on the right or left flipper. A R or L followed by a parenthesis denotes a tag placed in a secondary tag site; the numbers inside the parenthesis relate to the location of the tag.

1986 Confirmed Nesters

3268R
9896?

1987 Confirmed Nesters

3354L & 3358R	6866R & 6865L
9740R & 9742L	9741R & 9745L
	9747R & 9746L
9750R & 9749L	8106R & 8107L
8216R	

1988 Confirmed Nesters

3120R & 3119L	3268R & 10361L
6041R & 9355L	6374R & 6373L
6867R & 6868L	6870R & 6869L
6872R & 6871L	9771R & 9770L
10261R & 10259L & 10260R(3-4)	10266R(3-4) & 10259L
10267R & 10264L & 10263R(1-2)	10268R & 10354L
10269R & 6875L(3-4)	10273R & 10272L
10303R & 10302L	10350R
10351R & 10274L	10353R & 10352L
10355R & 10356L	10360R & 10359L(3-4)
	10369R & 10368L
10370R & 10364L	10398R & 10397L

1988 Turtles observed digging on Tern Island but without a confirmed nest

6179R	6355R & 6354L
10231R & 10230L	10270R & 10271L
10330R & 10335L	10349R
10358R & 10357L	10374R
10415R(3-4) & 10416L	10530R & 10529L(3-4)

Table 5. (continued)

1989 An effort was not made to verify nesting of turtles ashore on Tern Island; the following list is of females ashore digging.

3358R & 3354L	W207R & W206L
3396R & 3397L & W408R(2-3)	W208L
5365R & W18L	W212R & W211L
6220R & 6230R(3-4)	W214R(3-4) & W213L(3-4)
6667R & 6651L	W216R & W215L
8209R	W218R & W217L
8234R & W21L	W219R
9656R(3-4) & 9655L(2-3)	W221R & W220L
9660R & 9691L	W224R & W409L & W418R(3-4)
9732R	*W401R & W225L
9750R & 9749L	W403R & W402L
W12R & W412L & W413R	W405R & W404L
W210R & W14L	W407R & W406L
W20R & W19L	W411R & W410L
W23R & W22L	W414R & W415L
W24R & W25L	W417R & W416L
*W46R & W44L	W420R & W419L
*W121R & W120L	W421R & W422L
*W287R & W135L	W439R & W438L
*W315R & W137L	
*W198R & W197L	
W202R & W201L	
W205R & W204L & 6036L(5) & 6035R(5)	

*These turtles were also identified on East Island during the 1989 nesting season.

Table 6. Incubation periods¹ of green turtle nests monitored on Tern Island, French Frigate Shoals, 1986-89.

Year	Mean	# Nests	Range	SD	SE
1986	67.6	19	60-83	-	-
1987	63.0	34	54-85	-	-
1988	63.2	76	53-76	5.91	0.68
1989	70.5	99	59-97	6.79	0.68

¹As used here, incubation period is the time (in days) from when eggs were laid until the first hatchlings emerged.

Table 7. Hatching success of green turtles at Tern Island, French Frigate Shoals, 1986-89 seasons.

Year	# Nests	Total # Eggs	Hatched(%) ¹	Trapped(%)	Dead - stage of development				
					Full(%)	3/4(%)	1/2(%)	1/4(%)	Bad Eggs(%)
1986	23	1969	1670(84.8)	214(10.9)	5(0.3)	-----	53(2.7) ²	-----	241(12.2)
1987	48	4161	3137(75.4)	448(10.8)	88(2.1)	120(2.9)	110(2.6)	76(1.8)	630(15.2)
1988	85	8232	6603(80.2)	534(6.5)	79(1.0)	179(2.2)	141(1.7)	95(1.2)	1135(13.8)
1989	103	9170	7514(81.9)	224(2.4)	67(0.7)	261(2.8)	128(1.4)	55(0.6)	1145(12.5)

¹ This category consists of all hatchlings that made it out of the nest alive (escaped on their own and trapped ones that were rescued).

² All partially developed hatchlings were lumped together in 1986.

Table 8. Hatching success summary of 103 green turtle nests at Tern Island, French Frigate Shoals, 1989.

Item	Total	% of total eggs	\bar{x} (range)	SD	SE	# nests with item	% nests with item
Eggs	9170	100.0	89.0(44-127)	17.47	1.72	103	100.0
Alive Hatched	7514	81.9	73.0(0-124)	23.84	2.35	101	98.1
Escaped unassisted	7290	79.5	70.8(0-125)	24.17	2.38	101	98.1
Alive-trapped	224	2.4	2.2(0-37)	4.78	0.47	48	46.6
Dead:							
Fully Dev'd	67	0.7	0.7(0-7)	1.33	0.13	34	33.0
3/4 Dev'd	261	2.8	2.5(0-32)	4.52	0.45	59	57.3
1/2 Dev'd	128	1.4	1.2(0-17)	2.92	0.29	33	32.0
1/4 Dev'd	55	0.6	0.5(0-6)	1.16	0.11	25	24.3
Bad eggs ¹	1145	12.5	11.1(0-84)	14.30	1.41	97	94.2

¹This category includes both rotten and infertile eggs.

Table 9. Hatching success summary of 85 green sea turtle nests at Tern Island, French Frigate Shoals, 1988.

Item	Total	% of total eggs	\bar{x} (range)	SD	SE	# nests with item	% nests with item
Eggs	8232	100.0	96.8(54-146)	17.99	1.95	85	100.0
Alive Hatched	6603	80.2	77.7(0-124)	28.15	3.05	82	96.5
Escaped unassisted	6069	73.7	71.4(0-114)	27.27	2.96	82	96.5
Alive-trapped	534	6.5	6.3(0-68)	11.35	1.23	55	64.7
Dead:							
Fully Dev'd	79	1.0	0.9(0-20)	2.53	0.27	26	30.6
3/4 Dev'd	179	2.2	2.1(0-16)	3.15	0.34	47	55.3
1/2 Dev'd	141	1.7	1.7(0-19)	3.03	0.33	42	49.4
1/4 Dev'd	95	1.2	1.1(0-10)	2.11	0.23	29	34.1
Bad eggs	1135	13.8	13.4(0-114)	22.28	2.42	81	95.3

This category includes both rotten and infertile eggs.

Table 10. Hatching success summary of 48 green sea turtle nests at Tern Island, French Frigate Shoals, 1987.

Item	Total	% of Total Eggs	\bar{X} (Range)	# Nests with item	% Nests with item
Eggs	4,161	100.0	86.7 (36-117)	48	100.0
Alive hatched	3,137	75.4	65.4 (0-102)	46	95.8
Escaped unassisted	2,655	63.8	55.3 (0-96)	46	95.8
Alive-trapped	448	10.8	9.3 (0-38)	37	77.1
Alive with yolk sac	34	0.8	0.7 (0-11)	6	12.5
Dead Fully dev'd	88	2.1	1.8 (0-12)	22	45.8
3/4 dev'd	120	2.9	2.5 (0-11)	31	64.6
1/2 dev'd	110	2.6	2.3 (0-19)	27	56.3
1/4 dev'd	76	1.8	1.6 (0-23)	17	35.4
Infertile	61	1.5	1.3 (0-14)	15	31.3
Rotten	569	13.7	11.9 (0-67)	43	89.6

Table 11. Hatching success summary of 23 green sea turtle nests at Tern Island, French Frigate Shoals, 1986.

Item	Total	% of Total Eggs	\bar{x} (Range)	# Nests with item	% Nests with item
Eggs	1,969	100.0	85.6 (63-119)	23	100.0
Alive hatched	1,670	84.8	72.6 (30-112)	23	100.0
Escaped unassisted	1,456	73.9	63.3 (21-109)	23	100.0
Alive-trapped	214	10.9	9.3 (0-60)	21	91.3
Dead					
Fully dev'd	5	0.3	0.2 (0-1)	5	21.7
1/2 to 3/4 dev'd	53	2.7	2.3 (0-11)	17	73.9
Infertile or Rotten	241	12.2	10.5 (0-48)	22	95.6

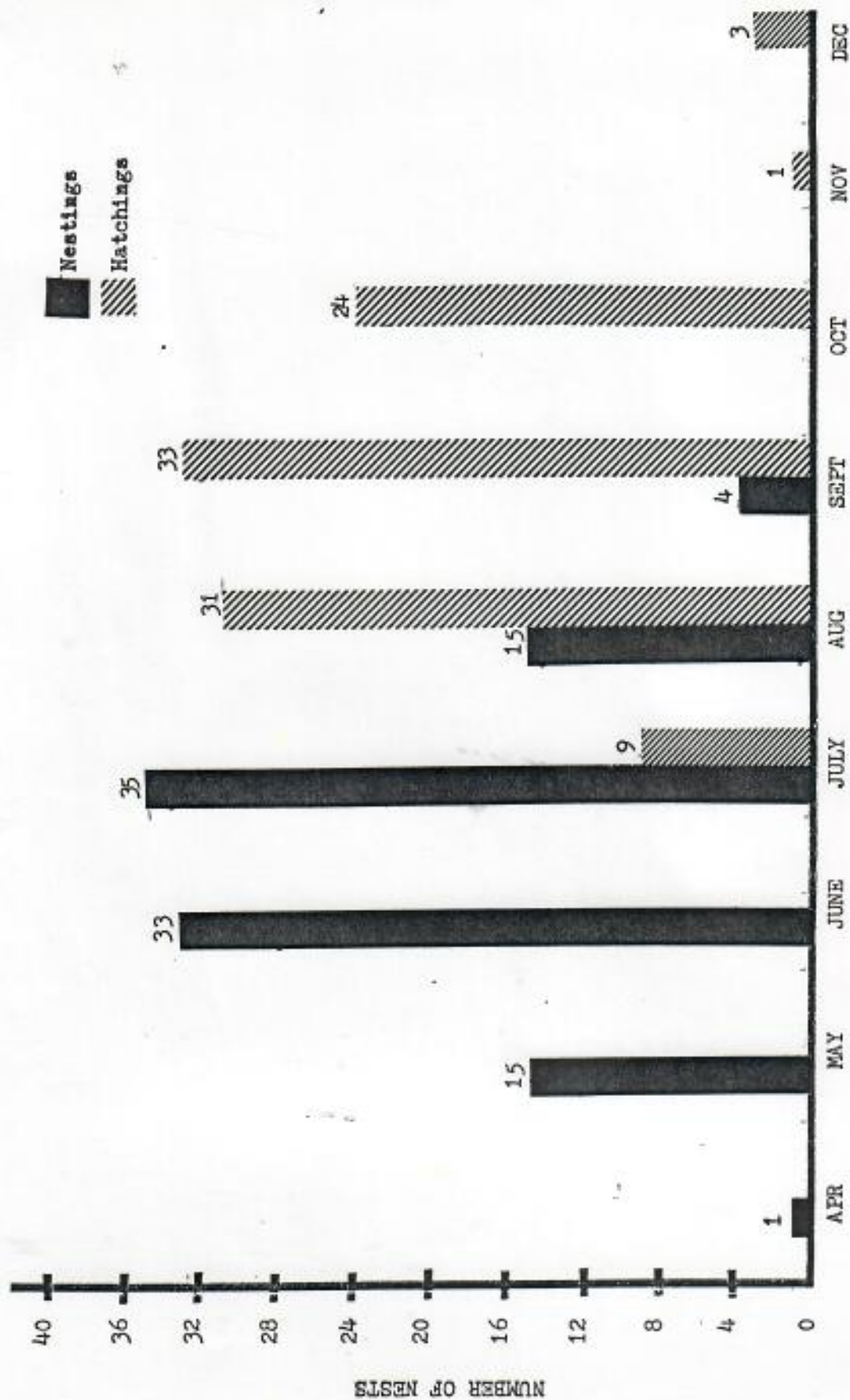


Figure 1. Hawaiian green turtle nesting and hatching at Terra Island, French Frigate Shoals, 1989. One hundred and three nests were observed. The first and last nests were laid on 28 April and 28 September, respectively. One hundred and one of these nests hatched. The first and last nests hatched on 19 July and 27 December, respectively.

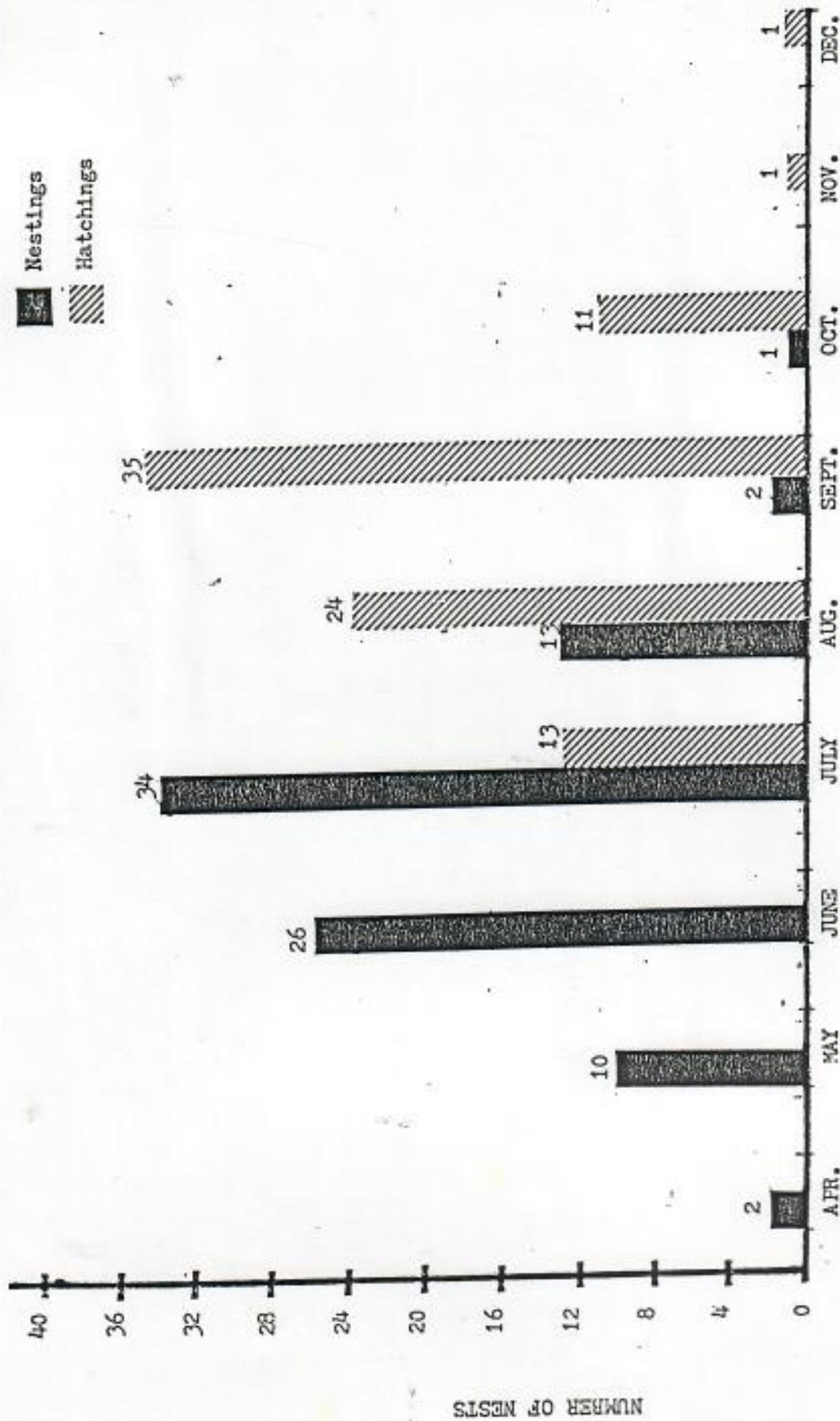


Figure 2. Hawaiian green sea turtle nesting and hatching at Tern Island, French Frigate Shoals, 1988. Eighty-eight nests were observed. The first and last were layed on 26 April and 1 October, respectively. Eighty-five of these nests hatched; the first on 8 July and last on 9 December.

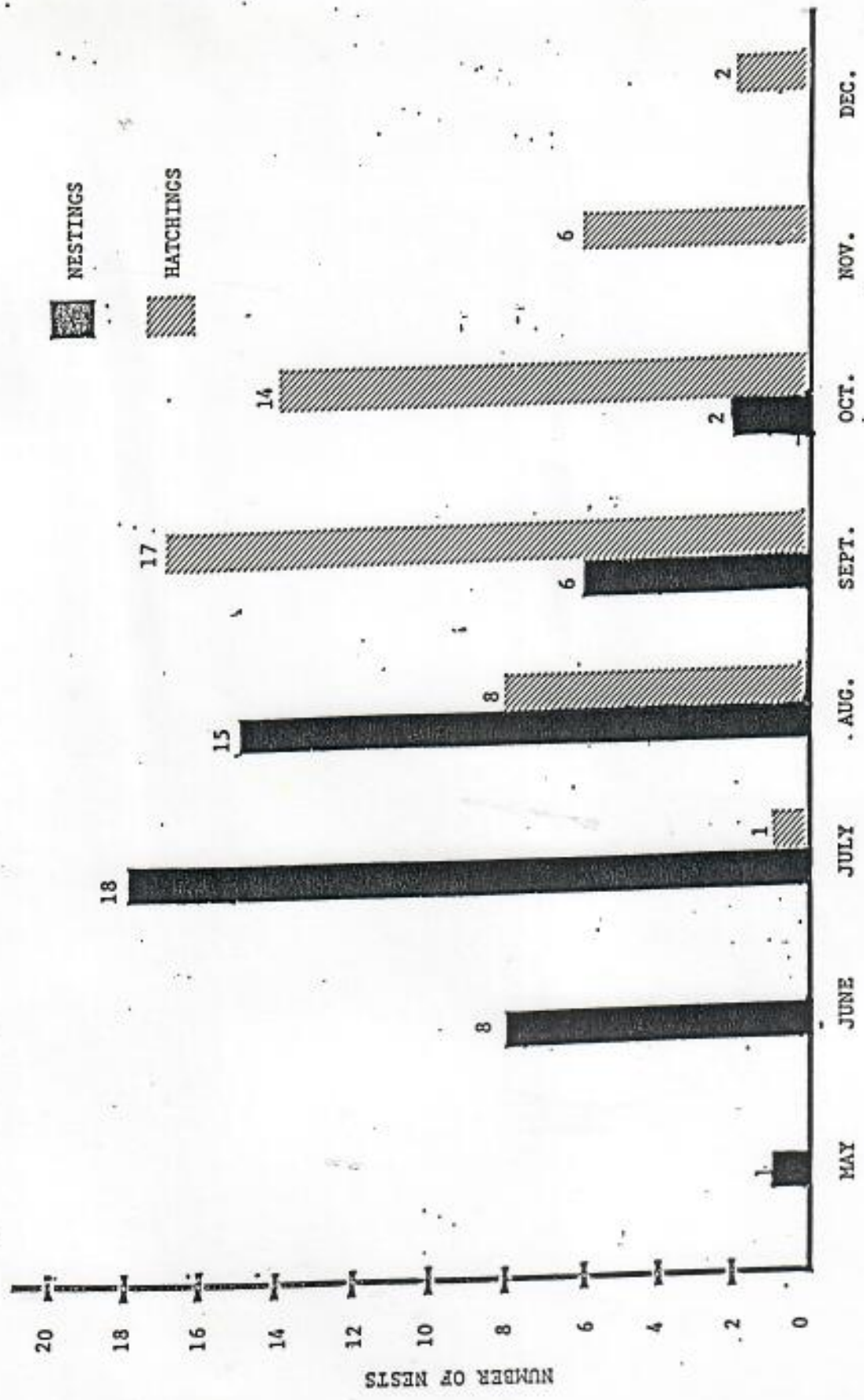


Figure 3. Hawaiian green sea turtle nesting and hatching at Tern Island, French Frigate Shoals, 1987. Fifty nests were detected. The first and last nests were laid on 25 May and 20 October, respectively. Forty-eight nests hatched; the first on 29 July and last on 26 December.

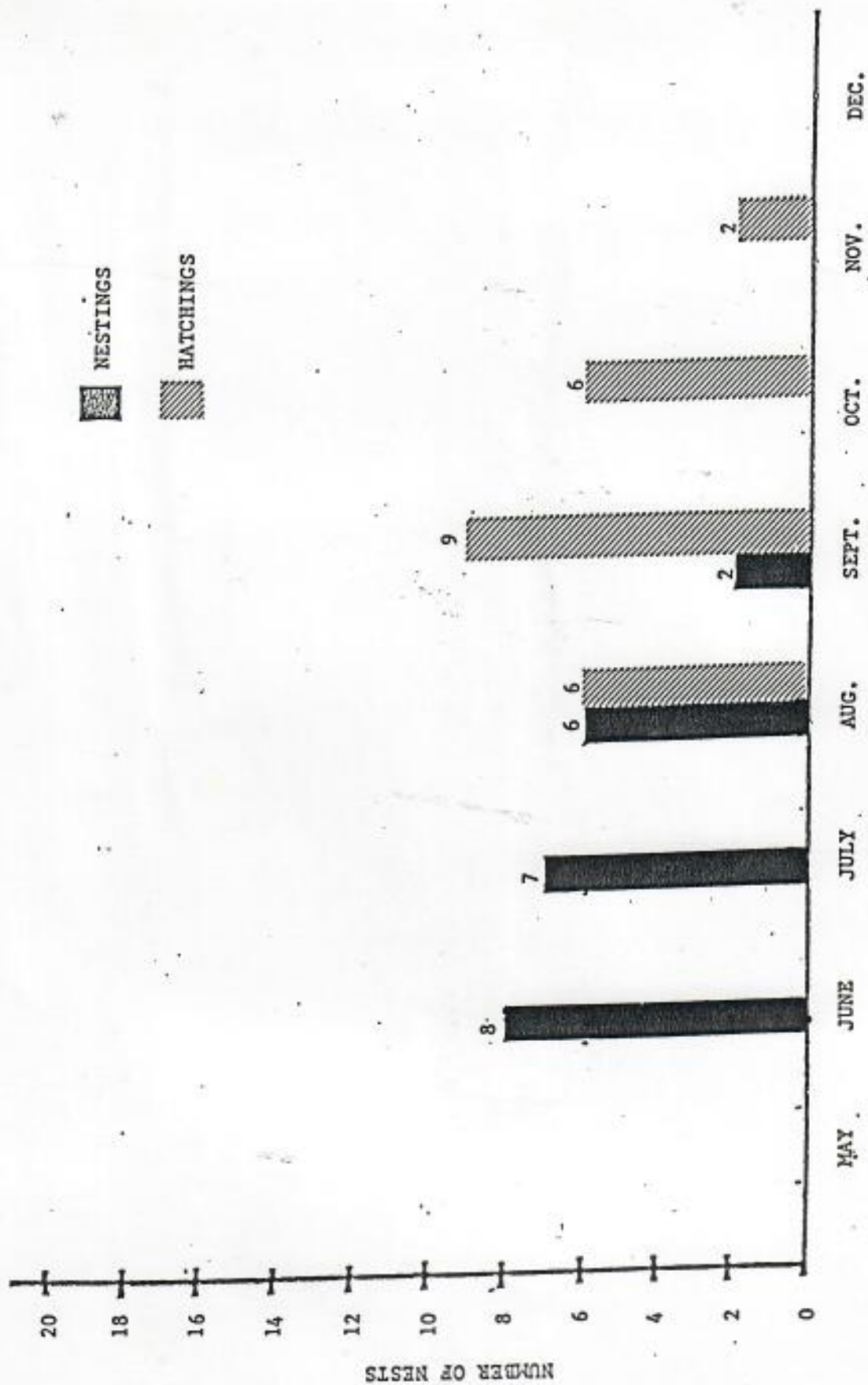
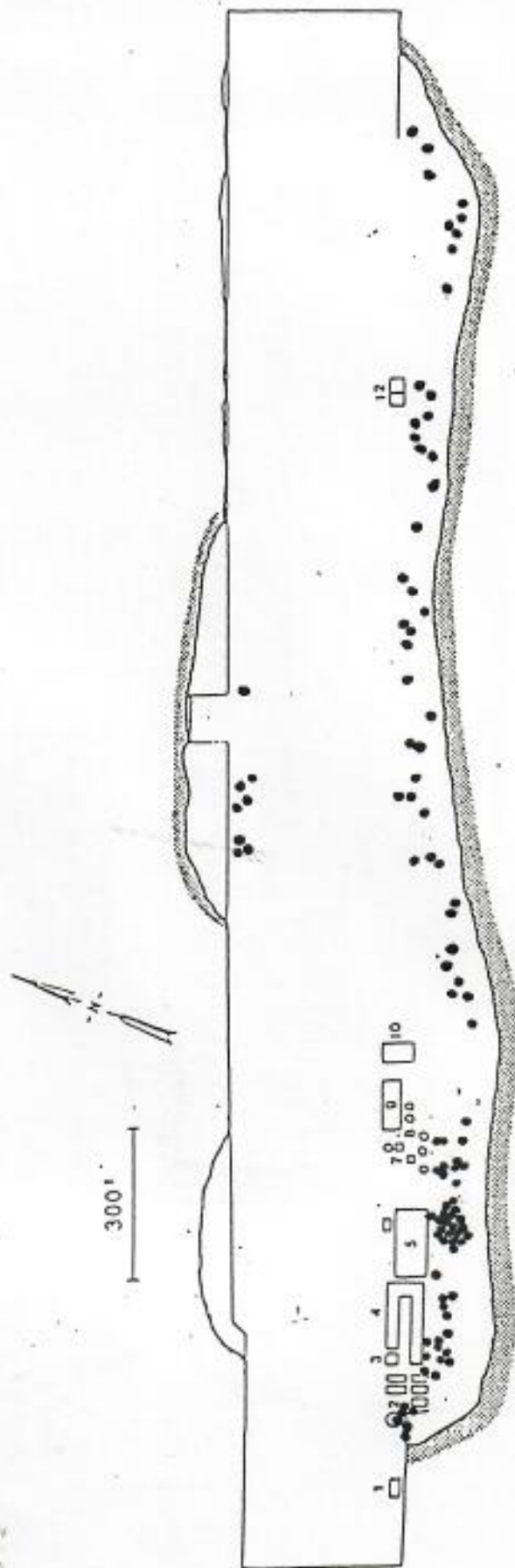


Figure 4. Hawaiian green sea turtle nesting and hatching at Tern Island, French Frigate Shoals, 1986. Twenty-three nests were found. The first and last nests were laid on 6 June and 22 September, respectively. All 23 nests hatched; the first on 15 August and last on 16 November.

Figure 5. Locations of 103 green turtle nests found on Tern Island, French Frigate Shoals, 1989



- | | |
|-------------------------------|----------------------------|
| 1. Boat House | 7. Pump House |
| 2. Fuel Oil Storage Tanks | 8. Fresh Water Tanks |
| 3. Garage | 9. Signal Power Bldg. |
| 4. Barracks-Subsistence Bldg. | 10. Old Signal Power Bldg. |
| 5. Recreation Court | 12. Storage Buildings |

Figure 6 . Locations of 88 green sea turtle nests found on Tern Island, French Frigate Shoals, 1968.

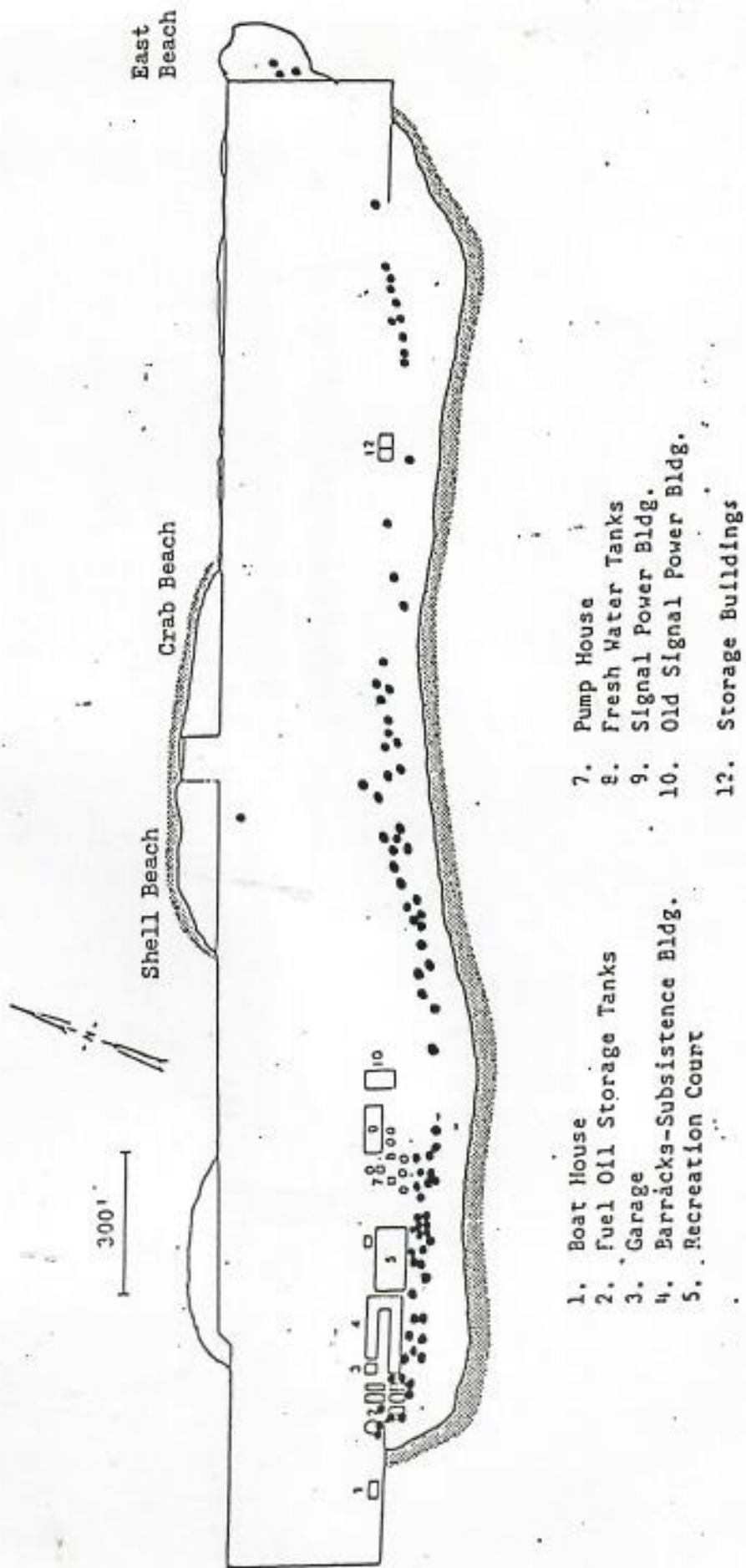
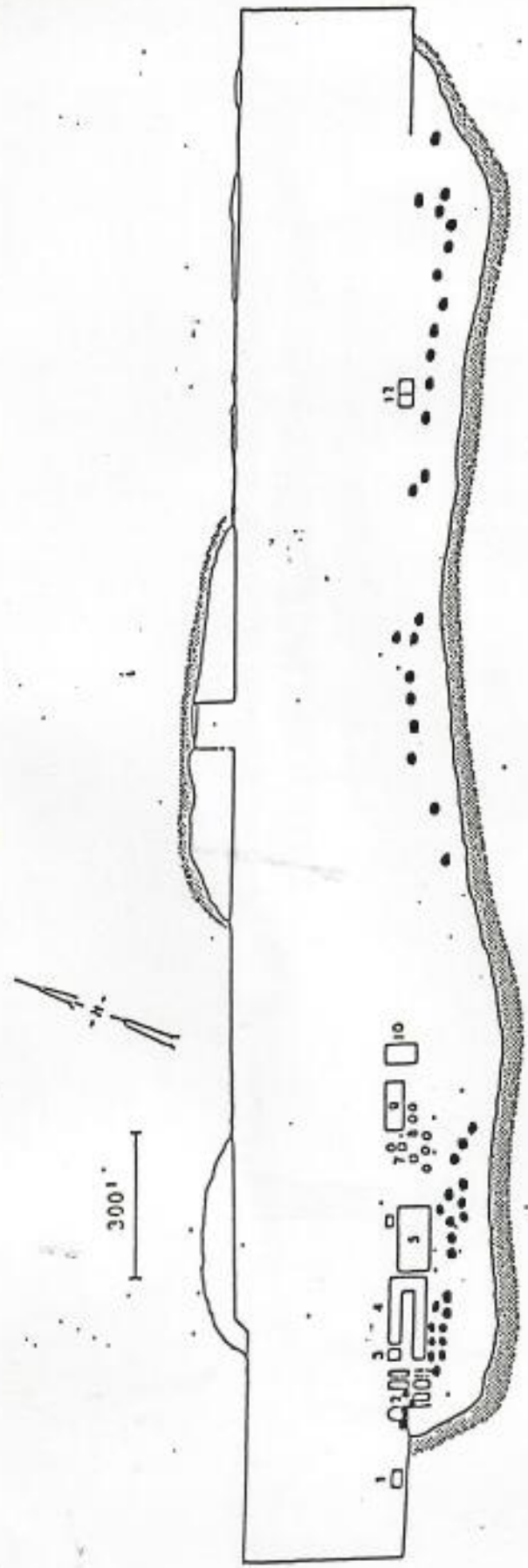
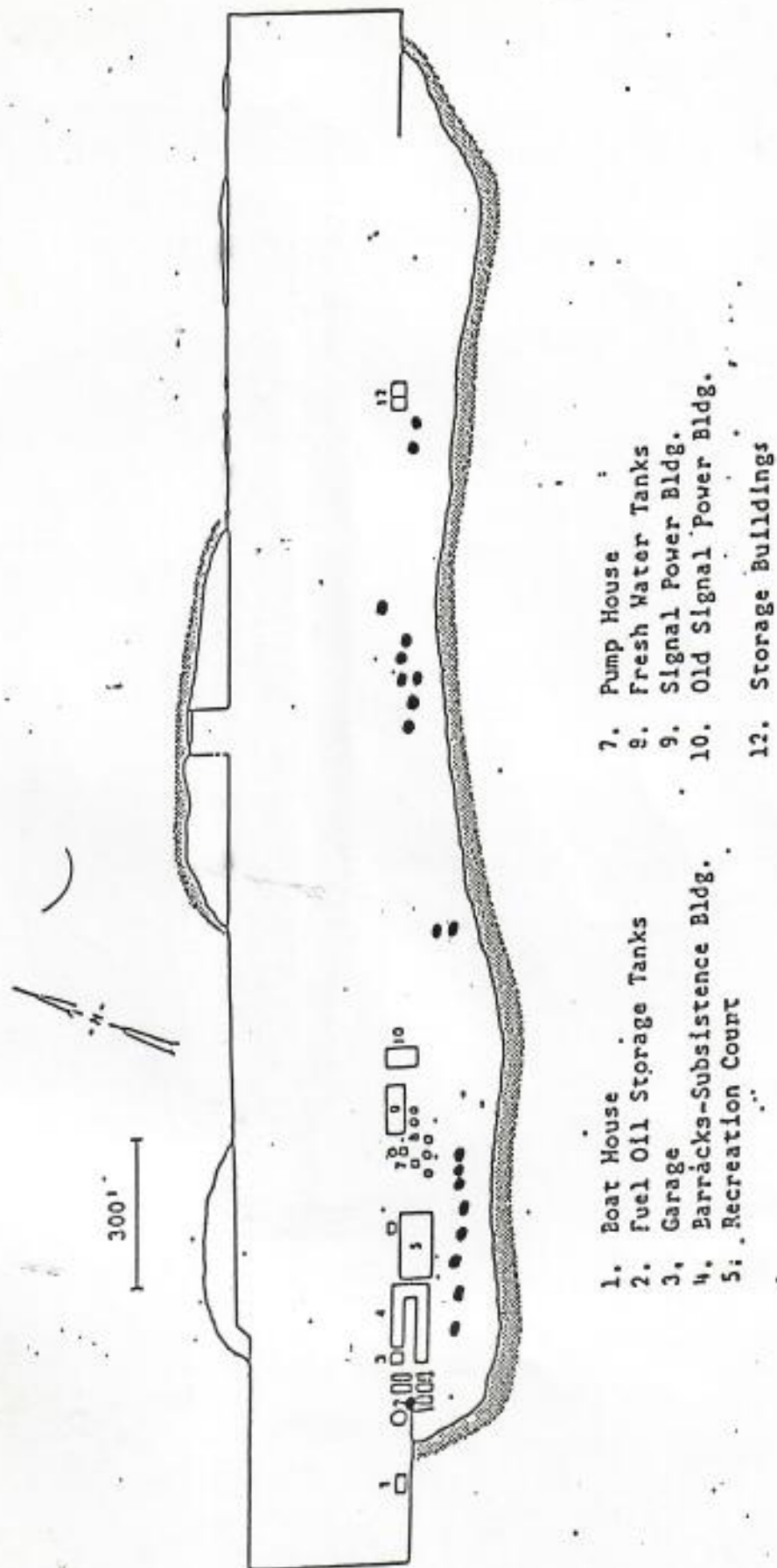


Figure 7. Locations of 48 green sea turtle nests found on Tern Island, French Frigate Shoals, 1987.



- | | |
|-------------------------------|----------------------------|
| 1. Boat House | 7. Pump House |
| 2. Fuel Oil Storage Tanks | 8. Fresh Water Tanks |
| 3. Garage | 9. Signal Power Bldg. |
| 4. Barracks-Subsistence Bldg. | 10. Old Signal Power Bldg. |
| 5. Recreation Court | 12. Storage Buildings |

Figure 8. Locations of 20 green sea turtle nests found on Tern Island, French Frigate Shoals, 1986.



APPENDIX A

RAW DATA

1989 Tern Island Turtle Nest

Record#	NESTNO	LOCATION	LAYDATE	HATCHDATE	INCUB	EGGS	ALIVE	ESCA
							<i>Alive = Escap</i>	
1	19	497/35	05/21/89	07/19/89	59	81	80	
2	3	597/55	05/07/89	07/20/89	74	83	76	
3	5	383/31	05/11/89	07/20/89	70	74	69	
4	2	452/36	05/05/89	07/23/89	79	83	74	
5	18	224/46	05/20/89	07/27/89	68	79	69	
6	21	860/27	05/24/89	07/30/89	67	122	116	
7	1	728/59	04/28/89	07/31/89	94	58	27	
8	13	736/56	05/16/89	07/29/89	74	95	76	
9	6	820/40	05/13/89	08/03/89	82	90	85	
10	22	456/31	05/25/89	08/03/89	70	60	54	
11	20	735/55	05/23/89	08/07/89	76	87	64	
12	27	748/55	06/01/89	08/08/89	68	78	78	
13	12	755/57	05/16/89	08/09/89	85	85	67	
14	28	392/31	06/01/89	08/10/89	70	112	112	
15	26	805/56	06/01/89	08/11/89	71	94	53	
16	40	741/59	06/12/89	08/13/89	62	120	116	
17	32	717/57	06/06/89	08/14/89	69	78	41	
18	36	717/49	06/08/89	08/14/89	67	69	65	
19	M5	311/36	06/04/89	08/14/89	71	76	67	
20	9	308/41	05/14/89	08/13/89	91	68	43	
21	30	62/34	06/02/89	08/16/89	75	88	64	
22	24	608/62	05/30/89	08/15/89	77	86	79	
23	50	820/47	06/18/89	08/17/89	60	104	21	
24	35	739/55	06/08/89	08/18/89	71	89	78	
25	42	774/46	06/13/89	08/19/89	67	86	75	
26	M4	527/49	06/04/89	08/20/89	77	96	80	
27	48	795/54	06/16/89	08/23/89	68	98	88	
28	46	806/56	06/15/89	08/21/89	67	111	98	
29	M9	824/55	06/10/89	08/22/89	73	70	64	
30	44	438/34	06/14/89	08/22/89	69	127	125	
31	52	790/53	06/18/89	08/23/89	66	68	60	
32	54	701/47	06/20/89	08/23/89	64	83	82	
33	53	169/52	06/19/89	08/24/89	66	76	57	
34	47	748/50	06/15/89	08/24/89	70	109	100	
35	51	862/28	06/18/89	08/26/89	69	92	50	
36	39	741/57	06/12/89	08/27/89	76	106	76	
37	64	826/40	06/26/89	08/29/89	64	85	78	
38	58	866/22	06/22/89	08/31/89	70	85	21	
39	67	715/58	06/28/89	09/01/89	65	116	112	
40	49	391/44	06/16/89	09/02/89	78	104	73	
41	M17	716/55	06/24/89	09/02/89	70	88	70	
42	65	788/58	06/27/89	09/03/89	68	113	85	
43	69	860/26	06/29/89	09/04/89	67	110	82	
44	68	437/30	06/28/89	09/05/89	69	85	83	
45	73	741/41	07/03/89	09/06/89	65	92	84	
46	71	822/48	07/02/89	09/06/89	66	44	44	
47	82	74/38	07/08/89	09/06/89	60	109	70	
48	74	139/50	07/03/89	09/06/89	65	126	93	
49	M18	shellB	06/24/89	09/07/89	75	93	85	
50	M22	ShellB	07/02/89	09/11/89	71	70	66	
51	72	737/55	07/02/89	09/11/89	71	88	79	
52	80	701/45	07/07/89	09/11/89	66	77	74	
53	66	740/58	06/28/89	09/12/89	76	98	90	
54	75	326/36	07/04/89	09/15/89	73	98	90	
55	70	827/56	07/01/89	09/16/89	77	105	82	
56	81	ShellB	07/07/89	09/16/89	71	121	109	
57	83	756/53	07/09/89	09/16/89	69	86	85	
58	M25	ShellB	07/09/89	09/18/89	71	81	69	

DATA

and Trapped

PED	TRAPPED	DEADFULL	DEAD3QT	DEADHALF	DEADQT	BADEGGS
73	7	0	0	0	0	1
76	0	0	3	0	0	4
65	4	0	2	0	0	3
74	0	0	2	0	0	7
68	1	0	9	0	0	1
116	0	0	1	0	1	4
27	0	0	1	8	1	21
76	0	0	0	1	0	18
85	0	0	0	0	1	4
52	2	1	0	1	0	4
64	0	1	0	17	1	4
75	3	0	0	0	0	0
67	0	0	0	9	4	5
112	0	0	0	0	0	0
53	0	0	3	0	3	35
116	0	0	0	0	0	4
40	1	0	0	5	3	29
65	0	0	0	0	0	4
67	0	0	0	0	1	8
43	0	0	0	4	3	18
64	0	1	2	6	2	13
78	1	0	1	0	0	6
21	0	0	5	3	6	69
76	2	0	0	3	2	6
75	0	0	0	0	1	10
80	0	0	3	0	0	13
87	1	0	6	0	0	4
98	0	0	3	3	4	3
61	3	0	2	2	1	1
125	0	0	1	0	0	1
60	0	1	0	0	0	7
82	0	0	1	0	0	0
53	4	1	0	6	0	12
100	0	0	0	0	0	9
50	0	4	1	0	0	37
75	1	1	3	0	1	25
76	2	0	5	0	0	2
21	0	0	2	1	0	61
110	2	1	0	2	0	1
73	0	7	12	0	0	12
70	0	3	3	0	0	12
83	2	2	6	0	0	20
80	2	0	6	0	0	22
82	1	0	0	0	0	2
83	1	0	1	1	2	4
42	2	0	0	0	0	0
69	1	0	16	9	0	14
56	37	3	2	2	0	26
76	9	3	0	3	0	2
58	8	2	0	0	0	2
79	0	0	2	0	0	7
72	2	0	1	0	0	2
90	0	0	4	0	0	4
90	0	0	0	0	3	5
81	1	0	3	1	0	19
102	7	0	1	0	0	11
85	0	0	0	0	0	1
58	11	1	1	0	0	10

60	85	754/54	07/11/89	09/19/89	70	105	85
61	77	748/58	07/05/89	09/20/89	77	78	68
62	94	700/56	07/18/89	09/20/89	64	89	64
63	86	465/38	07/12/89	09/22/89	72	84	74
64	84	159/54	07/10/89	09/22/89	74	109	89
65	91	187/47	07/15/89	09/22/89	69	94	58
66	93	719/50	07/17/89	09/23/89	68	81	48
67	87	360/31	07/13/89	09/24/89	73	109	99
68	M32	874/29	07/26/89	09/25/89	61	95	77
69	106	293/41	07/13/89	09/25/89	74	115	103
70	96	ShellB	07/18/89	09/26/89	70	69	48
71	103	824/55	07/25/89	09/27/89	64	83	76
72	111	721/54	08/02/89	10/01/89	60	69	43
73	101	457/33	07/24/89	10/02/89	70	88	85
74	108	180/53	07/30/89	10/02/89	64	67	54
75	100	685/65	07/23/89	10/03/89	72	99	86
76	102	497/42	07/24/89	10/03/89	71	77	49
77	105	580/53	07/26/89	10/01/89	67	75	49
78	110	740/50	08/02/89	10/07/89	66	100	96
79	98	754/58	07/22/89	10/05/89	75	88	81
80	109	ShellB	07/30/89	10/09/89	71	102	82
81	16	490/46	05/20/89	/ /	0	108	105
82	107	533/49	07/27/89	10/10/89	75	57	45
83	99	748/52	07/22/89	10/10/89	80	56	48
84	M41	876/29	08/12/89	10/11/89	60	49	36
85	M34	748/55	08/02/89	10/12/89	71	97	92
86	117	837/41	08/12/89	10/13/89	62	107	107
87	112	ShellB	08/08/89	10/13/89	66	95	89
88	115	400/29	08/11/89	10/15/89	65	82	80
89	118	86/34	08/13/89	10/16/89	64	79	78
90	M37	CrabBe	08/04/89	10/16/89	73	81	55
91	114	570/58	08/10/89	10/16/89	67	74	68
92	113	330/40	08/09/89	10/16/89	68	116	108
93	119	395/32	08/14/89	10/17/89	64	96	89
94	120	384/36	08/18/89	10/19/89	62	94	89
95	122	302/41	08/22/89	10/27/89	66	94	80
96	25	618/63	05/30/89	/ /	0	57	0
97	88	348/37	07/13/89	/ /	0	84	0
98	41	715/50	06/12/89	/ /	0	117	116
99	124	756/53	08/23/89	10/30/89	68	101	93
100	127	410/29	09/05/89	11/22/89	78	86	74
101	129	589/59	09/17/89	12/07/89	81	77	67
102	132	424/41	09/28/89	12/17/89	80	98	53
103	130	840/44	09/21/89	12/27/89	97	73	27

1283 10th Street, 10th St, 10th St

85	0	1	2	0	0	17
68	0	2	2	0	0	6
64	0	4	2	0	0	19
74	0	0	3	0	0	7
88	1	0	13	2	0	5
57	1	3	11	3	0	19
48	0	0	19	2	0	12
98	1	0	6	0	0	4
76	1	0	9	1	0	8
102	1	0	2	0	0	10
48	0	1	4	2	0	14
72	4	1	4	0	0	2
43	0	0	3	1	4	18
85	0	1	0	0	0	2
54	0	0	3	0	4	6
81	5	2	2	0	0	9
49	0	0	4	17	0	7
48	1	0	4	3	0	19
96	0	0	0	0	1	3
81	0	0	2	0	0	5
79	3	0	0	0	0	20
105	0	0	0	0	0	3
45	0	0	0	1	2	9
48	0	0	1	1	2	4
29	7	0	5	0	0	8
92	0	1	0	0	0	4
107	0	0	0	0	0	0
84	5	0	0	0	0	6
79	1	0	0	0	0	2
72	6	1	0	0	0	0
54	1	0	0	0	1	25
66	2	0	0	0	0	6
101	7	6	1	0	0	1
83	6	3	0	0	0	4
80	9	0	0	0	0	5
80	0	2	1	1	0	10
0	0	0	0	0	0	57
0	0	0	0	0	0	84
116	0	0	0	0	0	1
93	0	1	0	0	0	7
74	0	0	4	3	0	5
53	14	0	6	0	0	4
40	13	0	0	4	1	40
10	17	5	32	0	0	9

Island: TERNYear: 1989

Nest #	Nest DATE/Time	Location EW NS	Turtle Tag #s	Paint #	# false PITs	Hatch date/Time	# Inhabitation Days	Stake Position	Comments
1	4/28	728 59	no tags	—	0			1M inland	P
2	5/5 before 0730	452 36	—	—	2			1M inland	P
3	5/7 before 0715	597 55	—	—	4			1M inland	P? click along nest at deep as usual
4	5/10 before 0700	860 26	—	—	0			3FT board	P
5	5/11 before 0700	823 21	—	—	1			1M inland	P
6	5/13 before 0700	820 40	—	—	0			1M inland	P
7	5/13 before 0700	575 58	—	—	0	Change		1M inland	P
8	5/14 before 0730	820 47	—	—	0	Make stake		4 FT board	P
9	5/14 before 0730	306 41	—	—	0			1M inland	P
10	5/14 before 0730	607 63	—	—	1	Position		2 FT INLAND	P
11	5/13 before 0900	666 65	—	—	0	Consistent		4 FT Inland	M
12	5/16 0730	755 57	R W12 L W13	B	0			4 FT Inland	P
13	5/16 before 0730	736 56	—	—	0			1 1/2 M tower	P
14	5/18 before 0830	646 65	—	—	3			1M tower	P
15	5/19 before 0800	813 57	—	—	2			1M tower	P
16	5/20 "	490 46	—	—	1			1M N inland	P
17	5/20 "	345 38	—	—	2			1M GNB	P
18	5/20 "	224 46	—	—	2			1M E	P
19	5/21 before 0700	497 35	—	—	2			1M W	P
20	5/23 0500	735 55	9555 L 9558 R	—	1			1M N	P
21	5/24 ?	860 27	—	—	2			4 FT tower	P
22	5/25 ?	456 31	—	—	0			1M North	P
23	5/26 before 0600	560 53	—	—	0			1M N	N
24	5/30 1:15	609 62	3354 L 3358 R	—	2			1M inland	P
25	5/30 2:30	618 63	—	C	0			1M inland	P

NEST FORM

Island: TERNYear: 1989

Nest #	NEST DATE / Time	Location EW NS	Turtle Tag #s	Paint #	# False PITS	Hatch date / Time	#Incuba-Tion Days	Stake Position	Comments
26	6/1	805 56			0				
27	6/1 1016	748 55	8234 R W21 L		0				
27	6/1	546 51			0				
28	6/1	392 31			0				
29	6/1	196 48			1				
30	6/2 0930	62 34	no tag		0				
M2	6/3	669 60			3				
M3	6/3	597 60							
M4	6/4	527 49	OVER K 665 L		1				Probable
M5	6/4	311 36	?		2				Probable
21	6/5	368 31	W204 L		3				
M6	6/4	94 46			0				
32	6/6 0600	717 57	7652 L 8656 R		3				N
33	6/6 ?	533 48			0				P
34	6/7 Am	424 39			0				
M7	6/7	Shell Beach	W23 R W21 L		6				maybe bit doubtful
35	6/8	739 55	3392 L W202 R		0				
36	6/8	717 49			3				
M8	6/8	691 64			?				
37	6/8	438 38			1				
M9	6/10	824 55	M4L W46R	East 19	?				
38	6/10	300 40	1904 L		1				P
M10	6/10	800 54	C		4				maybe a mistake
39	6/12 ?	741 57	W-23 R		0				P
40	6/12 0600	721 59	W204 L	East 19	0				Not

P

Island:

TERN

Year: 1989

Nest #	NEST DATE/Time	Location EW NS	Turtle Tag #'s	Paint #	# False PITS	Hatch date/Time	# in incubation Days	Stake Position	Comments
60	6/22	306 42			0				P
61	6/23	384 32			8?				P
M16	6/23	387 40			9				M
M17	6/24	712 55			1				M
M15	6/24	Shell bench			3		Between Pier & Rocks		M
62	6/25	456 38			0				P
M19	6/26	842 41			0				M
63	6/26	338 39			0				P
64	6/26	826 40			0				P
65	6/27	788 58			0				P
66	6/28	740 58			0				P
67	6/28	715 58			0				P
68	6/28	437 30			0				P+
69	6/29	860 26			0				P
M20	6/30	778 49			2				M
M21	6/29	689 62			1				M
70	7/01	827 56		197	0				P
71	7/02	822 48			1				P
72	7/02	737 53			0				P
M22	7/02	Shell bench			5				M
73	7/03	741 41			3				N
74	7/03	139 50			0				P
75	7/04	326 36			2				P
76	7/04	305 37			2				P
77	7/05	748 58			1				P

Eggs found at beach within 100 ft. closest to beach

GREEN SEA TURTLE

NEST FORM

Island: _____

Year: _____

Nest #	NEST DATE / Time	Location EW / NS	Turtle Tag #s	Paint #	# False Pits	Hatch date / Time	# incubation Days	Stake Position	Comments
78	7/06 6:30 AM	493 41	953 L 952 R		3				P
79	7/06	322 37			0				P
M23	7/06	146 50			0				M
80	7/07	701 45			0				P
81	7/07	Shell beach			0			4 ft rocks	P nest about 1/2 way between Log & East End of Shell B.
M24	7-08	740 54			2			SN	
82	7-08	407 38	none		3			SN N	Nest
83	7-09	756 53			0				P
M25	7-09	Shell Beach	3397 L 2408 R 27		0	mean 118 - eggs sand bc just making - no eggs			P
84	7-10	159 54			0				P
85	7-11	754 54	W12R	B	2				No L tag
86	7-12	465 38			0				P
M26	7-12	415 29			2				M
M26	7-12	455 41			3				M
M27	7-12	850 42			2				M
M28	7-12	305 37			0				M
87	7-13	960 31			0				P
88	7-13	348 37			1				P
89	7-13	283 41			0				P
90	7-14	776 43			1				P
M29	7-15	496 42			1				M
91	7-15	187 47			0				P
M30	7-17	822 41			1				M
92	7-17	717 55			0				
93	7-17	719 50			0				

GREEN SEA TURTLE

NEST FORM

Island: TERNYear: 1989

Nest #	NEST DATE / Time	Location EW NS	Turtle Tag #s	PAINT #	# False PITs	Hatch date / Time	#Incuba-Tion Days	Stake Position	Comments
94	7/18	700 56			0			P	
95	7/18	538 49 Shell punch			1			P	
96	7/18				2			P	on Bush west end of shell bench spreading its way to live away
97	7/18	475 44			3			P	
98	7/22	254 58		A	0			N	
99	7/22	748 52		G	1			N	
M31	7/22	304 40			4?			M	
101	7/23	685 65			?			P	
102	7/23	457 33		H	1			N	
102	7/24	497 42			1			P	
M32A	7/24	341 40			0			M	
103	7/25	824 55		B	0			N	
M32B	7/26	874 29			0			M	
104	7/26	587 57			3			P	
105	7/26	580 53			0			P	
106	7/26	298 38			0			P	
107	7/27	533 49			1			P	
M33	7/27	546 52			0			M	
108	7/30	180 53			0			N	
109	7/30	Shell Bench JUST SE of east end of log			1			P	
M34	8/02	748 55			0			M	On 10/10 nest 29 some eggs destroyed
M35	8/02	735 54			0			M	
110	8/02	740 50			0			P	
111	8/02	721 54			1			P	
M36	8/02	607 58			?			M	

GREEN SEA TURTLE

NEST FORM

Year: 1989

Island: TERN

Nest #	Nest Date/Time	Location EW/NS	Turtle Tag #s	Paint #	# False Pits	Hatch date/Time	#Incuba-Tion Days	Stake Position	Comments
M37	8/4	Crab Beach			0			No stake	Least possible nest M
M38	8/6	Shell beach			1				M Just East of clearing
M39	8/8	285/42 Shell beach		DD	0				M
112	8/8			?	1				P mark of foot
113	8/9	330/40			0				P
114	8/10	520/58			0				P
M40	8/9	4/9/29			1				M
115	8/11	400/29			0	NO NEST			P
116	8/11	243/44		K	3				P
117	8/12	837/41	W497R	178	2				N
M41	8/12	876/29			0				M
118	8/13	86/34			1				P
119	8/14	325/32			1				P
M42	8/15	682/64			0				M
120	8/18	384/36			0				P
121	8/21	242/43			2	NO NEST			P-
122	8/22	302/41			1				P
123	8/22	Shell beach			3	NO NEST			Just east of log - in Swamp of nests
124	8/23	756/053	W457W468	A	3				N
M43	8/24	244/45		K	5				M
125	8/25	138/50		K?	8				P
M44	8/27	701/41			0				M
126	9/05	805/55			0				maybe plus
127	9/05	410/29			0				P+
128	9/08	66/36			0				M+

GREEN SEA TURTLE

HATCHING SUCCESS FORM

Year: 1989

Island: TERN

Nest #	Hatch date / Time	pre-hatch PIT	Total Eggs	"Alive" Hatched	Escaped		Dead but part. developed		Bad Eggs	Comments
					Unassisted	Trapped OK	Full	1/2		
19	7/19	?	81	80	73	1			1	
3	7/20/89	Y	83	76	76	0	3		4	
5	7/20/89	Y	74	67	65	4	2	1	2	Sign of mold on 0140
2	7/23/89	Y	83	74	74	1	2	1	7	All part develop stages about same stage
10	7/26-7/28	??	99	69	68	1	1	1	4	ONE P/B NEST
11	7/30	Y	122	116	116	0	1	1	21	High To Fe stage, was covered several times
13	7/31	?	58	27	27	0	1	1	18	one pin for egg in nest
6	8/3	?	90	85	85	0	1	1	4	5 birds on nest
22	8/3	?	60	54	50	2	1	4	4	17 birds on nest
20	8/7	?	89	64	64	0	1	4	4	
29	8/8	?	93	75	75	3	9	4	5	
12	8/9		85	67	67	0	3	3	35	young nest! All fine sound!!
28	8/10		112	112	112	0	3	3	3	close to hatching event lots of bad eggs - high temp
26	8/11		94	53	53		5	3	4	
40	8/13		120	116	116	1	5	3	29	About 20 eggs chg by another female and destroyed
32	8/14		78	41	40	1			4	
36	8/14		69	65	65				8	
35	8/14		76	67	67				8	
9	8/14		68	43	43				8	
20	8/15		88	64	64		2	2	13	Bad eggs on top
24	8/15		84	79	78	1	1	2	4	TRAPPED OK - ARE HATCHING NEST ADJACENT TO 20
50	8/17		104	81	81		5	3	69	Nest had been partially covered by another female
35	8/18		89	78	76	2*	3	2	6	Rattapped by defecation
42	8/19		86	75	75	2*	1	1	10	

GREEN SEA TURTLE

HATCHING SUCCESS FORM

Island: TERN

Year: 1989

Nest #	Hatch date / Time	pre-hatch PIT	Total Eggs	"Alive" Hatched	Escaped UNASSISTED	Alive Trapped		Dead but part. developed			Bad Eggs INFERT ROTTEN	Comments
						OK	Yolk	Full	3/4	1/2		
M4	8-20-89		96	80	80			3			13	
48	8-23-89		98	88	87	1		6			4	
46	8-24-89		111	96	98			3	3	4	3	
M9	8-22-89		70	64	6							
44	8-22-89		127	122	125							
52	8/23/89		68	60	60			1			2	5
54	8/23/89		83	82	82			1		6	12	
53	8/24/89		76	59	53	4					9	SHALLOW NEST
47	8/24/89		109	100	100			4	1		37	
51	8/26/89		92	50	50	1		1	3		25	
34	8/27/89		106	76	75	2		1	3	1	2	SPALDING NEST 7 HATCHING, STIFF PLAST NUTRITION 1255
64	8/29/89		85	78	76	2			5		6	
58	8/31/89		85	21	21			2	1		1	
67	9/01/89		116	112	115	2		1	2			
49	9/02/89		104	73	73	-		7	12		2	10
M17	9/02/89		88	70	70			3	3		3	9
65	9/03/89		113	85	83	1	1	2	6		2	18
69	9/04/89		110	82	80	2		6	6		22	
66	9/05/89		65	63	62	1					2	
73	9/06/89		92	84	83	1		1	1	2	4	one Trapped by oval Rubble
71	9/06/89		44	44	42	2						This Trapped under sand
82	9/06/89		109	70	69	1		16	9		14	NE MUDY SAND - SHALLOW NEST
74	9/06/89		126	93	56	37		3	2	2	26	2 ATTEMPTS HATCHING ABOUT 4 HOURS FROM SURFACE
M16	9/07/89		93	85	76	9		3	3	3	2	6-12 Traps under Oval
M22	9/11/89		70	66	58	8		2			2	Trapped under oval Rubble

GREEN SEA TURTLE

HATCHING SUCCESS FORM

Year: 1989

Island: TERN

Nest #	Hatch/Time date	pre-hatch PIT	Total Eggs	'Alive' Hatched	Alive		Dead but part. developed		Bad Eggs	Comments
					Escaped unassisted	Trapped OK	Full	1/4		
72	9/11/89		88	79	79		2		7	
80	9/11/89		77	74	72	2	1		2	
81	9/12/89		98	90	90		4		4	2 white going through mesh
75	9/15/89		98	90	90			3	5	
70	9/16/89		105	82	81	1	3	1	3	16
81	9/16/89		121	109	102	7	1		11	
83	9/16/89		86	85	85				1	
M25	9/18/89		81	69	58	11	1		10	
79	9/19/89		61	48	48		1	2	10	
85	9/19/89		105	85	85		1	2	17	rocks at surface
77	9/20/89		76	68	68		2	2	6	
94	9/20/89		89	64	64		4	2	19	
86	9/22/89		84	74	74		3		7	
84	9/22/89		109	89	88	1	13	2	5	
91	9/22/89		94	58	57	1	3	11	19	
93	9/23/89		81	48	48		19	2	12	
87	9/24/89		109	99	98	1	6		4	
M32B	9/25/89		95	77	76	1	9	1	8	
90	9/25/89		115	103	102	1	2		10	
103	9/27/89		69	48	48		1	4	14	large coral rubble
111	10/1/89		83	76	72	4	1	4	2	
101	10/2/89		69	43	43		3	1	8	
108	10/2/89		88	85	85		1		2	mean pink color in some of the unhatched eggs
100	10/3/89		99	86	81	5	2	2	9	
102	10/3/89		77	49	49		4	17	7	

5 birds
Terns on D
relative to
nest

10/10/89

m

Year: 1989

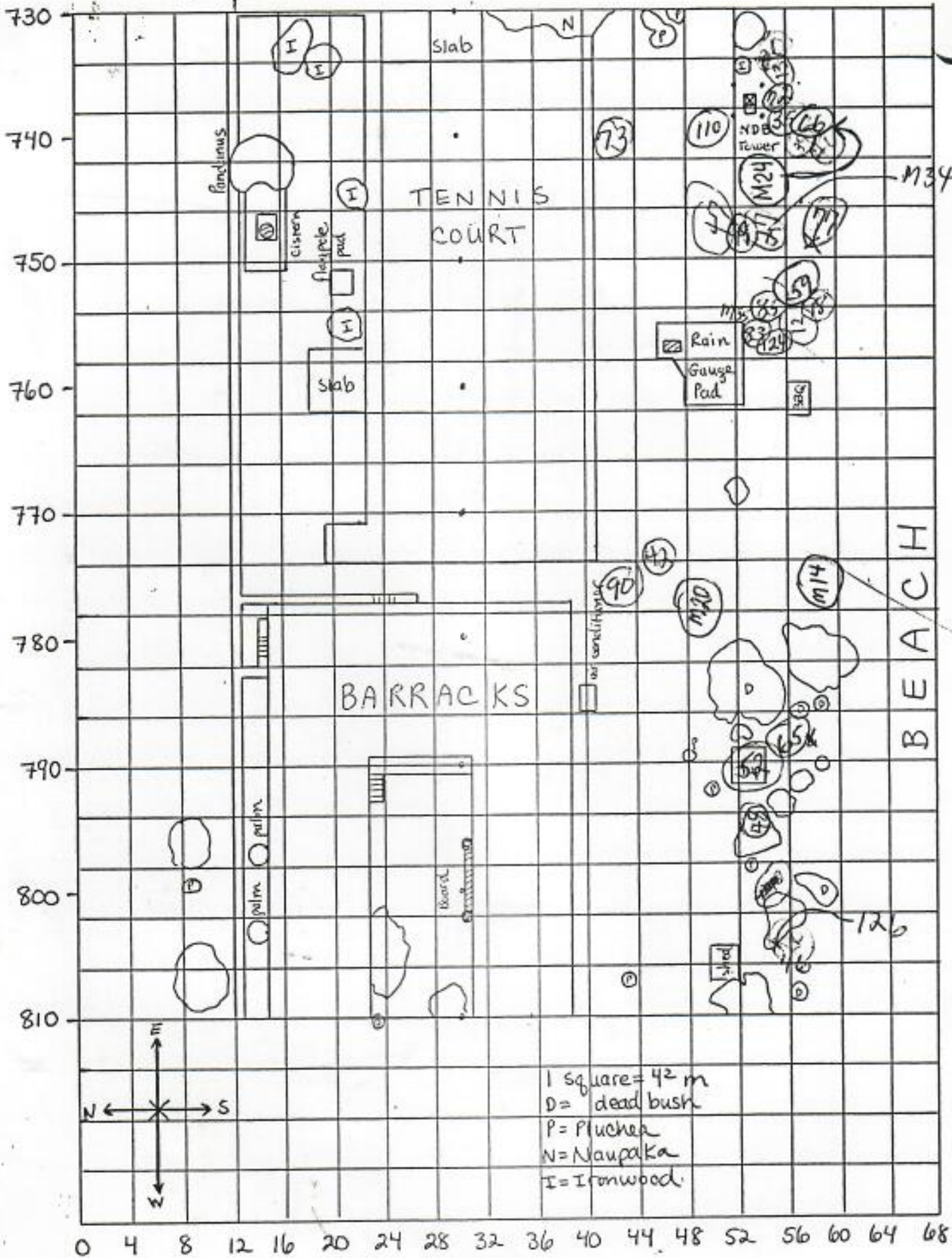
Island: Tern

Nest #	Hatch Date/Time	pre-hatch PIT	Total Eggs	"Alive" Hatched	Alive		Dead but part. developed			Bad Eggs Invert. Rotten	Comments
					Escaped unassisted	Trapped OK	Full	3/4	1/2		
✓ 105	10/1/89		75	49	48	1	4	3		19	
✓ 110	10/7/89		100	96	96				1	3	
✓ 98	10/5/89		88	81	81		2			5	coarse substrate (small beach)
✓ 109	10/07/89		102	82	79	3				20	
✓ 116	unknown		108	105	105					3	
✓ 107	10/10/89		57	45	45					9	4.5' deep
✓ 99	10/10/89		56	48	48					4	
✓ M41	10/11/89		49	36	29	7				8	
✓ M34	10/12/89		97	92	92		1			4	
✓ 117	10/13/89		107	107	107					6	coarse substrate
✓ 112	10/13/89		95	89	84	5				2	chunks of coral trapped the 6 hatchlings
✓ 115	10/15/89		82	80	79	1				25	coarse substrate
✓ 118	10/16/89		79	78	72	6			1	6	
✓ M37	10/16/89		81	55	54	1				1	
✓ 114	10/16/89		74	68	66	2				1	
✓ 113	10/16/89		116	108	101	7		1		4	
✓ 119	10/17/89		96	89	83	6		3		5	hatchlings trapped under roots of dead mangrove logs
✓ 120	10/19/89		94	89	80	9				10	small nest along beach
✓ 122	10/27/89		94	80	80	0		2	1	57	nest probably by a crab
✓ 25	orig nest Hatched									84	small nest along beach
✓ 88	orig nest Hatched									1	nest probably by a crab
✓ 41	Hatch days missed		117	116						7	nest probably by a crab
✓ 124	10/30/89		101	93	93		1			5	two nest washed over at least 2 nights
✓ 127	11/22/89		86	74	74	0		4	3	4	lots of coral rubble trapped eggs in
✓ 129	11/28/89		77	67	53	14		16		40	counted
✓ 132	12/19/89		98	53	40	13		4	1	9	over
✓ 130	12/27/89		73	30	10	19		5	32	9	

APPENDIX B
MAP LOCATIONS

SECTOR

3



March 1986 G. Narum

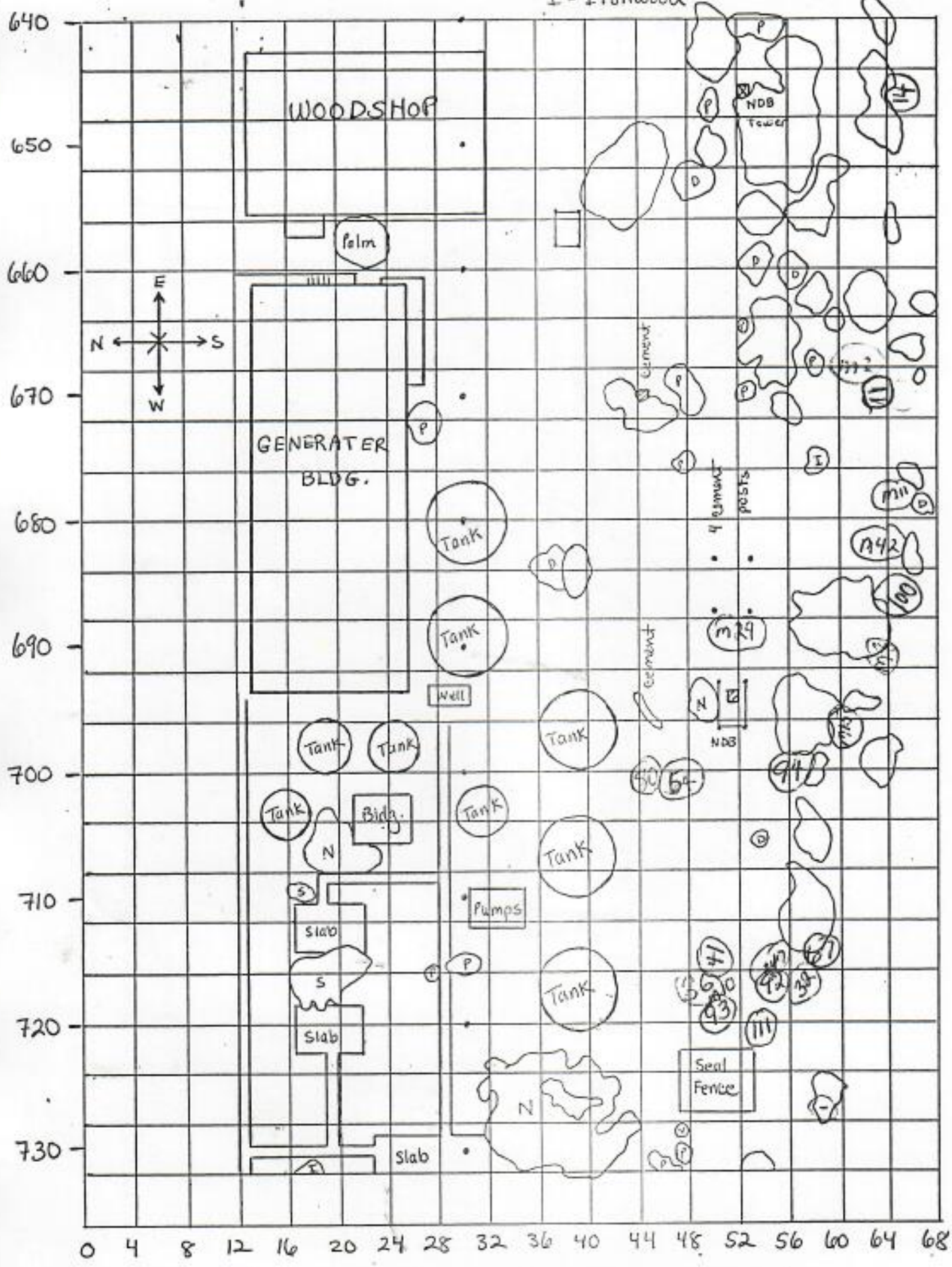
square = 4² m

SECTOR

P = Pluchea

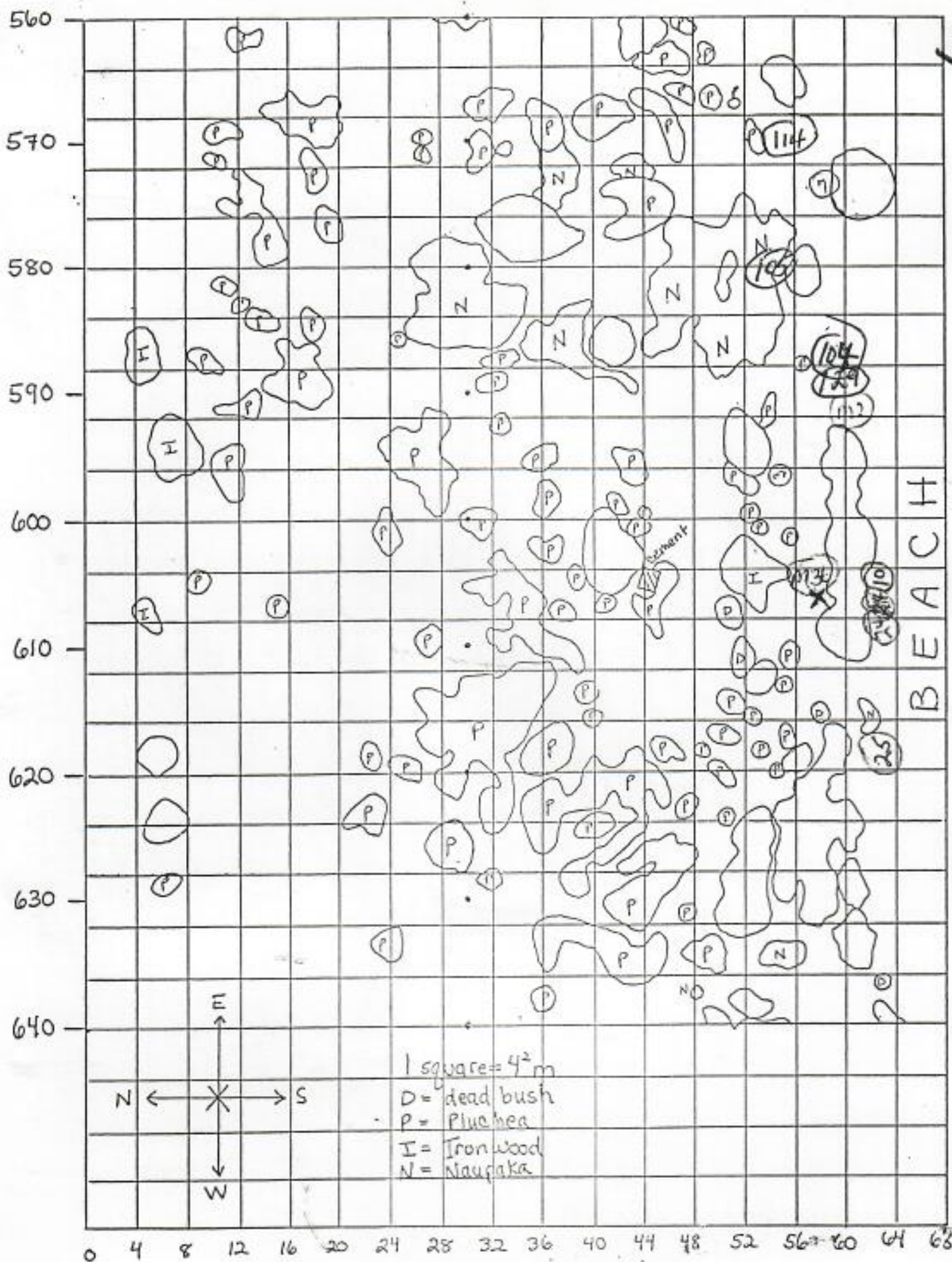
S = Sea Grape

I = Ironwood



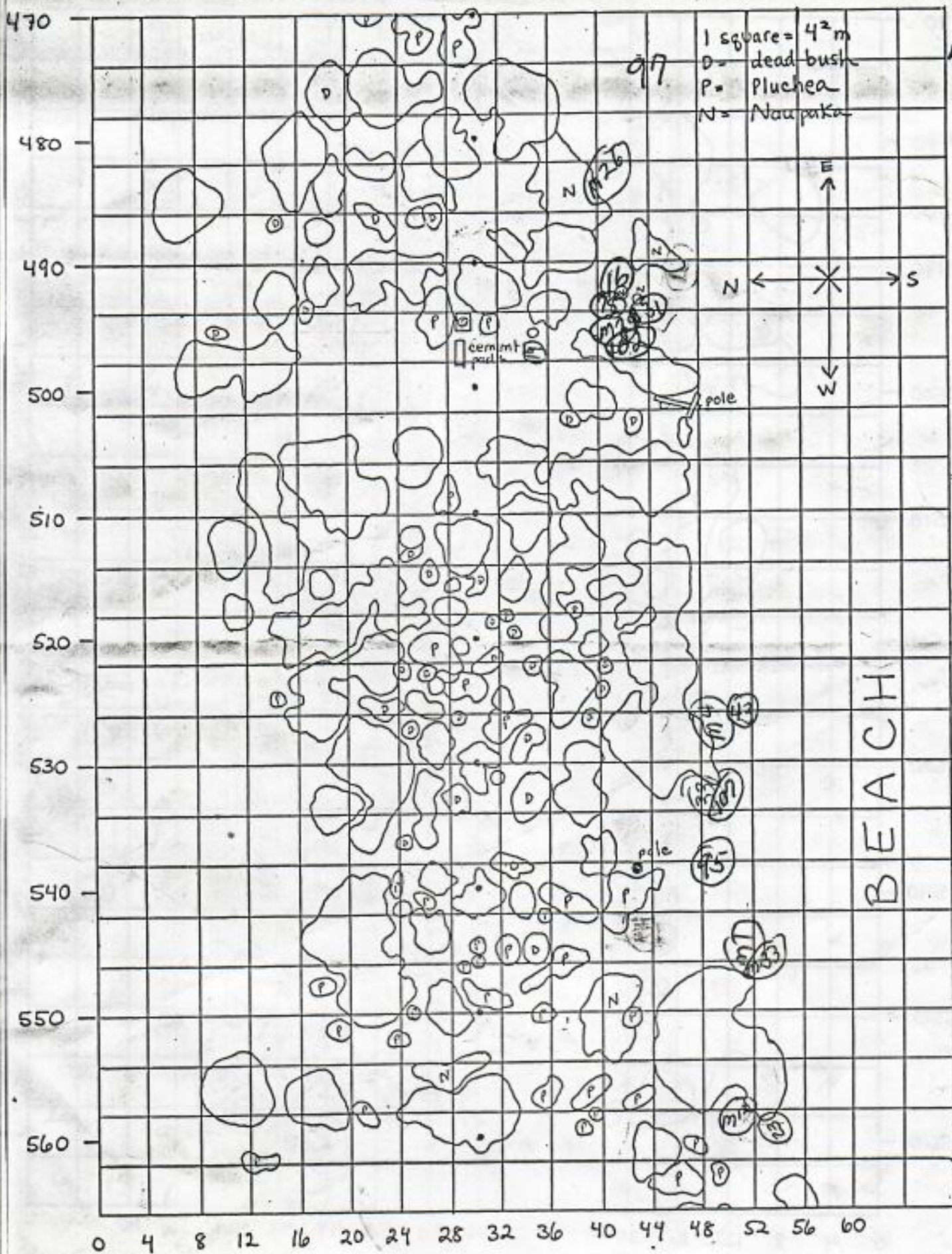
March 1986 G. Narum

SECTOR



March 1986 G. Naticum

SECTOR

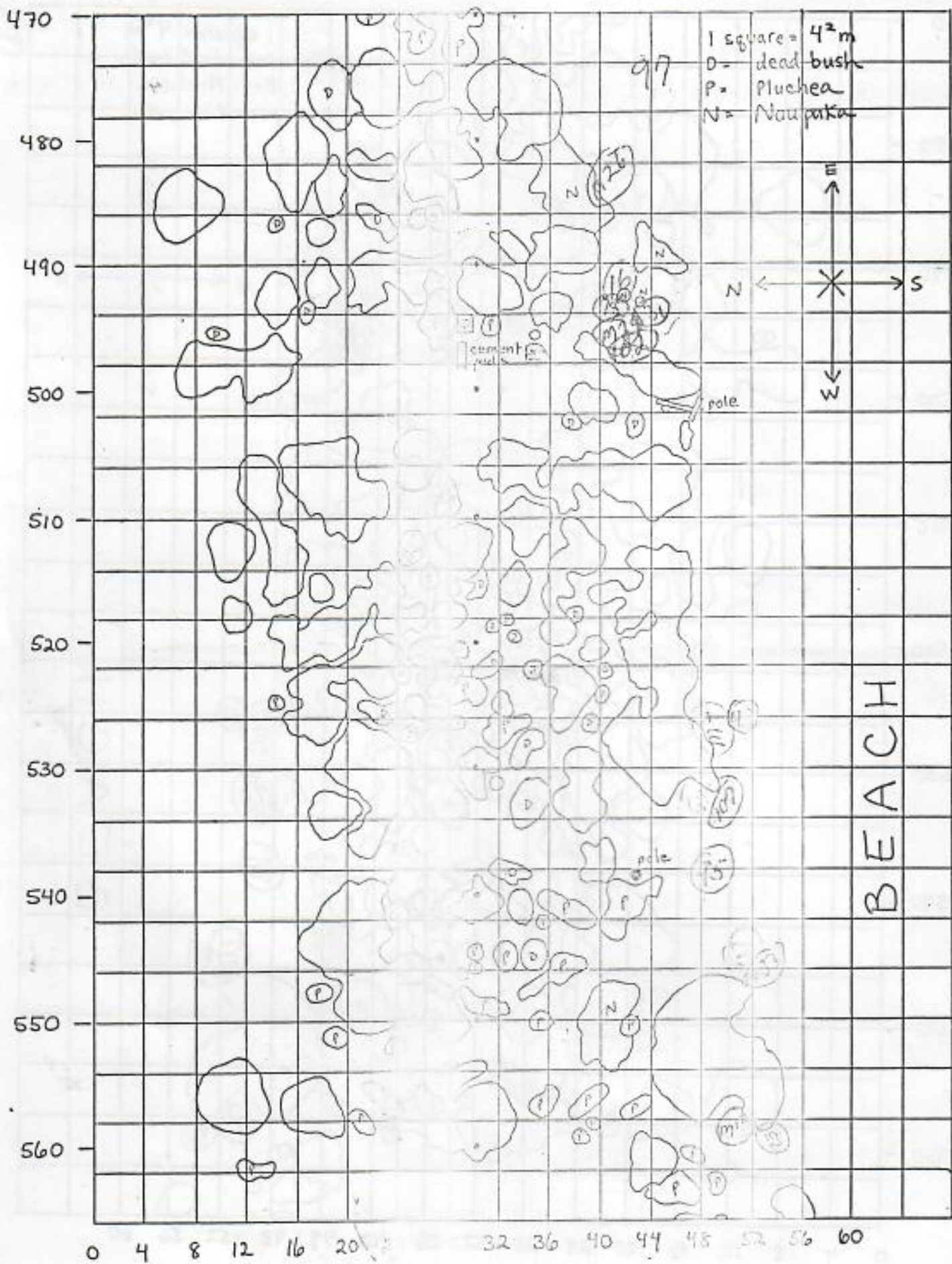


6

March 1980 G. Nair um.

SECTION

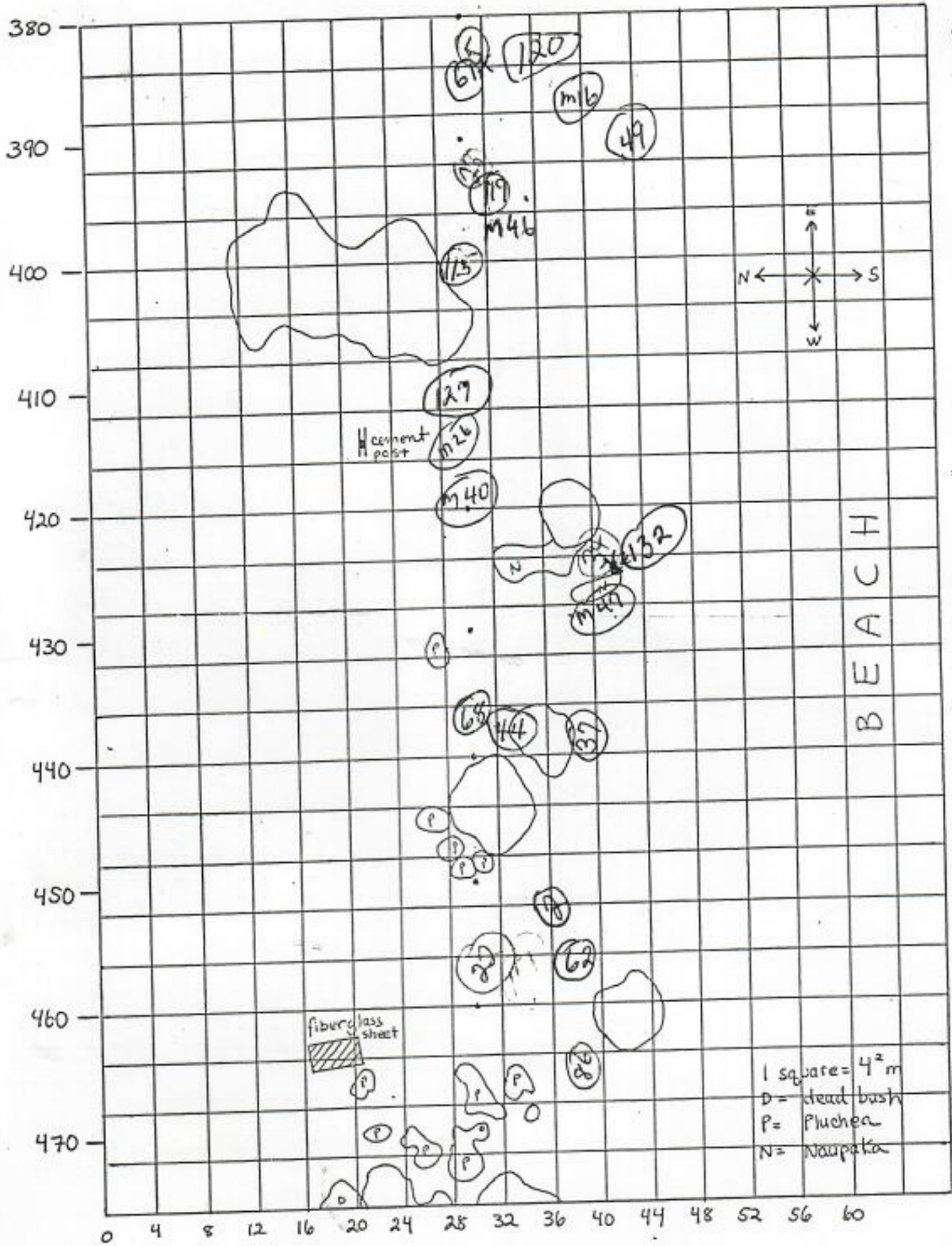
6



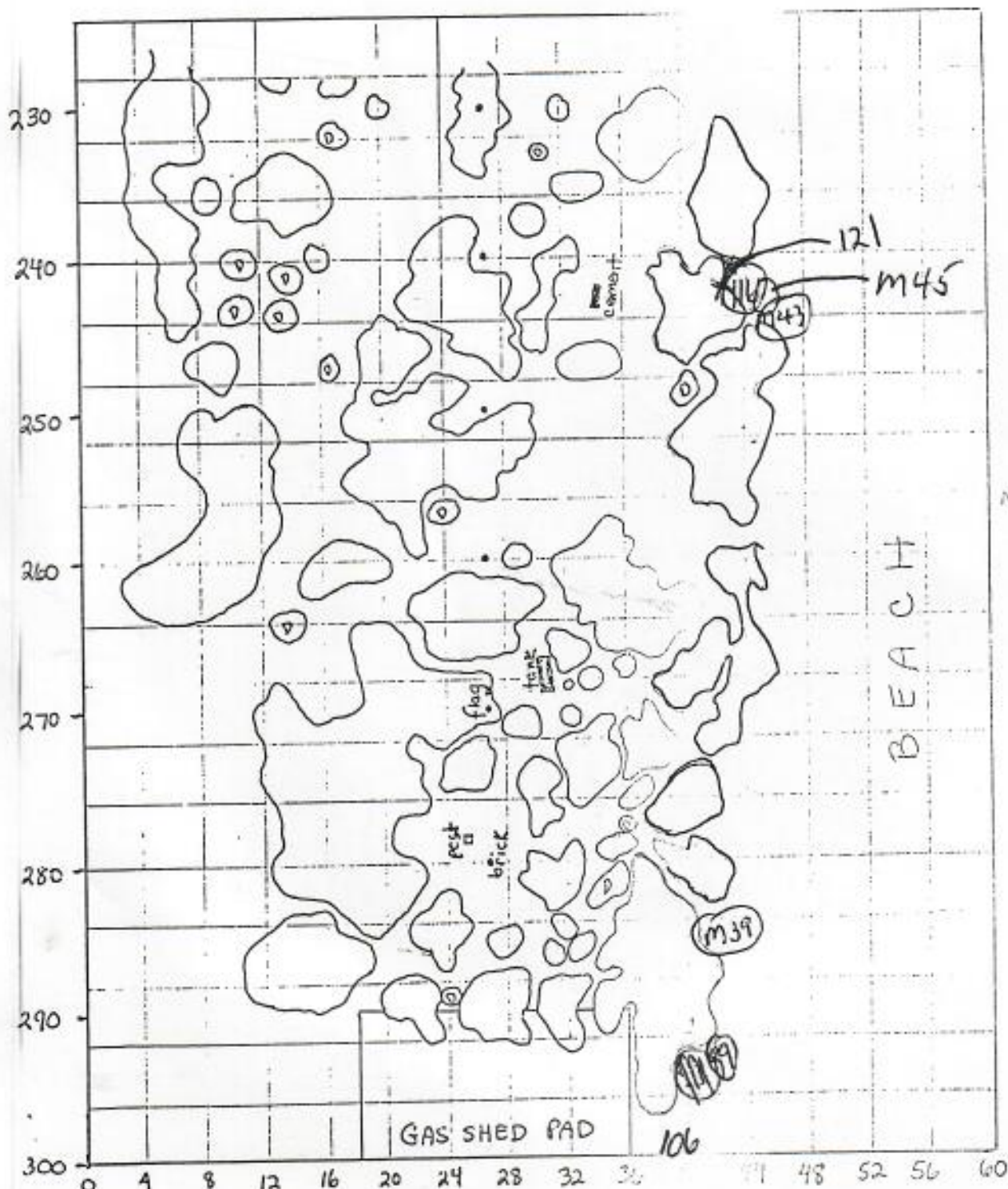
March 1980 G. Nairum.

SECTOR

7



march 1986 G. Narum

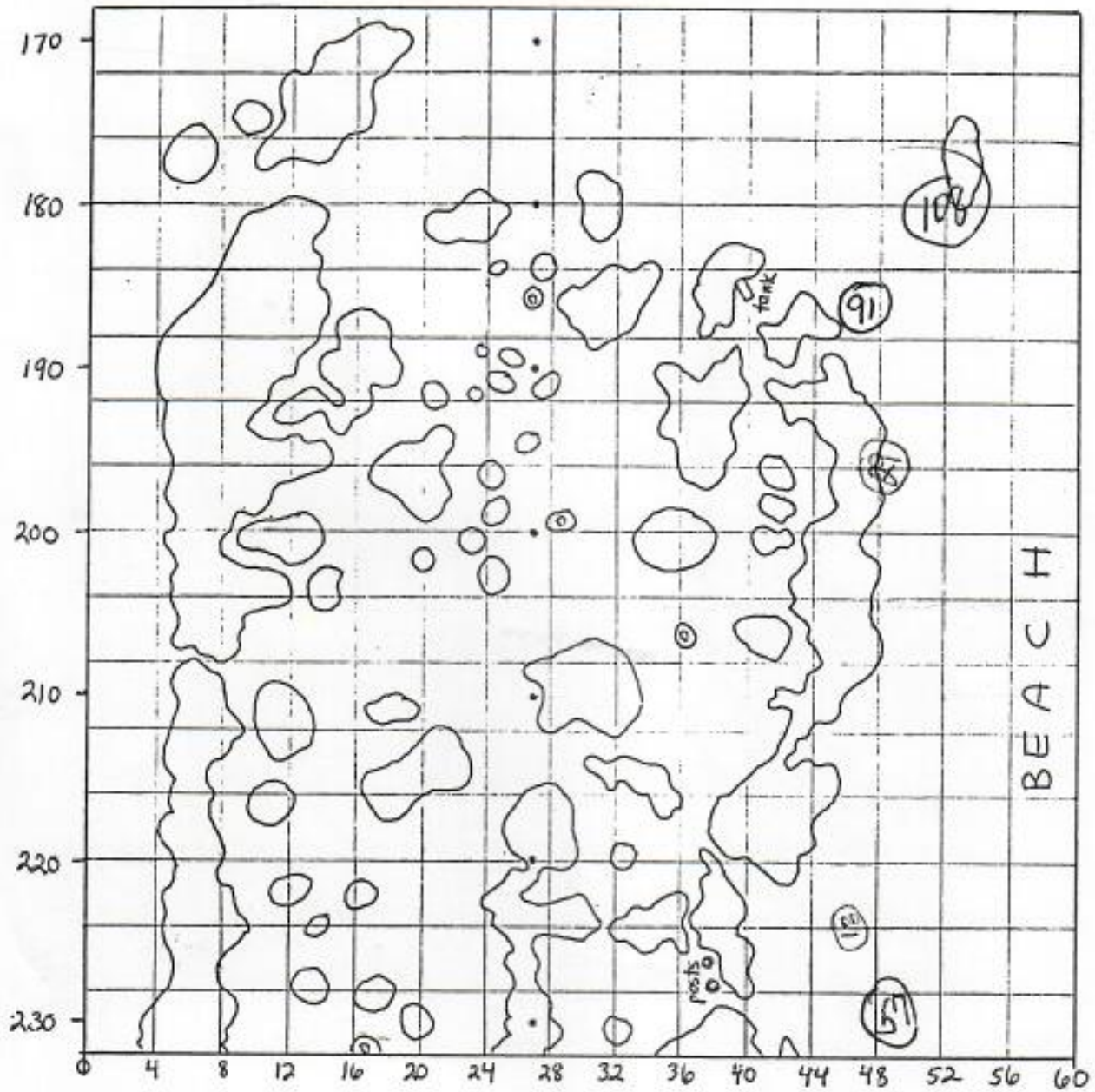


GAS SHED PAD

BEACH

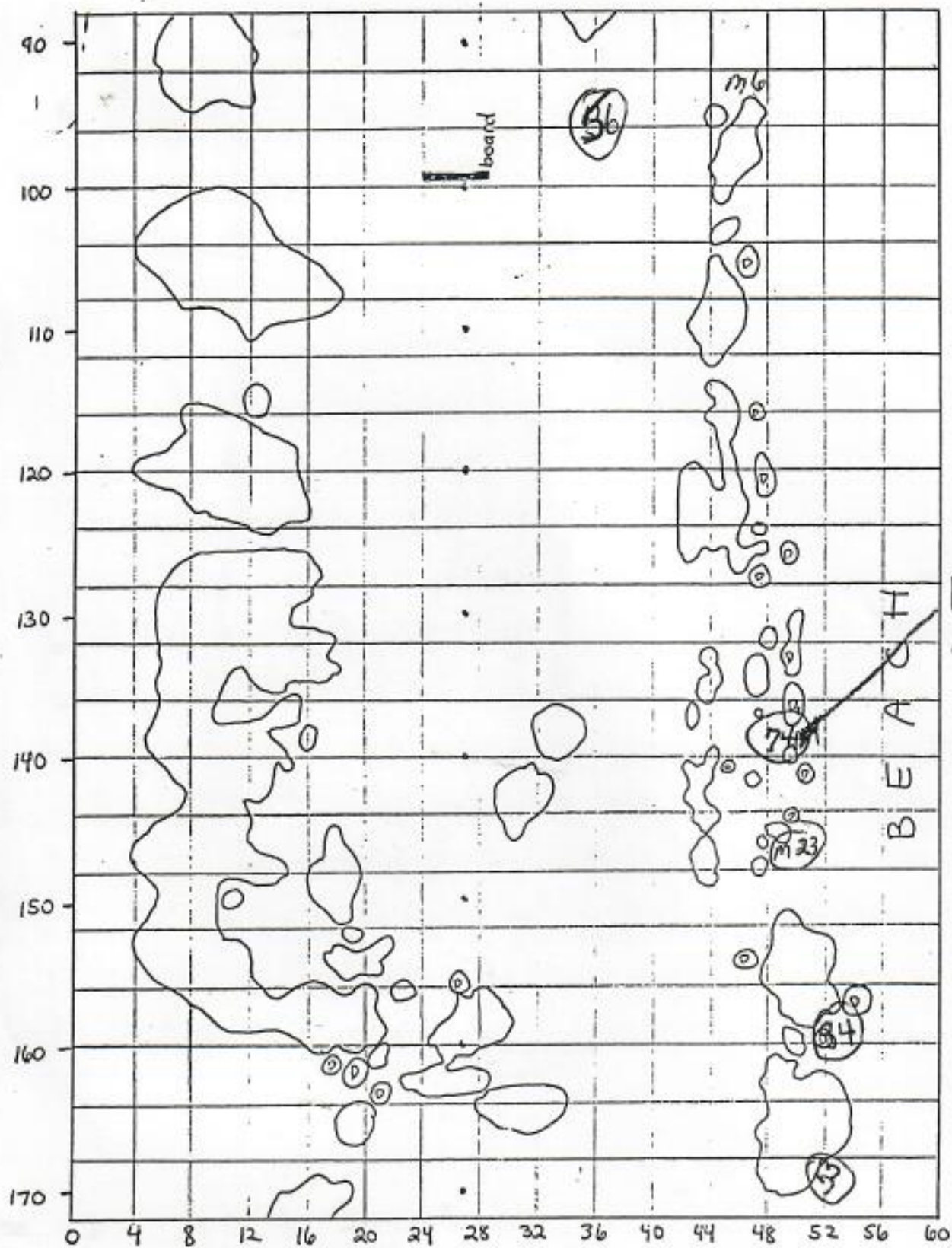
SECTOR A
60 meters long

1 square = 100
D = dead



SECTOR B
60 meters long

1 square = 2² meters
D = dead bush



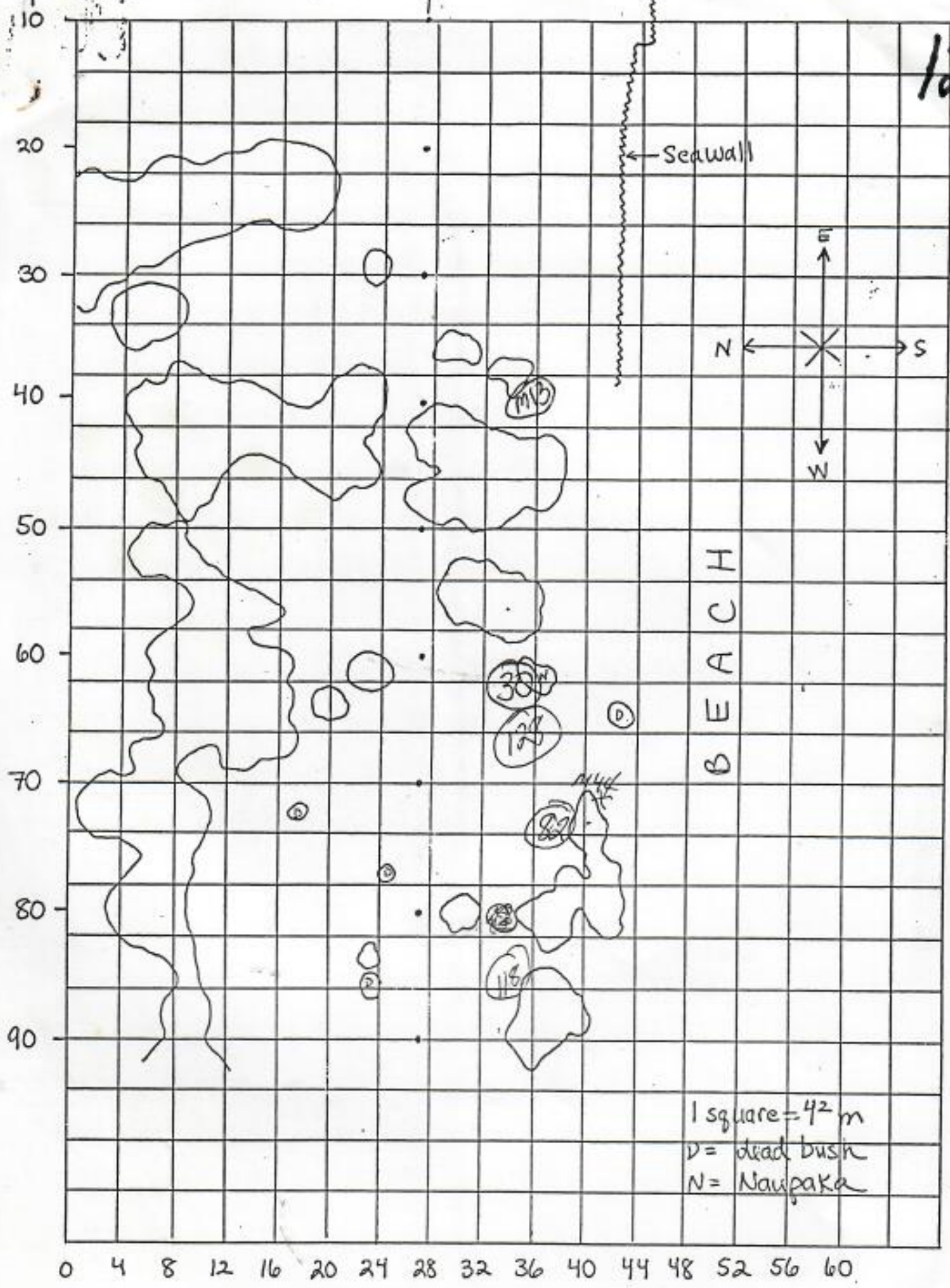
SECTOR C
80 meters long

1 square = 2² meters
D = dead bush

11

SECTION

↑ Stake line 27 m in



1 square = 42 m
 D = dead bush
 N = Naupaka

0 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60