Honolulu Star-Bulletin
A1 □ Monday, January 17, 1994

Fuel spill near Rose Atoll is worse than estimated

OCEAN WATCH
By Susan Scott

REMEMBER the long-line fishing boat brimming with diesel fuel that recently wrecked near Rose Atoll? Well, Honolulu biologists who have been keeping an eye on this wildlife refuge are discovering far more damage from the spilled fuel than they originally estimated.

American-owned Rose Atoll near American Samoa is a special place. The smallest atoll in the world, Rose is almost completely square. And although it was named for the wife of some explorer, the place is indeed pink, the color of the coralline algae making up most of the surrounding reef.

In fact, almost everything at Rose Atoll is pink. I haven't been there but Beth Flint, wildlife biologist for the U.S. Fish and Wildlife Service, has. She told me that even the octopuses there have a pink tinge.

But Rose has more to it than being picturesque. It's also one of the few near-pristine wildlife refuges in the South Pacific.

Two tiny islands lie within the atoll, Rose Island and Sand Island. Sand Island is low-lying without much vegetation but Rose Island still has rare native trees growing on it.

These trees, called Pisonia, are tropical trees that thrive in guano-rich soil. Tree-nesting seabirds such as red-footed boobies, black noddies and two kinds of frigate birds, love these trees which provide nesting branches.

Researchers believe Pisonia were once prevalent on Laysan but today, only one living tree remains in the Hawaiian chain, that on Lisianski. Since these are two-sexed trees, meaning you need a male and a female to reproduce, the Lisianski tree may be the last of its kind in Hawaii.

ANYWAY, the Pisonia trees are one of the reasons Rose Atoll is so precious. Another is the number of sea turtles nesting there. Researchers have recently placed satellite tags on three turtles from Rose to monitor where these South Pacific turtles go during their foraging time.

Researchers also have spent considerable time and money recently eradicating rats on the islands. Without the alien rats, biologists hope ground-nesters such as shearwaters and petrels will return.

All those who knew of the fine virtues of Rose Atoll held their breath when news of the wreck reached Honolulu. But at first glance, things didn't look too bad. The boat, after all, was only leaking diesel fuel, a petroleum product that floats and evaporates quickly.

As it turned out, the saga was not yet over. The original accident happened in mid-November but in early December, just before a salvage company pulled the boat off the reef, the wreck broke open, spilling its oil contents.

THE plants and animals of the reef took it on the chin. In about a quarter of the atoll's reef area (about the size of 24 football fields), 75 percent of giant clams, an endangered species, were killed. In that area, the pink coralline algae was killed and bleached.

Also killed were marine snails which grazed on an olive-green type of seaweed. Now the slimy stuff is creeping over the formerly pink reef tops.

Dead sea urchins, oil-soaked sand, abandonment by reef fish, long-line fishing gear in the lagoon . . . on and on it goes. Much damage has been done and will likely continue. When biologists pick up rocks there, they still see a sheen and smell oil.

It will be a cold day in Hawaii before we see the end of oil spills at sea but the U.S. Coast Guard is working toward decreasing the incidents. In an evolving role as environmental educators, the Coast Guard is trying to foresee risks and minimize damage.

The Guard's primary goal in this area today is to prevent spills. In Hawaii, officials do this by publishing and distributing informational brochures and visiting facilities that handle petroleum products.

But accidents still happen and when they do, it's the Coast Guard that moves in to direct the cleanup, a tough job when the accident is 180 miles from Pago Pago, as is Rose Atoll.

In this case, the long-liner's owners are responsible for all costs, including those to repair damage to the area.

So how do you repair such widespread damage to a wildlife refuge? "With great difficulty," says Beth Flint. "Maybe the best way is to stand back and let nature do it."

Susan Scott is a marine science writer and author of three books about Hawaii's environment. Her Ocean Watch column appears Monday in the Star-Bulletin.

Initial Preliminary Natural Resource Damage Assessment Workplan
F/V Jin Shiang Fa Oil Spill at
Rose Atoll National Wildlife Refuge,
American Samoa

Date Prepared: 31 October 1993

Prepared by: John D. Cubit (DOC/NOAA/DAC, Long Beach)
Chip Demarest (DOI/USFWS/ES, Honolulu)

Anticipated date of assessment: approximately 2 to 6 November 1993

Note: The following is only an outline for conducting a preliminary natural resource damage assessment. Specific work to be conducted at Rose Atoll will largely depend on the professional judgement of scientists working at the site.

Basic Purpose: To estimate the extent to which natural resources under the trusteeship of the Department of the Interior, Department of Commerce, and American Samoa Government have been injured by petroleum products released from the *F/V Jin Shiang Fa*. This assessment is an "initial preliminary" assessment because the vessel is still aground on the reef and spilling petroleum products as of 30 October. The full extent of injuries can not be assessed until the vessel is removed from the reef and the release of petroleum products halted.

Cost-Benefit Considerations: given the considerable constraints of time, personnel, logistics, and personnel safety, this initial assessment will focus on the most readily documented injuries to the most valuable resources.

Report Preparation: Reports should be just data, without interpretation. Be sure to include dates and extent of areas examined. Be as factual as possible. Do not use subjective terms. For example, instead of "the snails showed widespread, heavy mortality" use "in an examination of approximately 100 trochid snails in a 100m by 300m swath on the reef flat marked on the field map, 50% were shells with decomposing tissue inside."

I. PATHWAY DETERMINATION

Purpose: to relate natural resource injuries to effects of petroleum products released from *F/V Jin Shiang Fa* to the exclusion of other causes.

Examples of evidence for pathway:

1) patterns in space: spatial distribution of mortality or other injury corresponds to spatial patterns of exposure to spilled petroleum products and not to other factors.
2) pattern in time: estimated time of death or other injury corresponds to time when organisms could have been exposed to spilled petroleum products (*i.e.*, after 14 October 1993).
3) symptoms of injury biota are consistent with effects of petroleum products rather than other possible factors, such as predation.
4) diesel fuel or other petroleum products are found in or on injured organisms.
5) birds are observed feeding through petroleum slicks; turtles or cetaceans are observed surfacing through petroleum slicks.

II. RECONNAISSANCE FOR INJURY

purpose: document plants and animals dead or otherwise injured.

Marine Resources:

1) signs of recent death (*e.g.*, fresh shells, fresh crustacean carapaces, clean coral skeletons, urchin tests and spines).
2) necrotic tissue (*e.g.*, rotting sponges, rotting soft corals, urchins losing spines, bacterial slime over sessile organisms).
3) bleaching (*e.g.*, loss of coloration on corals, sponges, *Tridacna*, coralline algae, colonial hydroids, anemones, fleshy algae, zoanthids).
4) recent growth of fast-growing algae (*e.g.*, a bloom filamentous algae carpeting substrate. In its initial stages, this bloom may appear only as a "peach fuzz" growing over coralline algae, corals, and other hard substrata).
5) partial mortality of colonial animals (*e.g.*, dead patches on corals, sponges, hydroids).
6) tissue remains (*e.g.*, inside mollusc shells including snails and

clams).

Terrestrial resources:

1) Dead bodies (*e.g.,* sea turtles, birds).
2) Sick animals (*e.g.,* weakened birds, sea turtles with respiratory problems).
3) Dead shoreline vegetation (*e.g.,* seaside plants with brown leaves, especially on side facing grounded vessel).
4) Damaged habitat (*e.g.,* oil in sand used for nesting by birds and sea turtles).
5) Oiled animals (*e.g.*, birds, bird eggs, sea turtles).

III. INJURY QUANTIFICATION AND EVIDENCE

1) for algae and sessile invertebrates, visually estimate percent cover of injured and dead organisms within defined areas (*e.g.*, "in a radius of 100 m from the bow of the ship, 25% of the crustose coralline algal cover on the reef flat was bleached to a chalky white color." Or, "Within 200 m of the ship, a layer of mucus approximately 2 mm thick covered the upper half of each brain coral growing in water less than 2 m deep."
2) count dead/injured per unit area or per unit length of shoreline (*e.g.*, "58 dead turtle hatchlings were found along 300 m of the beach on the lagoon side of Rose Island."
3) photos and video are excellent documentation: you cannot take too many pictures (try to include scale, keep a log of when and where pictures were taken).
4) collect carcasses and label.
5) collect any material showing signs of diesel or other petroleum products from ship (*e.g.,* beach vegetation, bird feathers).
6) ALL SAMPLES:
    a. oiled samples: seal in special chemically clean jars.
    b. other samples can go in plastic bags.
    c. seal all containers with evidence tape with information on tape.
    d. fill out custody form for samples.
    e. keep custody of samples until surrendered to appropriate authority.

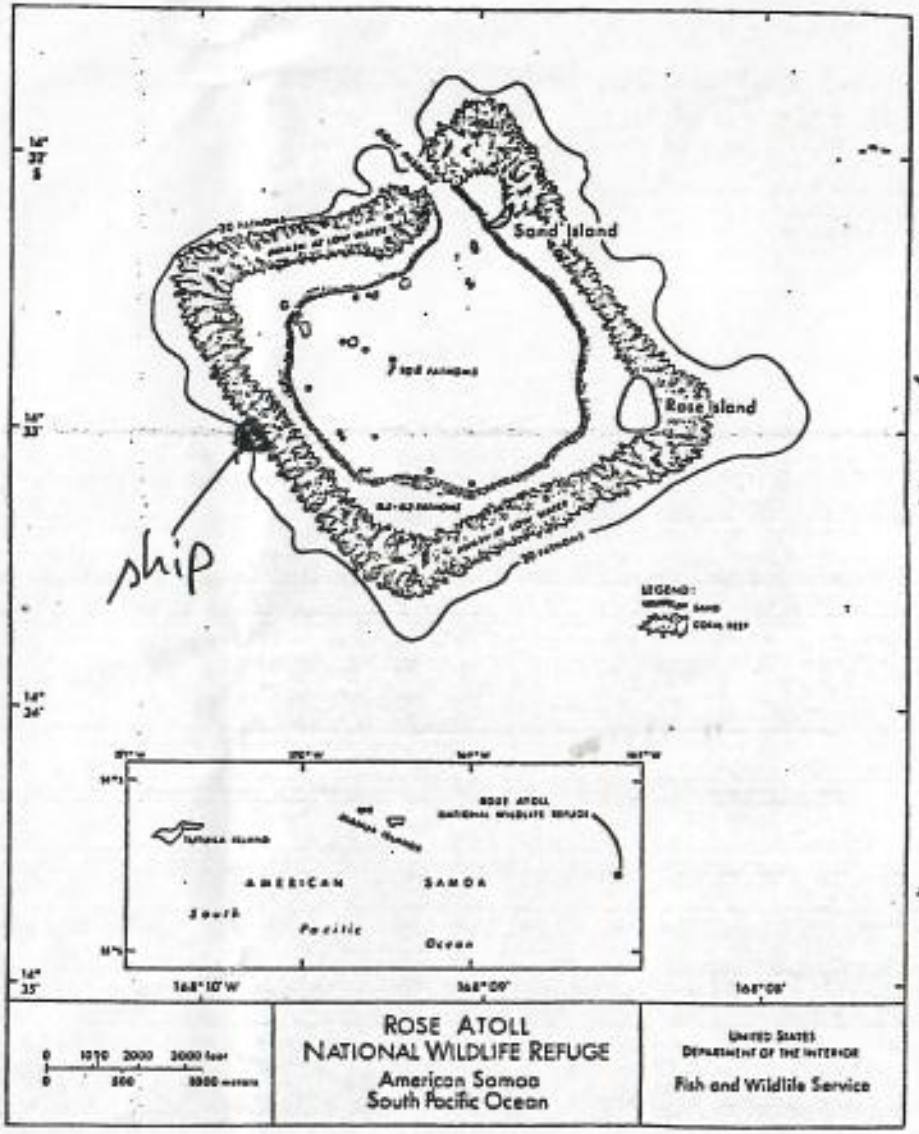
IV. SUGGESTED BEGINNING COURSE OF ACTION AT ROSE ATOLL

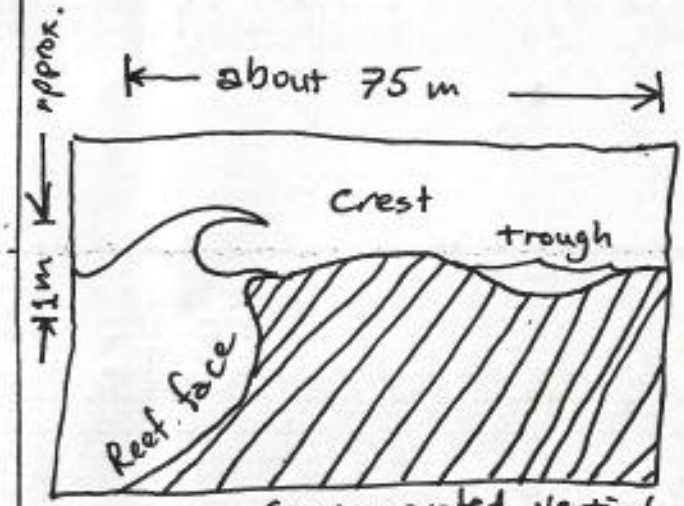
1) Make a visual reconnaissance for scope of injuries, noting gradients of injuries corresponding to gradients of exposure to petroleum products. (See attached diagram of habitats.)
   a. Start at habitats of atoll where exposure to petroleum product was probably greatest.
      Probable locations of highest petroleum exposure:
      i. Subtidal seaward face of reef adjacent to grounded ship.
      ii. On seaward side of coralline algal ridge on seaward edge of reef flat, near ship and possibly north of ship.
      iii. In trough on lagoon side of coralline algal ridge. [During the overflight on 30 October, a greenish color in the trough suggested a possible beginning algal bloom].
      iv. On outer edges of patch reefs in the lagoon.
      v. Along any other topographic feature that rises above water level and could trap petroleum product floating on the surface (*e.g.*, boulders, beaches, ridges).
   b. Examine these areas for injuries symptomatic of petroleum effects.
   c. Proceed away from these areas and examine biota for diminishing injuries.
2) Document injuries associated with exposure to petroleum products.
   a. Use the methods that will allow the most efficient collection of data. This will probably be photographs with scales. Estimate and note how much of the total area is represented by the photos.
   b. Where feasible in the time available, make other measurements as described in Section III.
3) Additional notes:
   a. The 30 October overflight showed a light-colored area on the reef flat, on the lagoon side of the ship. This may be a patch of sand and coralline

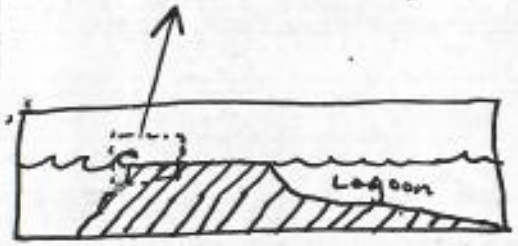
rubble being deposited by waves refracting around ship. Check this area to see if it is:

i. loose sediment;
ii. sediment being bound together by algal filaments;
iii. bleached coralline algae or other organisms.

b. Since proliferations of certain algae commonly occur after petroleum spills, also check adjacent areas for algal blooms. In particular, look for algal mats binding sediments on the reef face and reef flat (see diagram). Since the algae are not very visible at the surface, at first glance these mats may appear to be loose sediment. If found, scrape away edges of the mats to determine if these mats are growing over coralline algae or other organisms and smothering them.



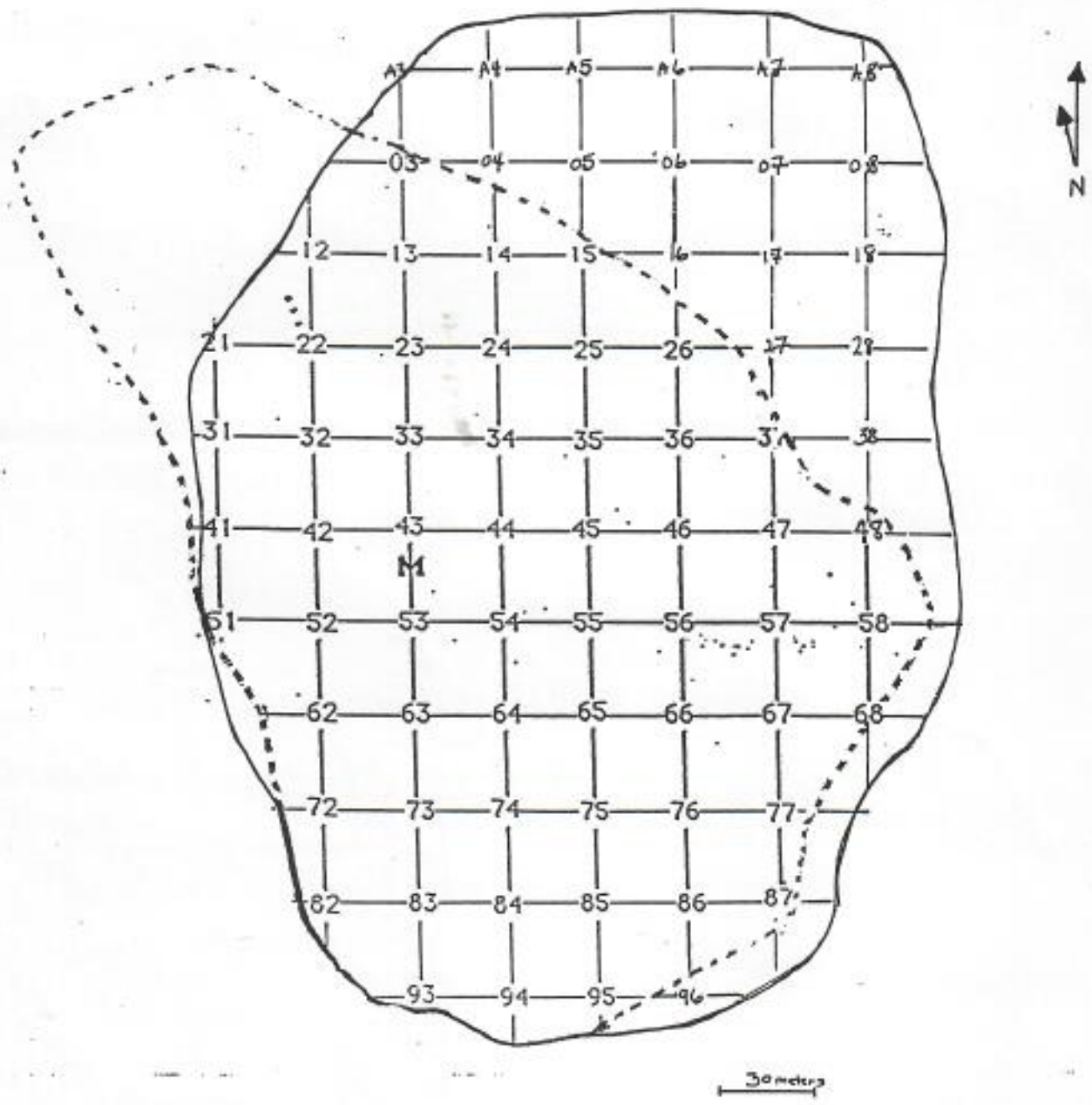




Cross sections through reef flat near grounded ship

31 Oct 93 jc

ROSE ISLAND SAMPLING GRID - 1992



ROSE ATOLL DATA
SUMMARIZED
BY
G. H. BALAZS

# ON REPORT	DATE	TAG #S	PAGE IN BOOK	TOTAL
9	11-03-71	1080/1080	105	
9	11-03-71	1081/1081	105	2
26	11-10-80	3502/3503	105	
26	11-12-80	3504/3505	105	
26	11-12-80	3506/3508	105	
26	11-12-80	3509/3510	105	
26	11-12-80	3511/3512/3514	105	5
27	11-18-91	5804/5805	105	
27	11-19-81	5807/5808	105	
27	11-20-81	5809/5810	105	
27	11-81 (HAWKSBILL)	5801	105	3 (+1)
29	10-07-82	5818/5819/5820/5821	105	
29	10-07-82	5822/5823/5824/5825	105	
29	10-09-82	5788/5789/5790	105	
29	10-10-82	5791/5792/5793	105	
29	10-12-82	5794	105	
29	10-13-82	5797/5798	105	
29	10-13-82	5799	105	7
30	10-23-84	6876/6877	105	
30	10-24-84	6878/6879	105	
30	10-26-84	6880/6881	105	
30	10-26-84	6882/6883	105	
30	10-26-84	6884/6885	105	5
34	11-09-86	6887/6888	100/102	1
36	10-12-88	6818/6819/6820	91	
36	10-13-88	6821/6822/6823	91	2
38	10-25-89	10632/10633/10634	85	
38	10-26-89	10635/10636/10637	85	2
39	08-16-90	N102/N103/N125	B. Bonswith paper	1
40	10-19-90	N107/N108	92	
40	10-29-90	N109/N111	92	2

ROSE ATOLL DATA
SUMMARIZED
BY
G. H. BALAZS
PAGE 2

# ON REPORT	DATE	TAG #S	PAGE IN BOOK	TOTAL
42	08-30-91	N224/N225	97	
42	09-08-91	N222/N223	97	
42	09-08-91	N220/N221	97	3
43	09-24-91	N152/N153	81	
43	09-25-91	N154/N155	81	
43	09-25-91	N156/N157	81	
43	09-26-91	N158/N159	81	
43	09-27-91	N160/N161	81	
43	09-27-91	N162/N163	81	6
45	09-21-92	N126/N127	24	
45	09-23-92	N130/N131	25	
45	09-23-92	N128/N129	25	
45	09-29-92	N132/N133	25	
45	09-30-92	N134/N135	25	
45	09-30-92	N136/N137	25	6
			TOTAL	45 + 1

Oil spill endangers atoll wildlife refuge

By Jon Yoshishige
Advertiser Staff Writer

A Coast Guard team was fighting to save a national wildlife refuge near American Samoa yesterday after a Taiwanese-flagged fishing boat carrying 100,000 gallons of diesel fuel ran aground there and began leaking oil.

A light sheen of oil was spreading five miles from Rose Atoll, where the Jin Shiang Fa ran aground Thursday morning, the Coast Guard said. Rose Atoll is about 130 miles east of American Samoa.

A darker pool of oil was seen widening closer to the 136-foot ship, whose captain had radioed the Coast Guard in American Samoa that his crew was abandoning ship.

Officials asked the freighter Polynesia, which was in the area, to pick up the 25 people from aboard. . They were rescued by the Liberian-flagged vessel after 11 hours drifting in two life rafts.

The 400-foot Polynesia arrived with the crew in Apia, Western Samoa, on Friday.

Crew members were flown to American Samoa, where they were being questioned by investigators from the Coast Guard Marine Safety Office in Honolulu, said Coast Guard Petty Officer Steve Aitkins, who returned to Honolulu from Pago Pago last night.

A Coast Guard team from California, the Pacific Strike Team, was spearheading the efforts to save the atoll. The group of pollution response specialists is equipped with containment booms, pumps, absorbent material and other equipment to clean up spills.

The team flew from Sacramento to Honolulu, then to Pago Pago, where it chartered a boat and sailed to Rose Atoll, Aitkins said.

— Clipped Dear Pam

IN HAWAII

10-year prison term in slaying

A plea agreement has resulted in a 10-year prison term for Darren J.K. Chang for his part in the 1990 slaying of Robert Ross Jones.

Chang, who was originally charged with two counts of murder, had pleaded no contest to a manslaughter charge.

As part of the plea agreement, the state reduced one murder charge and dropped the other.

Chang and co-defendant Steven Ray Bihag allegedly beat Jones during an argument in a Helemano pineapple field.

An autopsy was inconclusive on whether Jones died from the beating.

Bihag, also in a plea agreement, earlier pleaded guilty to a manslaughter charge and received a 10-year term.

—Associated Press

Fuel spill misses beach

A spill of 65,000 gallons of diesel fuel from a fishing boat at Rose Atoll last week has not affected the island's remote beach or damaged marine life in the area, the Coast Guard said Monday.

The Taiwanese-flagged, 136-foot vessel, Jin Shiang Fa, ran aground at the atoll 130 miles east of America Samoa Thursday morning and started leaking the diesel. The vessel was carrying 100,000 gallons of the fuel.

The Coast Guard's Pacific Strike Team personnel said a light sheen of diesel from the spill is diminishing and there is no impact to the atoll's beach.

Coast Guard officials said they are investigating the circumstances surrounding the incident.

Nuuanu leak not sewage

The Department of Wastewater Management says the leak into Nuuanu Stream over the weekend was not raw sewage.

A spokeswoman for the city says the seepage from under Leilehua Lane in lower Nuuanu Sunday was fresh water from a broken Board of Water Supply line.

The spokeswoman said test samples on the spilled water showed only traces of bacteria in the lower stream and in the storm drain leading to it.

Taiwan vessel seized

Another Taiwanese fishing vessel has been seized for illegally operating in U.S. waters, the Coast Guard said yesterday.

The fishing vessel Yih Cheng Tsai was found fishing 17 miles inside the exclusive economic zone of the U.S. near the Northern Mariana Islands on Sunday, according to a Coast Guard statement.

A Coast Guard party boarded the 70-foot vessel and found four of the five fish holds full of shark, marlin, tuna and barracuda, the statement said.

The Coast Guard said the cutter Galveston Island seized the fishing vessel and is escorting it to Guam, where custody of the ship and the eight crew members will be turned over to the U.S. Marshal.

In late August, the Galveston Island seized the Taiwanese vessel Der Cheng Tsai No. 6 after it was discovered illegally fishing inside U.S. waters.

by Bonnie J. Ponwith

ROSE ATOLL TRIP REPORT

Teacher's Workshop 8/14-8/19/90

INTRODUCTION

The annual Rose Atoll Teacher's Workshop was held 14-19 October, 1990. The primary objective of the trip was to increase the awareness and appreciation of the environment of Rose Atoll in Department of Education personnel so they, in turn, could pass it on to their students. Participants were provided the opportunity to assist in ongoing Fish and Wildlife Service and DMWR resource monitoring projects and to design and conduct individual projects.

OBJECTIVES

1) Provide supervision to ensure refuge policies were followed.

2) Provide technical assistance to teacher as they conducted independent studies.

3) Monitor turtle bird activity.

PERSONNEL

Fia Tiapula - Education Coordinator, DMWR
Bonnie Ponwith - Fishery Biologist, DMWR
Larry Madrigal - DOE
Larry Oney - A.S. Community College
Laborday Fa'atili- DOE
Fa'auma Moeaso- DOE
Peau Peau - DOE
Salele'a Mamea - DOE
Doug Foster - DOE
Mike Crook - Skipper, Tasi Lua

ITINERARY

14 August - Depart Pago Pago at 1255.

15 August - Arrive Rose Atoll at app. 0900. Set up camp and held a brief orientation. Conducted turtle track survey at 1030 and observed one set of tracks leading to what appeared to be a false nesting pit. Individuals began projects. Madrigal, Mamea, Ponwith snorkeled lagoon. Did turtle survey and 2200 and saw no new tracks. Additional night surveys were not conducted due to disturbance of nesting sooty terns. Tiapula and Madrigal walked the reef flat at 2230 to monitor nocturnal fish and invertebrate activity.

16 August - Turtle survey conducted at 0600 showed no new tracks. DOE personnel worked on individual projects. Ponwith walked the reef flat to Sand Island to map turtle tracks and pits and check for bird nesting activities. Madrigal and Ponwith snorkeled lagoon. Tiapula conducted reef walk with DOE personnel.

17 August - A green turtle was discovered at 0615 covering eggs. Teachers were notified and all were involved in tagging and measuring the turtle as she left the beach. Ponwith conducted a reef walk for teachers. Fiapula did followup on individual projects. Madrigal, Oney, Foster and Ponwith dove in the lagoon. Turtle ribs were found near transect steak #31.

18 August - Turtle survey begun at 0430 showed no new tracks. Teachers finished individual projects. Site were turtle ribs were discovered was revisited and more ribs and the skull were found. Turtle tracks were raked, and a garbage collection sweep of the island was made. Broke camp, packed the vessel and departed Rose Atoll at 1230.

19 August - Arrived Pago Pago 0700.

OBSERVATIONS

HURRICANE EFFECTS

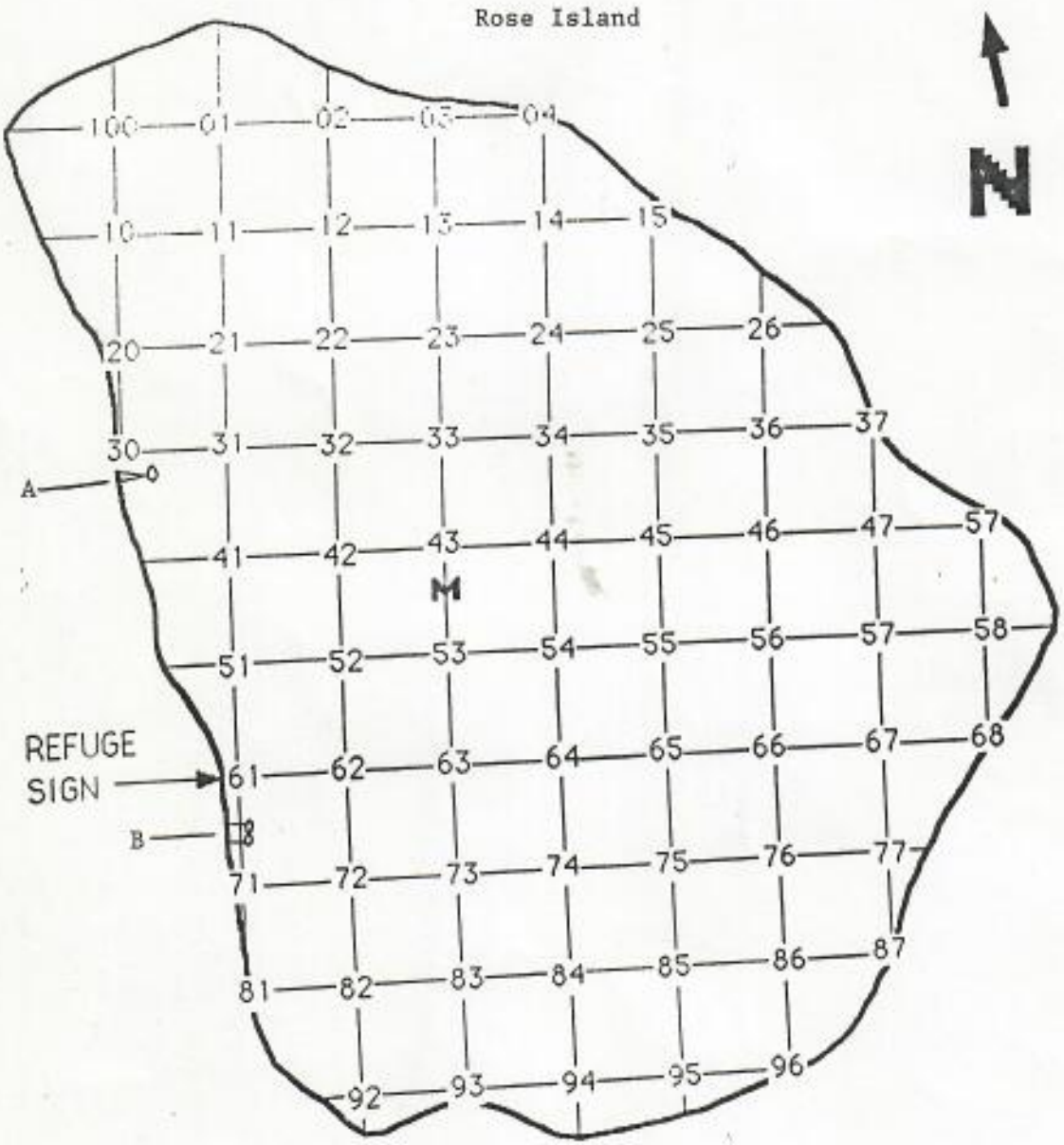
The effects of Hurricane Ofa which hit the Territory on 3 February, 1990, were evident on both Sand and Rose Islands. Sand Island was completely defoliated with the exception of one very healthy Tournafortia tree in the center of the island. Rose Island had a windrow of driftwood and debris banked up as far inland as 60 meters on the west by northwest shore. The wooden Fish and Wildlife sign was damaged by a fallen tree limb and the metal sign was knocked down.

REPTILES

TURTLES

Only one set of tracks, which led to what appeared to be a false pit, were observed on Rose Island upon arrival (Figure 1). A green turtle was discovered covering eggs at 0615 on 16 August. She had crawled up the beach into some low Tournefortia branches, dug a deep pit, moved one meter beyond it and dug a second pit. Upon arrival, she was using her back flippers to cover the eggs with fine sand. The false pit was by far the easier of the two to see after the actual nesting pit had been covered. It is possible that nesting pit counts done upon arrival to the island is an indicator of the number of false pits dug, not of actual nests. Carapace length was 101 cm, and the turtle was tagged with NMFS tags number 102 and 125 on the right front leg and number 103 on the left front leg.

Figure 1. Turtle tracks, false nests and nests observed on Rose Island during the August, 1990 expedition.



A. Turtle tracks and pit present upon arrival.

B. Turtle tracks, false pit and egg nest made by observed turtle.

Several nesting pits were found near the edge of the vegetation line around the island. One still bore a trace of the orange spray paint used to mark pits from the October 1989 trip, indicating that not all pits are washed away between nesting seasons.

The skull, several ribs and a plate from a dead green turtle were found near transect marker #31. The parts were collected and brought back to DMWR.

Five sets of tracks and 10 nesting pits were found on Sand Island (Figure 2.) One set of tracks looked very fresh. Since wind and wave action had been severe enough to remove nearly all the vegetation from the island, all old turtle pits would have been erased and thus, these 10 had been dug sometime between the February and August.

GECKO

A gecko was discovered in the turtle skull found at transect #31. It was the only one seen on this trip.

BIRDS

Quantitative bird population estimates were not conducted on this trip with the exception of masked booby and red-tailed tropic bird nest counts. Sooty terns were nesting in large, very dense colonies making it impossible to run the transect lines without extreme disturbance of the adult birds and possible high mortality of chicks and eggs.

Red-tailed Tropicbird (Phaethon rubricauda)

Twenty seven tropicbird nests were observed on Rose Island, one containing an egg and the rest containing chicks that ranged from newly hatched to half adult size.

Great and Lessor Frigate Bird (Fregata minor, F. ariel)

Several nests were sighted on the north end of Rose Island with chicks at varying degrees of maturity. One count of adult birds soaring over the island totaled to over 200 individuals.

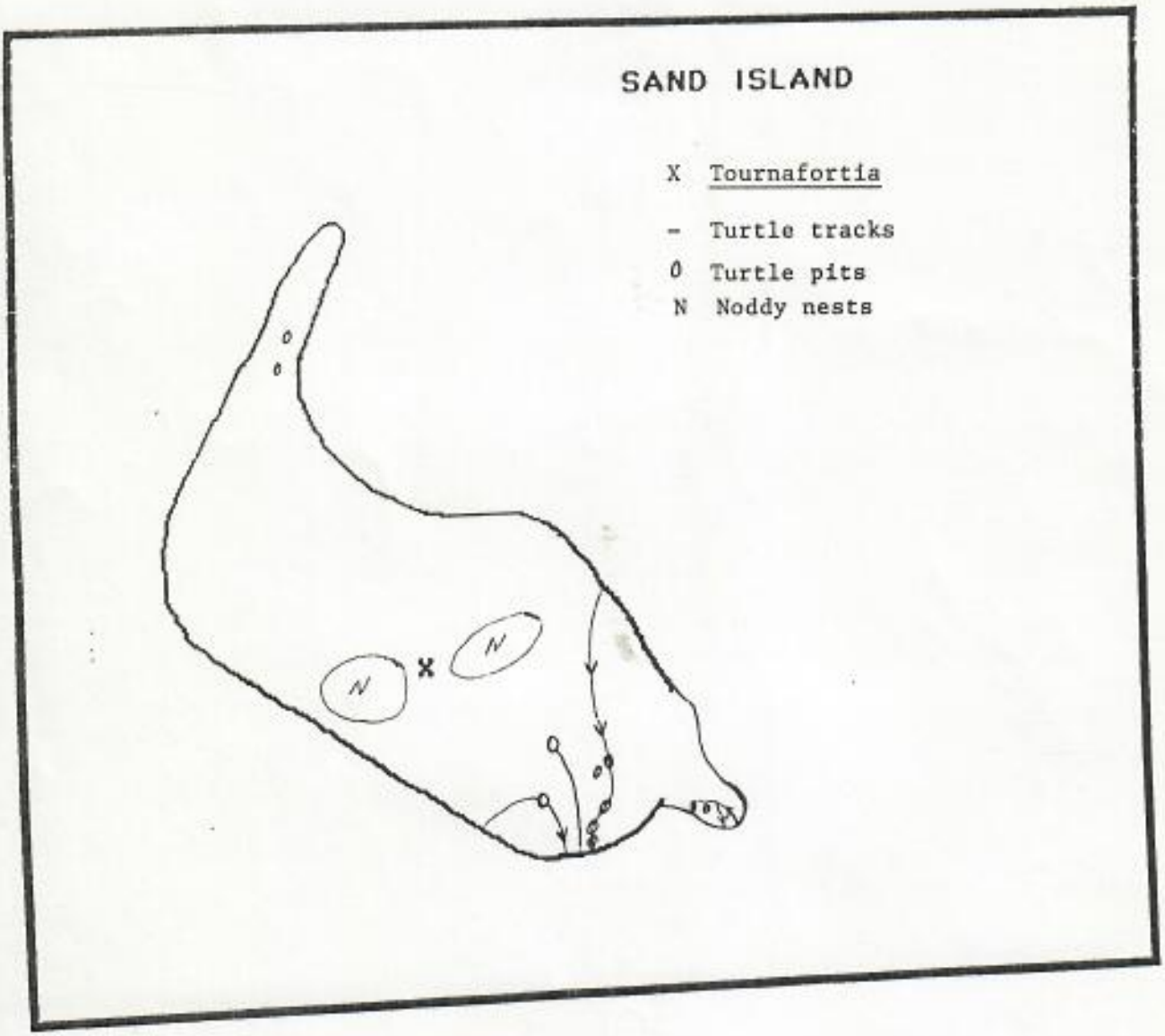
Masked Booby (Sula dactylatra)

Six chicks and one nest with eggs were counted in or near the Boerhavia meadow. Several tagged individuals were seen in the meadow. Attempts to read the band numbers with binoculars failed.

Brown Booby (Sula leucogaster)

No count of brown boobies was made. Some large, immature birds were

Figure 2. Turtle tracks and pits observed on Sand Island during the August 1990 expedition.



sighted and three nests with eggs were being tended in the Boerhavia meadow. Again, several banded birds were seen, but not captured.

Red-footed Booby (Sula sula)

Nests were abundant on the north side of the island and contained young chicks. Adult birds were observed collecting nesting material.

Sooty Tern (Sterna fuscata)

Rose Island was densely populated with sooty terns in three distinct nesting colonies (Figure 3). The north shore colony was the smallest and was made up of adults and chicks which were half adult size. Courtship and mating was observed among the birds in this colony.

The inland colony covered an area of approximately 450 square meters and a density ranging from one nest per square meter on the fringes of the colony to 12 nests per square meter nearer the interior. The nests contained a combination of eggs and hatchling chicks.

The south shore colony was approximately 270 square meters in area and had nests at densities equal to or slightly lower than those observed in the inland colony. Only eggs were found in the nests of this colony of terns. Some smaller groupings of sooty terns with chicks were found around the perimeter of the island, but the majority of the population was in one of the three main colonies.

White Tern (Gygis alba)

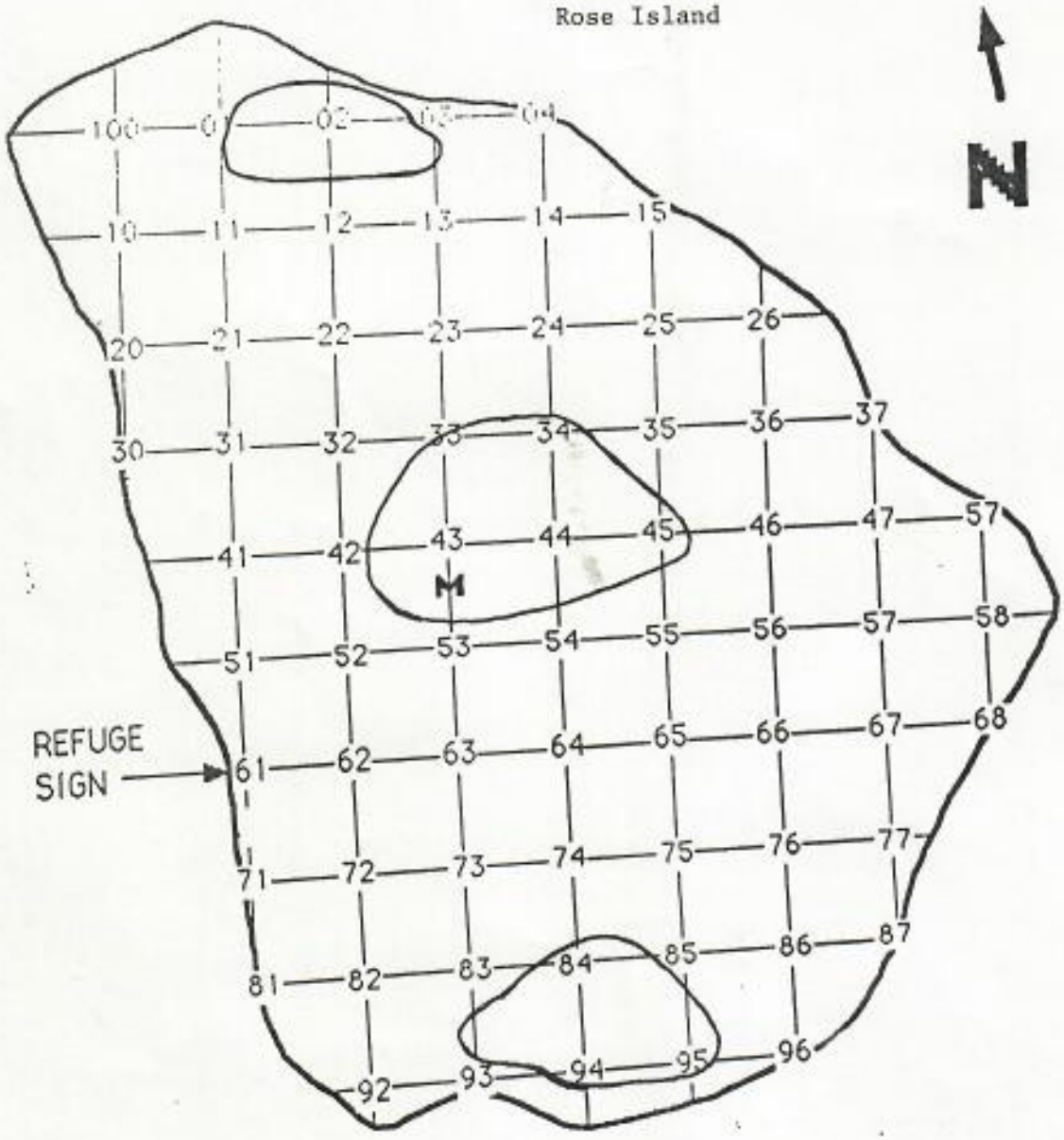
Two groupings, one on the north and one on the south shoreline, of approximately 15 individuals each, were seen. The white terns were active in the mornings, soaring and gliding in and out of their roosting areas, and would perch on shoreline tree branches in the afternoons. No eggs were observed.

Brown Noddy (Anous stolidus)

Approximately 55 brown noddy nests containing eggs or small hatchlings were seen on Sand Island. The nests consisted of dead Tournafortia leaves and small twigs and two to three species of gastropod shells. Brown/black noddies were observed perching in branches on Rose Island but no nests were seen.

In addition to these observations, one wandering tattler and one bristle-thighed curlew were seen on the south shore of Rose.

Figure 3. Locations of three nesting colonies of Sooty terns found on Rose Island during the August 1990 expedition.



MAMMALS

Rats

The qualitative observation was that the rat population was down somewhat from the October 1989 trip, but that they were still abundant and quite bold.

Two evenings from 1700 to 1900 (dark) were spent near the fringe of the inland sooty tern colony watching bird/rat interaction. Rats frequently ran back and forth through the colony to get from one tree root system to another. The birds responded by pecking at the moving target. One rat confronted a bird that was incubating an egg and actually made contact with it, biting at the bird's beak. A rat was seen to grab a chick and drag it away from the colony, toward the protective roots of a tree. As it neared the tree, two more rats joined in the effort. In an attempt to get close enough to see what happened next, the rats were disturbed and left their prey behind. The chick survived the attack and wandered back into the colony.

Unlike the October 1989 trip, only a few tern egg mortalities occurred that could be directly attributed to rats. Possible explanations are that eggs were so abundant and widely distributed that egg mortalities were not localized as was the case in last year's trip, making them seem less profound, or perhaps the rats preferentially feed on hatchling chicks.

Whale

A whale spout was spotted near the western edge Atoll as we approached the island on 8/14. The animal was not seen.

MARINE FAUNA

One dive, several snorkels and several reef walks were made during the stay at Rose Atoll. Notable observations are as follows:

-an octopus was seen in a tide pool on the coralline algae reef flat
-once again, black tipped reef sharks were abundant in the lagoon
-giant clams T. maxima were found attached to the substrate by byssal threads alone, rather being anchored into a coral head by growing coral, a rare phenomenon in Tutuila waters
-more empty giant clam shells were seen on this trip than on the October, 1989 trip. Both coral embedded and free empty shells were observed on the reef flat of the lagoon. It is difficult to say what factor(s) played a part in the increased mortality; hurricane, octopus/fish predation, trespass, etc.

RECOMMENDATIONS

1) Prior to leaving, a float plan must be submitted to Office of Communications, the Port Administration and with DMWR. Also, the vessel should carry an FM radio capable of reaching Manu'a.

Possession of two-way radios for contact between the island and the boat and the island and the diving skiff is also strongly recommended.

2) Some metal disk tags used to identify transect posts are missing. Extra disks, a set of numbered chisels and wire for attachment should be taken to replace them.

3) A line, presumably used to mark a transect, was suspended from a tree on the outer perimeter of the inland sooty tern colony and ran the entire length of the colony. Fallen branches pinned the line to the ground for about half its length which made the line very taught. Several birds became entangled in the portion that was grounded and many flying birds hit the suspended portion of the line as they flew in and out of the colony. It is recommended that no lines be left on the island, either suspended or on the ground, for any purpose.

4) Severity of storms on the island can be monitored by noting changes in the count and position of coral blocks deposited on the reef flat. The blocks should be mapped to provide a baseline from which to begin.

5) Mark all nesting pits with steaks so new ones can be differentiated from the old on subsequent trips.

6) Upon return to Rose, check to see if the false pit and actual nesting pit dug by the turtle that was tagged are both visible. It is predicted that only the false pit will be detected. If this is the case, a means of estimating the number of actual egg nests would be important. Each time the island is visited, the ratio of egg nests to false pits observed being dug by each turtle should be recorded. On subsequent trips, the factor can be applied to new, false pit counts to predict the number of egg pits which had been dug.

REFERENCES

Forsell, D.J. 1989. Fall Survey of Rose Atoll - 23-27 October 1989. Administrative Report, U. S. Fish and Wildlife Service, Hawaiian and Pacific Islands National Wildlife Refuge, 20 pp.

Apia, Samoa Islands, 1993

Times and Heights of High and Low Waters

October

	Time	Height		Time	Height
	h m	ft	cm	h m	ft	cm
1 F	0057	0.4	12	16 Sa 0116	-0.2	-6
	0646	2.9	88	0714	3.4	104
	1306	0.5	15	1331	0.0	0
	1905	3.1	94	1936	3.7	113
2 Sa	0134	0.5	15	17 Su 0211	0.0	0
	0723	2.8	85	0806	3.2	98
	1337	0.6	18	1425	0.2	6
	1940	3.0	91	2029	3.6	110
3 Su	0211	0.6	18	18 M 0310	0.1	3
	0801	2.7	82	0904	3.0	91
	1409	0.7	21	1524	0.4	12
	2021	3.0	91	2128	3.3	101
4 M	0254	0.7	21	19 Tu 0415	0.3	9
	0846	2.6	79	1008	2.8	85
	1451	0.9	27	1629	0.6	18
	2107	2.9	88	2229	3.1	94
5 Tu	0347	0.8	24	20 W 0524	0.5	15
	0937	2.5	76	1116	2.7	82
	1539	1.0	30	1739	0.8	24
	2200	2.8	85	2339	3.0	91
6 W	0447	0.9	27	21 Th 0630	0.5	15
	1037	2.4	73	1230	2.6	79
	1645	1.0	30	1851	0.8	24
	2258	2.8	85	◐		
7 Th	0554	0.8	24	22 F 0048	2.9	88
	1142	2.4	73	0733	0.6	18
	1758	1.0	30	1335	2.7	82
				1952	0.8	24
8 F	0005	2.8	85	23 Sa 0148	2.9	88
	0658	0.7	21	0826	0.5	15
◑	1247	2.6	79	1429	2.7	82
	1906	0.8	24	2047	0.7	21
9 Sa	0106	3.0	91	24 Su 0241	2.9	88
	0754	0.6	18	0912	0.5	15
	1347	2.8	85	1511	2.8	85
	2008	0.6	18	2133	0.7	21
10 Su	0207	3.1	94	25 M 0324	2.9	88
	0845	0.3	9	0953	0.5	15
	1439	3.0	91	1550	2.9	88
	2103	0.4	12	2214	0.6	18
11 M	0301	3.3	101	26 Tu 0402	2.9	88
	0934	0.1	3	1027	0.5	15
	1529	3.3	101	1622	3.0	91
	2153	0.1	3	2251	0.5	15
12 Tu	0353	3.5	107	27 W 0435	2.9	88
	1020	0.0	0	1100	0.5	15
	1619	3.6	110	1654	3.1	94
	2244	-0.1	-3	2326	0.5	15
13 W	0443	3.6	110	28 Th 0510	2.9	88
	1106	-0.1	-3	1131	0.5	15
	1707	3.8	116	1728	3.2	98
	2334	-0.2	-6			
14 Th	0533	3.7	113	29 F 0001	0.5	15
	1152	-0.2	-6	0545	2.9	88
	1756	3.9	119	1203	0.5	15
				1801	3.2	98
15 F	0024	-0.3	-9	30 Sa 0036	0.5	15
	0622	3.6	110	0621	2.9	88
	1241	-0.1	-3	1235	0.6	18
●	1845	3.8	116	1836	3.2	98
				31 Su 0112	0.5	15
				0700	2.8	85
				1308	0.7	21
				1913	3.2	98

November

	Time	Height		Time	Height
	h m	ft	cm	h m	ft	cm
1 M	0151	0.6	18	16 Tu 0253	0.1	3
	0740	2.8	85	0845	3.0	91
	1345	0.7	21	1502	0.5	15
	1956	3.2	98	2104	3.4	104
2 Tu	0232	0.6	18	17 W 0349	0.3	9
	0826	2.7	82	0944	2.8	85
	1426	0.8	24	1600	0.6	18
	2040	3.1	94	2159	3.1	94
3 W	0320	0.7	21	18 Th 0450	0.4	12
	0914	2.6	79	1045	2.7	82
	1517	0.9	27	1706	0.8	24
	2131	3.0	91	2258	2.9	88
4 Th	0416	0.7	21	19 F 0550	0.6	18
	1010	2.6	79	1146	2.6	79
	1617	0.9	27	1812	0.9	27
	2229	3.0	91			
5 F	0517	0.7	21	20 Sa 0000	2.8	85
	1109	2.6	79	0650	0.6	18
	1727	0.9	27	1248	2.6	79
	2331	3.0	91	◐ 1914	0.9	27
6 Sa	0619	0.6	18	21 Su 0100	2.7	82
	1214	2.7	82	0742	0.7	21
◑	1837	0.8	24	1343	2.7	82
				2010	0.8	24
7 Su	0036	3.0	91	22 M 0156	2.6	79
	0719	0.5	15	0831	0.7	21
	1315	2.9	88	1431	2.7	82
	1943	0.6	18	2101	0.8	24
8 M	0138	3.1	94	23 Tu 0244	2.6	79
	0813	0.4	12	0913	0.7	21
	1413	3.2	98	1513	2.8	85
	2041	0.4	12	2145	0.7	21
9 Tu	0237	3.2	98	24 W 0327	2.6	79
	0905	0.2	6	0951	0.6	18
	1506	3.4	104	1549	3.0	91
	2137	0.1	3	2227	0.6	18
10 W	0333	3.3	101	25 Th 0406	2.7	82
	0956	0.1	3	1027	0.6	18
	1558	3.6	110	1625	3.1	94
	2230	0.0	0	2304	0.5	15
11 Th	0425	3.4	104	26 F 0444	2.7	82
	1046	0.0	0	1102	0.6	18
	1649	3.8	116	1700	3.2	98
	2323	-0.2	-6	2339	0.4	12
12 F	0518	3.4	104	27 Sa 0521	2.8	85
	1134	0.0	0	1136	0.5	15
	1740	3.9	119	1736	3.2	98
13 Sa	0013	-0.2	-6	28 Su 0018	0.4	12
	0608	3.4	104	0601	2.8	85
	1225	0.0	0	1210	0.5	15
●	1830	3.8	116	○ 1815	3.3	101
14 Su	0105	-0.2	-6	29 M 0053	0.3	9
	0659	3.3	101	0640	2.8	85
	1314	0.1	3	1247	0.5	15
	1920	3.7	113	1852	3.3	101
15 M	0158	-0.1	-3	30 Tu 0132	0.3	9
	0753	3.2	98	0721	2.8	85
	1406	0.3	9	1324	0.6	18
	2011	3.6	110	1934	3.3	101

December

	Time	Height		Time	Height
	h m	ft	cm	h m	ft	cm
1 W	0211	0.4	12	16 Th 0320	0.2	6
	0806	2.8	85	0911	2.8	85
	1409	0.6	18	1528	0.5	15
	2019	3.3	101	2125	3.1	94
2 Th	0257	0.4	12	17 F 0410	0.4	12
	0854	2.8	85	1002	2.7	82
	1459	0.6	18	1624	0.7	21
	2109	3.2	98	2213	2.8	85
3 F	0347	0.4	12	18 Sa 0501	0.5	15
	0947	2.8	85	1053	2.6	79
	1555	0.7	21	1725	0.8	24
	2202	3.1	94	2306	2.6	79
4 Sa	0443	0.5	15	19 Su 0556	0.7	21
	1043	2.8	85	1150	2.5	76
	1658	0.7	21	1826	0.9	27
	2303	3.0	91			
5 Su	0543	0.5	15	20 M 0002	2.5	76
	1145	2.9	88	0649	0.7	21
	1811	0.6	18	1248	2.5	76
				◐ 1930	0.9	27
6 M	0007	3.0	91	21 Tu 0103	2.4	73
	0644	0.4	12	0743	0.8	24
	1248	3.0	91	1343	2.6	79
◑	1921	0.5	15	2026	0.9	27
7 Tu	0113	2.9	88	22 W 0159	2.3	70
	0746	0.4	12	0831	0.8	24
	1349	3.1	94	1431	2.7	82
	2026	0.4	12	2116	0.8	24
8 W	0216	3.0	91	23 Th 0249	2.4	73
	0844	0.3	9	0916	0.7	21
	1449	3.3	101	1516	2.8	85
	2126	0.2	6	2201	0.6	18
9 Th	0318	3.1	94	24 F 0337	2.4	73
	0940	0.1	3	0958	0.6	18
	1544	3.5	107	1556	2.9	88
	2222	0.0	0	2241	0.5	15
10 F	0414	3.1	94	25 Sa 0419	2.5	76
	1032	0.1	3	1036	0.6	18
	1636	3.6	110	1636	3.1	94
	2315	-0.1	-3	2318	0.4	12
11 Sa	0507	3.2	98	26 Su 0500	2.7	82
	1121	0.0	0	1113	0.5	15
	1727	3.7	113	1713	3.2	98
				2355	0.2	6
12 Su	0005	-0.2	-6	27 M 0541	2.8	85
	0557	3.2	98	1150	0.4	12
	1211	0.0	0	1754	3.3	101
●	1815	3.7	113			
13 M	0053	-0.2	-6	28 Tu 0032	0.1	3
	0647	3.1	94	0620	2.8	85
	1300	0.1	3	1227	0.3	9
	1902	3.6	110	○ 1833	3.4	104
14 Tu	0142	-0.1	-3	29 W 0110	0.1	3
	0734	3.0	91	0702	2.9	88
	1347	0.2	6	1308	0.3	9
	1950	3.5	107	1915	3.4	104
15 W	0230	0.0	0	30 Th 0150	0.1	3
	0822	2.9	88	0745	3.0	91
	1438	0.4	12	1352	0.3	9
	2038	3.3	101	2000	3.4	104
				31 F 0232	0.1	3
				0831	3.0	91
				1440	0.3	9
				2048	3.3	101

Time meridian 165° W. 0000 is midnight. 1200 is noon.
Heights are referred to the chart datum of soundings.

United States Department of the Interior
FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS OFFICE
P.O. BOX 50167
HONOLULU, HAWAII 96850

TAKE PRIDE IN AMERICA

July 13, 1990

Mr. Tim Ohashi
District Supervisor
Honolulu Area Office
Animal Damage Control
P. O. Box 50225

Dear Mr. Ohashi:

This follows up and documents our telephone conversation yesterday concerning your proposal to use the rodenticide Talon-G on the U. S. Fish and Wildlife Service's Rose Atoll National Wildlife Refuge, American Samoa. Rodents are a pest species on Rose and are not native to the Atoll. Rats are known to attack, kill, and eat hatchling sea turtles and nesting seabirds.

Green sea turtles are listed as threatened species under the Endangered Species Act and are known to nest on Rose; hawksbill sea turtles are listed as endangered and may nest there. We concur with your determination that there is virtually no chance for either turtle (or any other listed species) to be adversely affected by the use of Talon-G at Rose, and any decrease in the rodent population there would aid in the conservation of these two species. Reduction in the number of rodents would also improve the nesting success of seabirds using the island.

No further consultation with this office regarding your obligations under Section 7 of the Endangered Species Act are required. If we can be of further assistance, please contact us again.

Sincerely yours,

William R. Kramer

William R. Kramer
Acting Field Office Supervisor
Fish and Wildlife Enhancement

cc: Assistant Refuge Manager, Hawaiian Islands NWR, FWS, Honolulu, HI
→George Balazs, NMFS, Honolulu, HI

EXPEDITION REPORT - ROSE ATOLL

October 11 - 15, 1988

BY

DOUGLAS J. FORSELL, RICHARD A. BAUER, and WILLIAM KNOWLES

March 6, 1989

This report may be cited as follows: Forsell D. J., R. A. Bauer, and W. Knowles. 1989. Fall Survey of Rose Atoll - 11-15 October 1988. Administrative Report, U. S. Fish and Wildlife Service, Hawaiian and Pacific Islands National Wildlife Refuge. 20 pp.

INTRODUCTION

The purpose of this trip was to conduct surveys of the marine environment, vegetation, turtles, and marine birds of Rose Atoll. Three days and two nights were spent on the island. The trip was a cooperative effort of the American Samoa Government's Office of Marine and Wildlife Resources and the Hawaiian and Pacific Islands National Wildlife Refuge.

PERSONNEL

Douglas J. Forsell, Refuge Manager - Remote Islands Complex, Hawaiian and Pacific Islands NWR

Richard A. Bauer, Biological Technician - Remote Islands Complex, HPINWR

William Knowles - Wildlife Biologist, Office of Marine and Wildlife Resources (OMWR), American Samoa Government.

Aito Sunia, Fisheries Technician, OMWR

Alia Henry, Fisheries Technician, OMWR

Lei Vea Vea - Second Mate - FV Samaaulmoana

ITINERARY

9 October - Depart Honolulu at 1615 enroute to Pago Pago, American Samoa. Arrive Pago Pago 2030.

10 October - Surveyed beaches of south shore of Tutuila Island for shorebirds. Organized equipment and planned trip with Bill Knowles.

11 October - Shopped for groceries in the AM and loaded boat. Fisheries team backed out of trip when Paul Pedro, the ship's captain, told them he had to be back for a funeral on Saturday. This would give them only three days to do their surveys and they needed a minimum of four. Departed Pago Pago Harbor at 1420. Seas rough, wind 15 knots from the east; thus, only made about 7.5 knots.

12 October - Arrive Rose Atoll at 0930. Conduct census of turtle tracks. Found first turtle on reef flats and tagged her. Remarked Pisonia plot in pm and set rat traps. Attempted to conduct night transects in Pisonia forest, but disturbance to Sooty Terns too great. Banded boobies. Walked beaches every two hours throughout the night and only found one turtle to tag.

13 October - Collected rats from traps in AM and while Knowles dissected rats others conducted complete count of Tournefortia forest. In late afternoon Knowles and Forsell conducted census of Pisonia forest and put out line between trees to facilitate census of terns and rebated rat traps. Bower censused Sand Island. After dark Forsell conducted census of Sooty Terns while others did turtle surveys. Banded more boobies.

14 October - Collected rat traps and surveyed Sand Island in AM. Took photos of habitat and measured area of terns censused the previous night. Packed camp and had boat loaded by 1200. Went SCUBA diving in early PM and departed the Atoll 1440.

15 October - Arrive Pago Pago at 0610. Unloaded boat and checked into the hotel. Cleaned camp equipment and wrote notes.

17 October - Went SCUBA diving with David Itano to look at an area which might support comparable environments to Rose Atoll. Conducted surveys of shorebirds at the airport and golf course. Went to top of rainmaker pass to view fruit bats and see the proposed national park.

18 October - Depart Pago Pago at 0430 hours. Arrive Honolulu at 1030 hours.

RESULTS

Vegetation

All plants were green and appeared to be thriving. The major change which has occurred was that several large Pisonia had fallen in the middle of the forest creating a large opening in the canopy (Figures 1 and 2). This has allowed the Sooty Terns (Sterna fuscata) to enter the forest and the majority of sooty nesting is occouring in this area. The cause of the die off is unknown, but Knowles postulated that a large amount of saltwater may have washed over the island during Hurricane Tusi and killed the trees.

The Tournefortia appeared to be healthy and may be encroching on the Borhavia meadow (Knowls pers. obs.). No Portulaca was observed in the Borhavia meadow. Coconuts seem to be reproducing well, but it is unclear weather these have been planted by visitors or are natural. Most coconuts on the ground had been eaten by rats (Rattus exulans).

The vegetation on Sand Island appears to be recovering from the damage of the hurricane. There were nine live tournifortia bushes, a few seedlings, and several dead shrubs. Borhavia is growing well on the central portion of the island as is one small coconut tree (Figure 3).

Red-tailed Tropicbird (Phaethon rubricauda)

Six pairs of Red-tailed Tropicbirds were found nesting on Rose Island. We found two pairs with eggs, one with a medium aged chick and two young ready to fledge (Table 1).

Masked Booby (Sula dactylatra)

A total of 10 pairs of Masked Boobies were estimated to be nesting on Rose Island, based on counts of 4 nests with young, 1 nest with eggs, and 5 fledglings (Tables 1 and 2). Twenty eight adults were found on the island to have bands or were banded by us. We were unable to estimate how many birds were occupying territories as the area is so small that a small amount of disturbance causes the birds to start moving about the meadow. All nesting was confined to the Borhavia meadow. A few second year birds and adults were captured on the shore adjacent to the Borhavia medow.

Brown Booby (Sula leucogaster)

We found 35 Brown Booby young on the island all were older chicks with primaries and rectricies growing (Table 1). This is obviously the end of the nesting season for this species. There were many birds roosting in the trees around the island at night, perhaps several hundred.

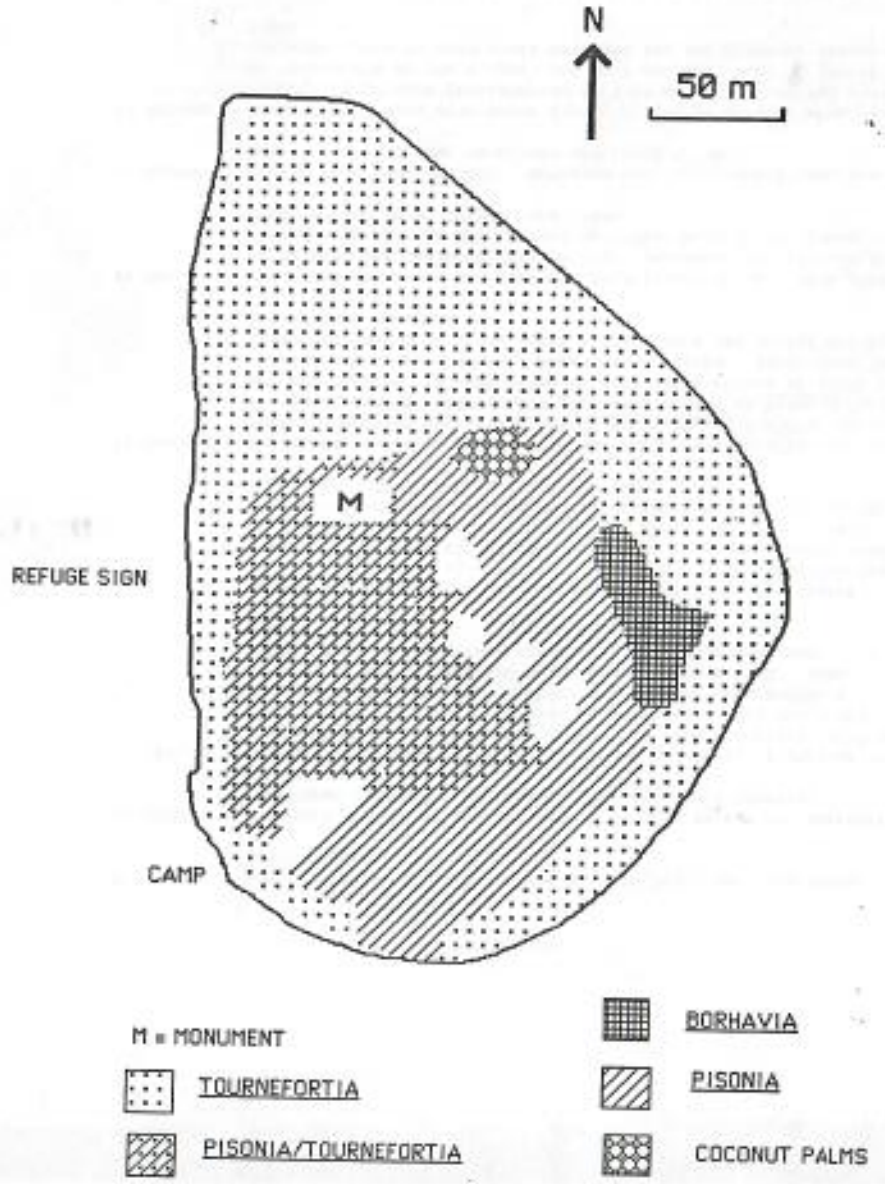


Figure 1. Vegetation observed on Rose Island in October of 1988.

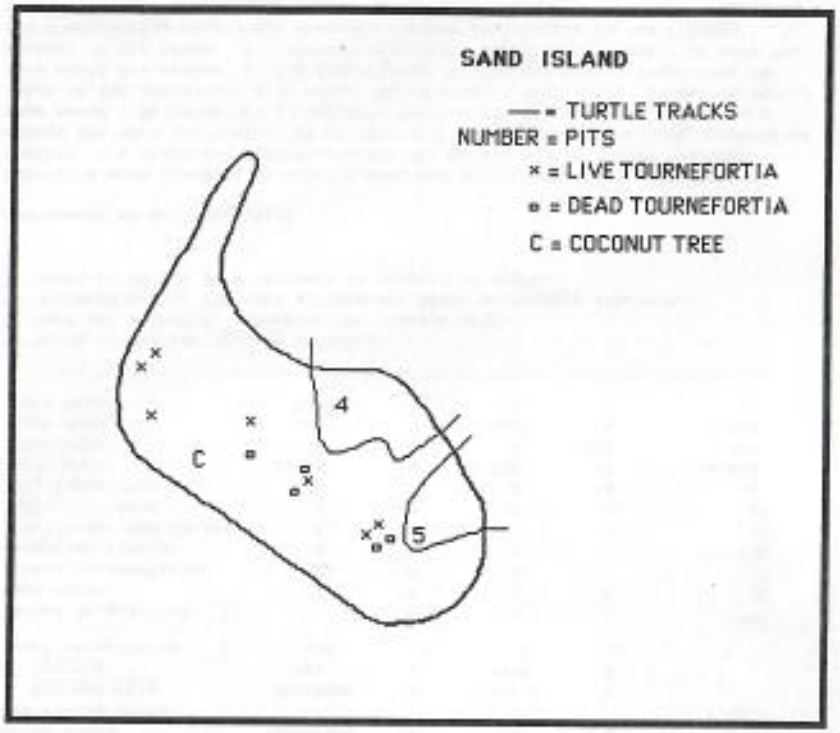


Figure 2. Vegetation, turtle pits, and turtle tracks observed on Sand Island, Rose Atoll in October of 1988.

Table 1. Detailed reproductive chronology and populations of frigatebirds and boobies on Rose Atoll, 12 - 16 October 1988.

Species	EGGS		AGE CLASSES OF CHICKS PRESENT											
	1	2	1	2	3	4	5	6A	6B	6C	7	8	9	10	Total
Red-Tailed Tropicbird	2	0	0	0	0	0	0	1	0	0	0	0	0	2	5
(Tournefortia area only)	0	1	0	0	1	0	1	0	0	1	0	0	1	0	5
Masked Booby															
Brown Booby	0	0	0	0	0	0	0	4	11	4	1	2	3	10	35
Red-Footed Booby	2	0	0	0	1	1	2	48	72	39	20	7	4	0	205
Great Frigatebird	0	0	0	0	0	0	0	1	-	-	2	0	0	0	3

Table 2. Populations of birds estimated on Rose Atoll on 12 - 14 October 1988.

Species	Roosting/Courting		Nests		Adult Population Estimate
	Rose Is.	Sand Is.	Rose Is.	Sand Is.	
Red-tailed Tropicbird	0	0	5	0	10
White-tailed Tropicbird	1	0	0	0	1
Masked Booby	30+	0	5	0	40+
Brown Booby	hundreds	0	35	0	300
Red-Footed Booby					1,000+
Tournefortia	hundreds	0	205	0	
Pisonia	184	0	101[a]	0	
Great Frigatebird	8	0	3	0	
Lesser Frigatebird		0	0	0	100+
Reef Heron	1	0	0	0	1[b]
Lesser Golden-Plover	6+	0	-	-	7[b]
Wandering Tattler	5	5	-	-	10[b]
Bristle-thighed Curlew	6	0	-	-	6[b]
Ruddy Turnstone	2	0	-	-	2[b]
Gray-backed Tern	0	0	0	15	30
Sooty Tern	2,500	0	5,569	17	15,000
Brown Noddy	0	0	0	168	350
Black Noddy	345+	0	454[b]	0	1,000
White Tern	943[c]	0	11	0	400

[a] Based on daytime Pisonia transect.
[b] Reef not surveyed, estimates for islands only.
[c] occupied nests, 978 nest structures, based on Pisonia transect.
[b] based on 50 m x 20 m transect in Pisonia at night.

Red-footed Booby (Sula sula)

Red-foots were abundant on Rose Island, but because of their habit of nesting in a dispersed fashion amongst the canopy of the forest complete counts are very difficult. It is also difficult to determine nest contents of some nests. We conducted a complete count in the Tournefortia and found a total of 205 nests most with older chicks present (Table 1). Almost certainly some nests are missed in this dense forest but we suspect we found over 90 percent of the nests. The nesting chronology reported in Table 1 is only for the Tournefortia counts and does not include the samples in the Pisonia forest. Within the Pisonia forest transect we counted a total of 18 nests of which 15 appeared to be occupied. The transect in the Pisonia forest covers an area of 3,900 m^2. Based on an area of Pisonia of 23,000 m^2 we estimate there are an additional 38 nests in the Pisonia for a total of 242+ pairs nesting on the Atoll (Table 2). Additionally, many hundred red-foots roost in the trees at night.

Great Frigatebird (Fregata minor) or Lesser Frigatebird (F. ariel)

We found 3 nests in the Tournefortia which contained mostly feathered chicks. We assume from the habitat that the birds were greats but it unknown if lessers nest in trees. Over 80 frigates were observed above the island in the evening. Most of the birds appeared to be greats but at least one was a lesser.

Sooty Tern (Sterna fuscata)

Numbers of sooties was very difficult to estimate on Rose Island this year. We roughly counted 2,400 individuals at 2300 hours roosting in three incipient colonies along the beach. Within the Tournefortia we found several small colonies with medium to large chicks. We counted about 520 chicks during the complete count of the Tournefortia.

The largest colony was located in the Pisonia forest below the large opening in the canopy created by several large trees falling over. There were both small chicks and eggs present which made counting very difficult. We decided to census the birds at night using one observer with minimal light. This proved rather effective as most chicks did not scatter in front of the observer. A piece of nylon line was stretched along the Pisonia transect during the day and the observer returned after dark and counted a strip one meter on either side of the line. A total of 120 eggs and 165 small chicks were counted in the transect (Table 3). The length of the transect was measured the following day and found to be 140 m for a density of 1.02 chicks or eggs per square meter. The area of the colony was estimated by stopping every 20 m along the transect and estimating the width of the band of nesting terns. The mean width was found to be 35.4 m SE = 7.15, thus 35.43 times the length of 140 m gives an area of 4,960 m^2 and when multiplied by the density of 1.02 gives an uncorrected estimate of 5,049 pairs. If the 520 chicks estimated above are included we have a minimum population of 5,569 pairs and probably well over 6,000 if hatching success is considered. Seventeen medium sized chicks were found on Sand Island.

Table 3. Data from plots of Sooty Terns nesting in Pisonia forest on Rose Island on 13 October 1988. Plots are were all two meters wide, but were not of equal length, thus the estimate for terns must be calculated from the totals for a transect of 140 m length. The numbers in the description relate to the aluminum tags on trees along the Pisonia transect.

Plot	Discription	Eggs	Chicks	Adults	Width of Nesting area
1	490-491	1	18	40	40 m
2	491-492	37	49	66	50 m
3	492-493	21	38	68	60 m
4	493-494	4	3	4	5 m
5	494-495	25	35	37	45 m
6	495-496	27	13	30	28 m
7	496-497	5	9	48	20 m
Total		120	165	288	$\bar{x}$ = 35.4 m

The Sooty Terns would seem to be the bird most vulnerable to rat predation. We found no signs of predation by rats even though our disturbance certainly left a number of chicks and eggs unattended. The nesting terns precluded our trapping rats in this area, thus we did not have rat stomachs to analyze for this area and could not determine if predation was occurring.

Gray-backed Tern (Sterna lunata)

Gray-backeds were nesting on the western finger of Sand Island. We counted 16 birds and 15 eggs in the course coral rubble.

Brown Noddy (Anous stolidus)

These birds were abundant nesters on Sand Island. We counted 410 birds, 181 eggs, and 6 newly hatched chicks. No brown Noddys were found on Rose Island.

Black Noddy (Anous minutus)

These terns were found nesting only in the Pisonia forest. We counted Black Noddys as having active nests if the birds were sitting on a nest although we could not verify if a chick or egg was present. Additionally, during the nocturnal count of terns a number of nests were occupied which were unoccupied during the daytime counts. During the day along the Pisonia transect (4,100 m^2) we found a total of 176 noddy nests of which 81 had birds in attendance. Most of the birds on the nests appeared to be adults and not chicks, thus we assumed that this was the advent of the nesting season. If we extrapolate from the number of nests found in the 4,100 m^2 transect to the 23,000 m^2 pisonia habitat we estimate there are between 454 and 987 pairs of Black Noddies on the island. This number seemed high to us and we felt due to the limits of the sampling method the lower number may be the more accurate estimate.

White Tern (Gygis alba)

This tern was a common roaster in the tops of trees at night, but only two eggs and no young were found on the Pisonia transect. Three eggs were found in the Tournefortia counts. We estimate that about 15 pairs were nesting on Rose Island. A large number of birds were observed roosting at night. We counted 43 White Terns roosting in the tops of the Pisonia trees during a 50 m transect conducted at night. If we extrapolate from this limited transect of 1,000 m^2 we estimate 989 terns roosting in the Pisonia. We have no idea how many roost in the Tournefortia, but would guess that at least an additional 200 might be found at night.

Pacific Golden Plover (Pluvialis fulva)

A maximum of 13 birds were counted on coastal surveys, but a number of birds were found in the interior at all times of the day. Since we can not find all of the birds in the interior, due to heavy vegetation and the large area, we suspect this is a minimum number for the island and estimate there may be about 20 birds on Rose Island. The outer reefs were not surveyed for shorebirds.

Bristle-thighed Curlew (Numenius tahitiensis)

Knowles observed two flocks of 3 birds on 13 October. We think this was all of the birds on the island, but there may have been one or two additional individuals. One bird was observed roosting at night about five feet above the ground in a Tournefortia near the shore. None of the birds were banded.

Wandering Tattler (Heteroscelus incanus)

We counted 4 tattlers on the coastal survey of Rose Island. A flock of five birds were observed on Sand Island. The birds on Sand were in a flock, thus they may have still been migrating.

Ruddy Turnstone (Arenaria interpres)

Only two turnstones were counted on Rose Island.

Polynesian Rat

Rats were as usual very abundant although Knowles felt that they were not as abundant as on some of the other trips because only a few were observed during the day on this trip. We set 12 traps in the Tournefortia area as in the past, but the Sooty Terns nesting in the Pisonia forest prevented us from setting traps where they had been placed during past trips. We set traps along the southern 45 m of the Pisonia transect, near the monument, and the area to the west of the south end of the Pisonia transect. Trapping success was generally high ranging from 50 to 95 percent with an overall rate of 74 percent (Table 4). These trapping success rates are comparable to other efforts in the past two years.

Most rats were adults and several were pregnant or lactating indicating the population is not as yet above carrying capacity (Table 5). Measurements from the rats taken on the first day are presented in Table 5. The only food found in 18 individuals was vegetation. Our sample was biased, as we did not trap in the Sooty Tern colony so it is unknown what percent if any of the birds are preyed on by the rats. As has been reported by most observers to the island it is amazing how many rats are present. We observed up to 10 rats at once in the camp at night even after numerous animals had been trapped in the area. The rats seem to play an important role in the islands appearance. They apparently eat all the Pisonia leaves which fall. The soil is a rich humus completely devoid of leafy litter. When eradication of the rats occurs there should be an increase in leafy litter with an unknown effect on nesting

substrate for Sooty Terns. Hermit crabs may increase and control the leafy litter.

Table 4. Results of trapping effort at Rose Atoll on the nights of 12 and 13 October 1988. All traps were new Victor rat traps bated with fresh coconut.

	PISONIA		TOURNEFORTIA	
	12 October Number (%)	13 October Number (%)	12 October Number (%)	13 October Number (%)
Traps Set	19	19	12	12
Rats Caught *	18 (95)	12 (63)	6 (50)	10 (84)
Crabs Caught	1 (5)	2 (11)	0 (0)	0 (0)
Trap Sprung	0 (0)	5 (26)	4 (33)	1 (8)
Trap Unsprung	0 (0)	0 (0)	2 (17)	1 (8)

* Trap with two rats caught counted as one.

Table 5. Measurements and stomach contents of polynesian rats taken at Rose Island on 12 October 1988.

NUMBER	AGE	SEX	TAIL	REAR FOOT	EAR	STOMACH CONTENTS	(COMMENTS)
1	A	F	132	26	9	vegetation	
2	A	F	108	25	15	empty	(lactating)
3	A	M	152	29	18	vegetation	
4	J	F	141	27	14	"	
5	A	M	77broken	28	16	"	
6	A	F	138	26	15	"	
7	J	M	146	27	14	"	
8	A	M	138	26	14	empty	
9	A	M	136	28	missing	vegetation	
10	A	M	149	28	17	"	
11	A	F	128	27	13	"	(pregnant)
12	A	F	118	27	13	"	(lactating)
13	A	M	144	28	16	"	
14	J	M	158	24	15	"	
15	A	M	115broken	28	18	"	
16	A	F	93broken	26	14	"	(pregnant)
17	J	F	144	28	15	"	
18	J	F	145	27	17	"	

Fish and Reef Invertebrates

Bower and Fornell did four SCUBA dives (two in the lagoon, one in the outer channel, and one about 400 m southwest of the channel outside the reef. The coral appears to be healthy and the fish populations relatively diverse but lacking in numbers and size of individuals for an island with little fishing. Both grey-reef sharks and white-tipped reef sharks were noticeably absent.

Green Sea Turtle (Chelonia mydas)

Only two turtles were found on Rose Island. The first was found on the reef flats at low tide on 12 October and the other digging nest holes on both nights on the north west beach. Both turtles were tagged by us and appeared to have no scars from previous tags (Table 6). Observers walked the perimeter of the island every two hours on both nights and found no fresh tracks except for the individual which was tagged.

Figures 3 and 4 indicate where turtle tracks and pits were located on the beaches of Sand and Rose Islands. The observers had trouble in distinguishing the age of the tracks. Bill Knowles felt the tracks and pits listed as old were from last year, while the other authors felt the may have only been a few months old.

Table 6. Turtles taged on Rose Island on 12 and 13 October 1988.

DATE	NMFS TAGS	TAG PLACEMENT	SEX	CARAPACE LENGTH
12 October	6818	Left front leg (proximal)*	Female	38.75"
	6819	Right front leg (proximal)		
	6820	Right front leg (distal)		
13 October	6821	Right front leg(proximal)	Female	38.25"
	6822	Left front leg (proximal)		
	6823	Left front leg (distal)		

* Distal 3-4 inches of left front leg missing.

Trespass

We found no signs of recent trespass on the island. The two remaining steel boundary signs need new bolts as they are beginning to rust away. The redwood sign at the beach landing is holding up well, but the uprights are deteriorating and should be replaced in the next couple of years. The signs which contain the writing appear to be in good condition. Paul Pedro the captain of the Saosauimoana said the sign did have a roof, but it was lost in the hurricane. He also said the sign was knocked down by the winds and the ships crew fixed it. An interesting short coming of the sign is that no trespassing is written in four languages, but not in Samoan.

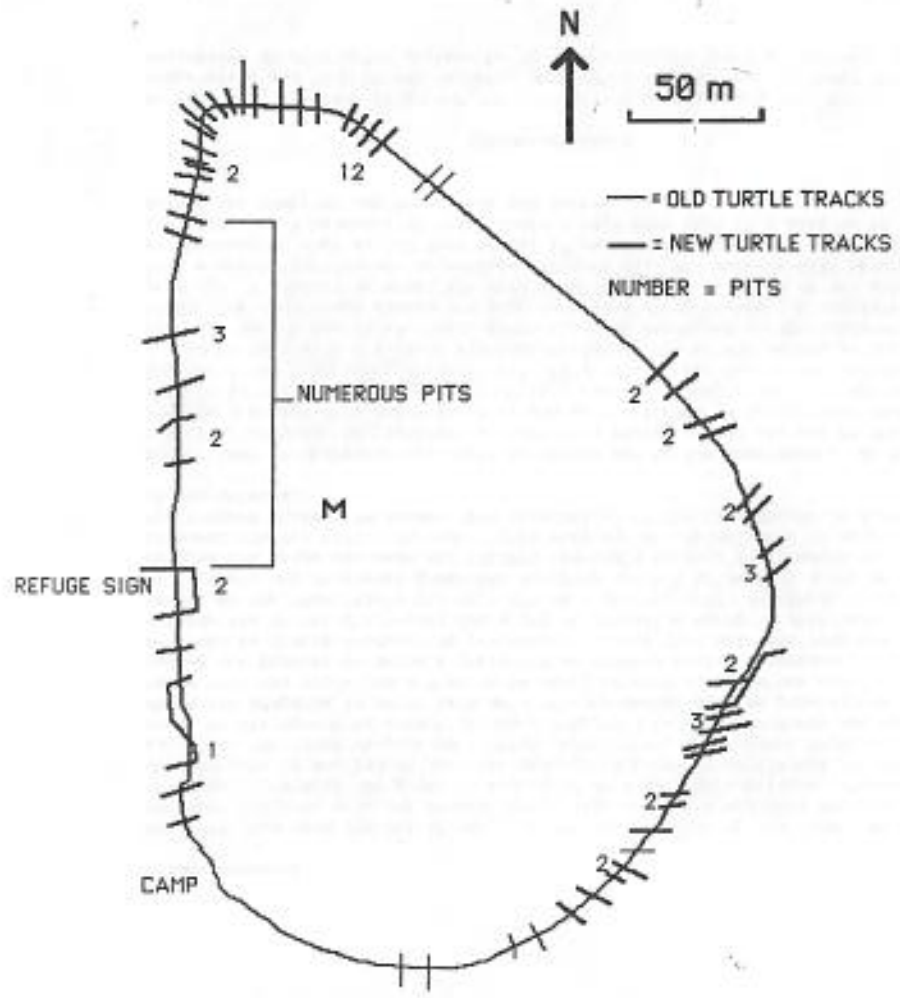


Figure 3. Turtle pits and tracks observed on Rose Island in October of 1988.

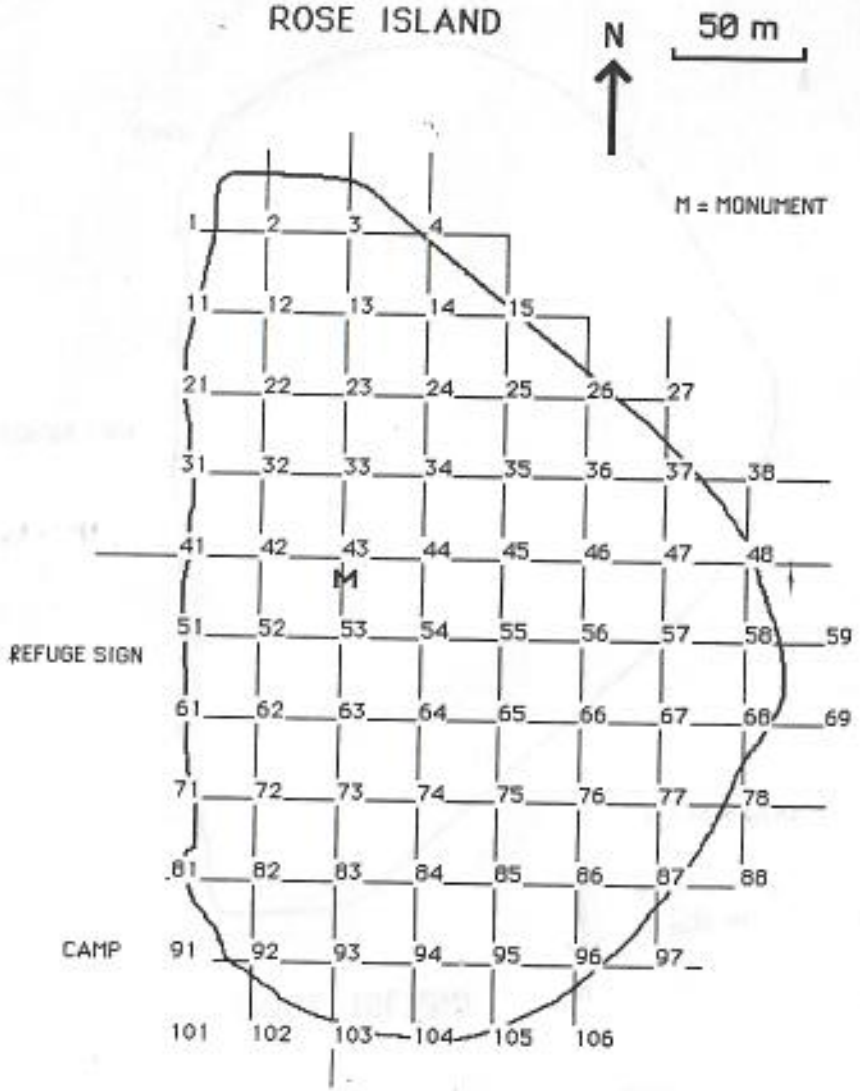


Figure 4. Suggested 30m grid for sampling birds and vegetation on on Rose Island.

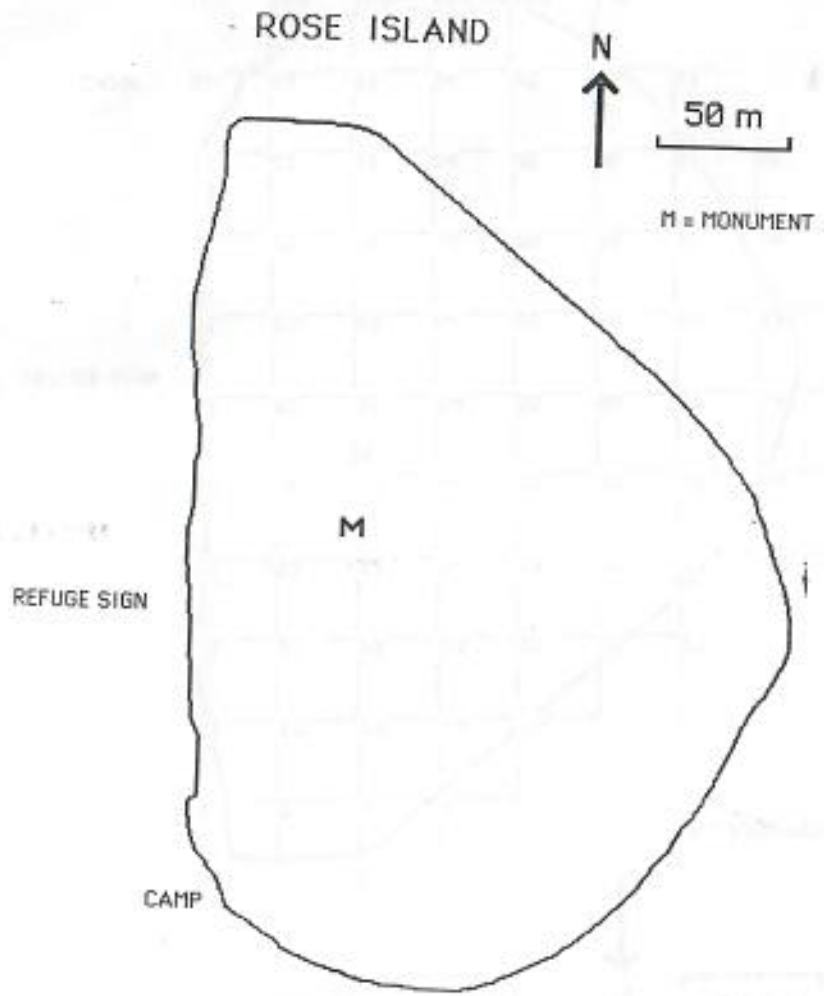
Recommendations

The most prominent feature of the atoll is the presence of the rats. We have now been trapping rats for several trips without seeing any real cycling of the population with the possible exception of after the hurricane. There are so many rats on the island that trapping seems to be of little use as essentially all the traps are sprung. Those which do not catch rats, catch hermit crabs or are sprung by either of these animals. Many of the traps are sprung while the trapline is being laid out. To get usable data on populations it seems that the traps would have to be reset several times in one evening to reduce the population below a threshold so numbers could be compared. While we found no direct evidence of predation it seems that with the complete elimination of leafy material the signs of predation would be difficult to detect as the dead chicks and eggs may well be completely consumed. I suggest we initiate the necessary paperwork to allow the use of several types of poisons and traps and seek the $20,000 necessary to fund a one month expedition to eradicate the rats. The work could possibly be accomplished by some of the Samoans through PR funds. The eradication of the rats should be a priority of the service.

Rose Island is extremely difficult to census due to the vegetation. As trees fall over it seems the habitat is undergoing change making the use of the Pisonia transect less representative and more difficult to extrapolate census results to the mixed Pisonia-Tournefortia habitat. Additionally, complete counts of the Tournefortia would be quite difficult for one or two individuals. I suggest that a 30 m grid of stations be laided out on the island so that if complete counts are impractical, plots could be conducted at the stations to facilitate consistent census and give us a base of reference for vegetation mapping. I suggest we start the grid from 10 m north or south of the monument on a magnetic north-south orientation (Figure 4). The markers will need to be substantial such as 0.5 inch rebar, 1" steel water pipe or 2 inch PVC. The grid should be numbered with aluminum tags such that if a station is missed the observer can back track and locate it.

Acknowledgements

We wish to thank Paul Pedro and the crew of the Sausauimoana for their hospitality and help at the Island. Aito Sunia and Lai Vaa Vaa aided in the collection of data which allowed us to do a much more thorough survey.



Master Permit No. 9149

BAND PREFIX: 1367	COMMON NAME	ADU #	STATUS	AGE/SEX	REGION	LAT-LONG	LOC	DATE MO. DAY YR.
515 51	BRBO	115.0	300	ASY - F	096	1435 1650	A	10-12-88
52								
53				L - U				
54								
55				ASY - M				
56								
57				F				
58				L U				
59				ASY M				
60				F				
61	Replaces 1117-93703							
62				L				
63				ATY M				
64				F				
65				ASY M				
66				F				
67				L - U				
68				ASY M				
69				F				
70	MABO	114.0		ATY M				
71	BRBO	115.0		L - U				
72				ASY - M				
73				F				
74				M				
75				F				
76				F				
77				M				
78				F				
79				M				
80				L - U				
81								
82								
83								
84								
85								
86								
87								
88								10-13-88
89								
90								
91								
92	Recap Last							
93	MABO	114.0	300	L - U	096	143 1650	A	10-13-86
94	BRBO	115.0		ASY - U				
95				M				
96				L - U				
97								
98	MABO	114.0						
99	BRBO	115.0		ASY M				
100				L - U				

REMARKS: This is southern Hemisphere 14° South 168 West

87-51561 replaces 1117-93703

5159 - Band placed on Brian Booby Local bird could be on MABO Local or Adult

Approval expires 04/30/90
OMB Approval # 1018-0086

Master Permit No. 9149

Banding Schedule
3-800 (Rev. 1985)

Master Permittee Hawaiian Is NWR

INCLUDES BAND NOS.
FROM 1367-51501
THROUGH 51600
REPORT ONLY CONTIGUOUS BAND NUMBERS

—Banding Locations—
A Rose Island, Rose Atoll, Am Samoa POC
B
C
D
E
F

BAND PREFIX		COMMON NAME	AOU #	STATUS	AGE-SEX	REGION	LAT-LONG	LOC	DATE MO. DAY YR.
1367 515	01	BRBO	115.0	300	L - U	096	1435-1680	A	10-12-88
	02	RFBO	116.0						
	03	MABO	114.0						
	04	BRBO	115.0						
	05								
	06								
	07	MABO	114.0						
	08	BRBO	115.0						
	09	MABO	114.0						
	10								
	11				ASY - F				
	12	BRBO	115.0		L - U				
	13								
	14				ASY - M				
	15								
	16				L - U				
	17				ASY - M				
	18								
	19								
	20				F				
	21				M				
	22				L - U				
	23								
	24				ASY-M				
	25								
	26	mABO	114.0		- U				
	27				F				
	28				AFY - U				
	29				ASY - U				
	30	BRBO	115.0		- F				
	31				- M				
	32				L - U				
	33				ASY - M				
	34								
	35				L - U				
	36	mABO	114.0						
	37				ATY - M				
	38	BRBO	115.0		ASY - F				
	39								
	40	mABO	114.0		L - U				
	41				ASY - M				
	42	BRBO	115.0						
	43	mABO	114.0						
	44	BRBO	115.0						
	45	mABO	114.0						
	46	BRBO	115.0						
	47	mABO	114.0		L - U				
	48	BRBO	115.0		ASY - M				
	49								
	50				L - U				

U.S. bandings to: Bird Banding Laboratory, Office of Migratory Bird Management, Laurel, MD 20708. Canadian bandings to: Canadian Wildlife Service, Environmental Management Service, Department of the Environment, Ottawa, Ontario, Canada K1A 0E7.

INSTRUCTIONS AND DEFINITIONS PROVIDED IN BIRD BANDING MANUAL

EXPEDITION REPORT - ROSE ATOLL

October 22 - 28, 1989

BY

DOUGLAS J. FORSELL

March 24, 1990

This report may be cited as follows: Forsell D. J.. 1989. Fall Survey of Rose Atoll - 23-20 October 1989. Administrative Report, U. S. Fish and Wildlife Service, Hawaiian and Pacific Islands National Wildlife Refuge, 20 pp.

INTRODUCTION

The purpose of this trip was to conduct surveys of the marine environment, vegetation, turtles, and marine birds of Rose Atoll. Three days and two nights were spent on the island. The trip was a cooperative effort of the American Samoa Government's Office of Marine and Wildlife Resources and the Hawaiian and Pacific Islands National Wildlife Refuge.

PERSONNEL

Douglas J. Forsell, Refuge Manager - Remote Islands Complex, Hawaiian and Pacific Islands NWR

Dr. Peter Craig, Supervisory Biologist - Office of Marine and Wildlife Resources (OMWR), American Samoa Government.

Bonnie Ponwith - Fisheries Biologist, OMWR

Wayne Syron - Wildlife Biologist, OMWR

Fale Tuilagi, Fisheries Technician, OMWR

Edwin Seui, Fisheries Technician, OMWR

ITINERARY

22 October - Depart Honolulu at 1450 enroute to Pago Pago, American Samoa. Arrive Pago Pago at 1950 hours.

23 October - Met with Mr. Phillip Langford, Assistant Director OMWR, and Dr. Peter Craig to discuss and clarify the Special Use Permit for visits to Rose Atoll. For safety reasons they did not wish to anchor the ship in the lagoon overnight. I stated this was not necessary as had been stated in the permit. Shopped for groceries and equipment in the AM and loaded boat. Departed Pago Pago Harbor at 1600. Seas were moderate.

24 October - Arrive Rose Atoll at 0845. Conducted count of turtle tracks and pits. Attempted to find permanent fisheries transects on the north shore outside of the reef. Censused and banded boobies in evening plus searched for turtles. Conducted another search for turtles from 2200 to 2300 hours.

25 October - Searched beaches for turtles from 0500 to 0600. Placed stakes to mark census grid on island from 0730 to 1200 hours. Went diving over pinnacles near Sand Island while Craig and Ponwith counted, measured, and recorded color of clams along transects. Placed more plot stakes form 1645 to 1830. Banded more boobies and looked for turtles from 1930 to 2100 hours. Conducted another search for turtles from 1000 to 2300 hours. Tagged one female turtle.

26 October - Searched for turtles from 0415 to 0630. Found one female digging a pit and laying eggs. Tagged her upon departure after laying completed. Began censusing bird in plots from 0730 to 0930. Surveyed Turtle tracks and birds on Sand Island from 0930 to 1100 hours. In afternoon Craig, Ponwith, and Tuilagi dove on east and south sides of Atoll to locate census plots while Forsell, Syron, and Seui continued placing grid stakes and censusing birds. Departed Island at 1800 hours enroute to Pago Pago. Weather nice until a sudden storm hit about 2200 hours.

27 October - Very uncomfortable ride home. Winds 25 knots from the south and didn't subside until early morning. Arrived Pago Pago at 0930. Unloaded ship, cleaned camp equipment, and wrote notes in AM. Wrote more notes in PM and did laundry.

28 October - Aircraft delayed 14 hours. Departed Pago Pago at 2030 hours. Arrived Honolulu about 0030 hours.

METHODS AND RESULTS

We attempted to make complete counts of all birds nesting on Rose Island. This was facilitated by placement of a 30 m grid system over the island so the birds could be counted within each 30 x 30 m area without our becoming disoriented in the forest and not missing or double counting birds (Figure 1). The grid pattern was based on two lines placed by Rowland in early 1989. The first central line was oriented on a magnetic north-south line starting 10 m north of the monument. A second line orienated on a magnetic east west axis began at the stake 10 m north of the monument. The northern portion of the grid and the east-west line were easy to follow and appear to be on good magnetic courses. The line extending south of the monument seems to be oriented about 10 degrees west of magnetic south. This had a minor effect on the accuracy of the grid but by the time the error was discovered we could not adjust. The eastern end of the grid was not completed thus the maps in this report created from the measurements of the grid may not be accurate. We attempted to count all birds in all of the grids, but time limitations prevented us completing census in all of the eastern grids. A quick survey of the area indicated very little use of the area by nesting birds.

Vegetation

On Rose Island, Several more large Pisonia had fallen in the middle of the forest creating a larger opening in the canopy than found in 1988. While the forests appear to be thriving with lots of new growth the older larger trees seem be falling and loosing their large branches. While we were on the island one branch measuring about 30 cm at the base and 12 m long fell. The branch contained a medium frigatebird chick which was killed and two large Red-footed Booby chicks. The cause of the die off is unknown. In 1988, Knowles postulated that a large amount of saltwater may have washed over the island during Hurricane Tusi and killed the trees. Since the trees appear healthy, it seems that perhaps the trees are reaching senescence or they are merely growing too large for the soft wood to support. I would expect in the next few years that most of the larger Pisonia will fall and be replaced by younger trees.

The Tournefortia appeared to be healthy, and very thick along the shore line. Knowles believed that the Tournefortia and may be encroaching on the Boerhavia meadow, but I could see little difference in one year. No Portulaca was observed in the Boerhavia meadow. Coconuts seem to be reproducing well and are slowly spreading. Most coconuts on the ground had been eaten by rats (Rattus exulans). An incomplete survey of the distribution of vegetation on Rose Island is presented in Figure 2.

The vegetation on Sand Island appears to be recovering from the damage of the hurricane Tusi. There were fifteen live Tournefortia bushes, a few seedlings, and several dead shrubs. Boerhavia is growing well on the central portion of the island as is one small coconut tree (Figure 3).

ROSE ISLAND SAMPLING GRID

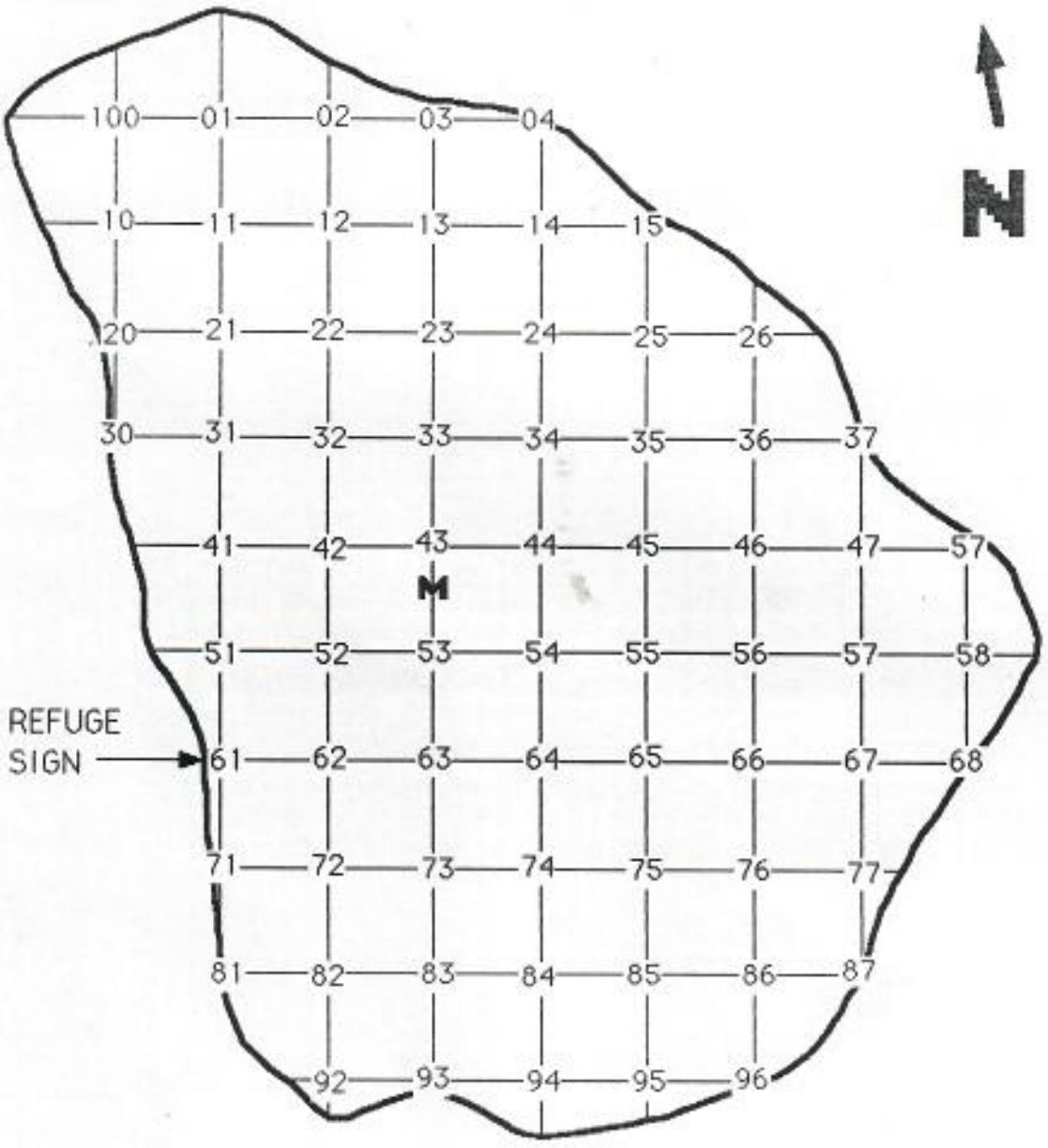


Figure 1. Rose Island with 30 m grid used for sampling the island. The numbers on the stakes may have ones or threes preceeding the numbers indicated on the grid.

Rose Island Vegetation

Figure 2. Vegetation observed on Rose Island during October 1989. This should be considered an incomplete map as several areas were done from memory and many coconut palms are not listed.

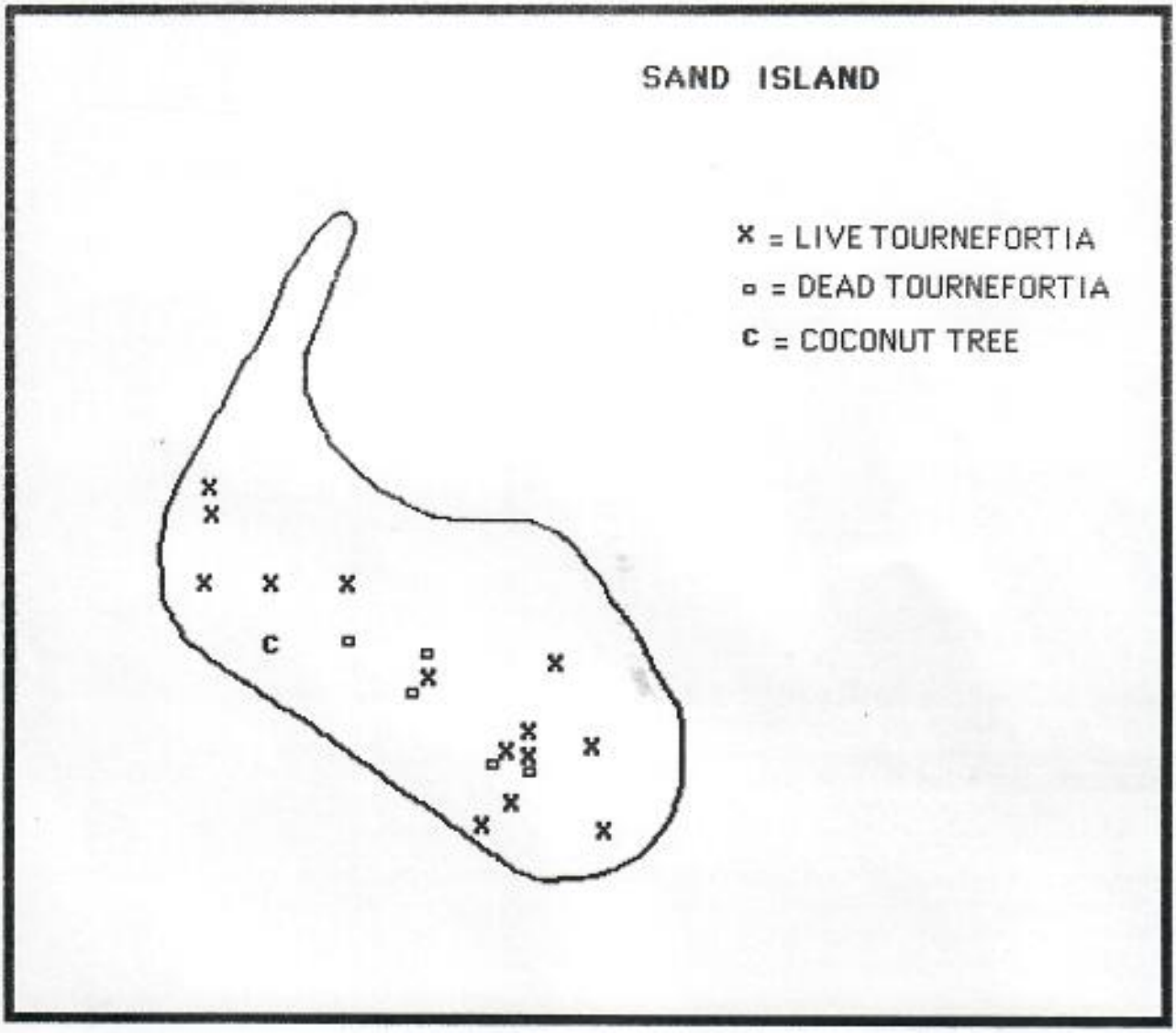


Figure 3. Vegetation observed on Rose Island during October 1989.

Red-tailed Tropicbird (Phaethon rubricauda)

Six pairs of Red-tailed Tropicbirds were found nesting on Rose Island. We found one pair with an egg and the remaining five nests had large chicks ready to fledge (Table 1).

Masked Booby (Sula dactylatra)

Only 4 pairs of Masked Boobies were estimated to be nesting on Rose Island, based on counts of 4 nests with young all containing medium to large chicks. (Tables 1 and 2). Thirty two adults were found on the island of which 28 were previously banded and four were banded by us (see attachments). In addition, bands were placed on five hatching year birds and three juvenile birds. We were unable to estimate how many birds were occupying territories as the area is so small that a small amount of disturbance causes the birds to start moving about the meadow. All except one nest was confined to the Boerhavia meadow.

Brown Booby (Sula leucogaster)

We found 15 nestling Brown Boobies on the island. All were older chicks with primaries and rectrices growing (Table 1). This was obviously the end of the nesting season for this species. I estimated one to two hundred birds roosting in the trees around the island at night. We banded 18 adults, 4 juveniles, and 15 chicks. We read bands on 4 previously banded adults.

Red-footed Booby (Sula sula)

Red-footeds were abundant on Rose Island. We conducted a complete count in all plots and found 270 nests containing medium or larger chicks (Tables 1 and 2). Almost certainly some nests are missed in this dense forest, but we suspect we found over 95 percent of the nests. This was the end of the nesting season and we suspect that many hundred more nests would be present in September. The majority of the nests are in the Tournefortia forest on the northern portion of the island.

Great Frigatebird (Fregata minor) or Lesser Frigatebird (F. ariel)

We found 55 nests in the Tournefortia which contained larger feathered chicks (Table 1). The species composition of the nesting birds was very difficult to determine as most nests had larger chicks present and the adults were not on the nests. We assumed from the habitat that the majority of the birds were greats, but toward the end of the survey we found at least two of the nests had female lessers in attendance. I believe that several of the nests may have been lessers. I believe this the first confirmed nesting record for this species at Rose Atoll. We counted over 80 frigates soaring above the island in the afternoon and many more were present in the early morning. Both greats and lessers were present, but the greats were far more abundant than lessers. The male lessers seemed to have rather faint white spots below the wings as compared to birds on Baker and Jarvis Islands.

Table 1. Detailed reproductive chronology and populations of tropicbirds, frigatebirds, and boobies on Rose Atoll, 25 - 26 October 1989.

Species	EGGS		AGE CLASSES OF CHICKS PRESENT												Total
	1	2	1	2	3	4	5	6A	6B	6C	7	8	9 LOCAL	10 LOCAL	
Red-Tailed Tropicbird	1	0	0	0	0	0	0	1	0	0	0	0	2	2	5
Masked Booby	0	0	0	0	0	0	0	1	1	0	0	0	1	1	4
Brown Booby	0	0	0	0	0	0	0	2	0	0	0	2	2	9	15
Red-Footed Booby	0	0	0	0	0	3	8	17	22	10	41	49	88	29	267
Frigatebirds Sp.	2	0	0	0	0	3	7	-	6	-	6	6	20	5	55

Table 2. Populations of birds estimated on Rose Atoll form 24 - 26 October 1989.

Species	Roosting/Courting		Nests		* Adult Population Estmate
	Rose Is.	Sand Is.	Rose Is.	Sand Is.	
Red-tailed Tropicbird	0	0	6	0	12
White-tailed Tropicbird	1	0	0	0	1
Masked Booby	36+	0	4	0	40+
Brown Booby	100-200	0	15	0	200
Red-Footed Booby	hundreds	0	270	0	1,000?
Great Frigatebird	300+	0	56	0	300+
Lesser Frigatebird					
Lesser Golden-Plover	7+	2	-	-	9[a]
Wandering Tattler	1+	5	-	-	10[a]
Bristle-thighed Curlew	4	0	-	-	6[a]
Ruddy Turnstone	2	0	-	-	2[a]
Gray-backed Tern	0	0	0	2	4
Sooty Tern	2,000	0	30	567	3,000
Brown Noddy	0	0	3	145	300
Black Noddy	45+	0	7	0	50
White Tern	18+	0	4	0	100

[a] **Reef not surveyed, estimates for islands only.**

Sooty Tern (Sterna fuscata)

Very few Sooty Terns were found nesting on Rose Island this year. Terns were starting to nest along the northeastern shore, with 30 eggs found on the first day. By evening all but five of the eggs hade been predated by rats and hermit crabs. Numerous rats were observed eating the eggs and it was unknown if the crabs were merely scavenging or were destroying eggs. I suspect that the crabs are not a major predator since I have not observed them eating eggs on other remote islands where there are much larger populations of crabs. The largest colony of Sooty Terns was located on Sand Island where we counted 567 eggs on the eastern end of the island.

Gray-backed Tern (Sterna lunata)

Gray-backeds were nesting on the western finger of Sand Island. We counted only two adult birds and two fledgling chicks. The nesting season is apparently completed for this species and we suspect that many more birds nested earlier in the year.

Brown Noddy (Anous stolidus)

These birds were abundant nesters on Sand Island. We counted 143 eggs, and 2 newly hatched chicks. We found only 3 nests of Brown Noddys in the crouches of trees on Rose Island. One was destroyed by rats while we were there.

Black Noddy (Anous minutus)

We found only seven active nest and approximately 100 old nest structures on Rose Island. Most of the nests were in the mixed Pisonia/Tournefortia forest along the South shore of the island. There were only 35 birds observed roosting during the day which is much lower than past surveys in this season. We do not know if the nesting season was over for the year or if only a few birds are nesting this year.

White Tern (Gygis alba)

Very few White Terns were found on the Rose Island this year. During daytime surveys only two eggs, one chick, and eighteen roosting adults were found. Night surveys were not conducted this year, thus we have no data to compare with other years. It was my impression that there were very few White Terns as compared to 1988.

Pacific Golden Plover (Pluvialis fulva)

A maximum of 7 birds were counted on coastal surveys, but a number of birds were found in the interior at all times of the day. Since we can not find all of the birds in the interior due to the heavy vegetation and the large area we suspect this is a minimum number for the island and estimate there may be about 15 birds on Rose Island. The outer reefs were not surveyed for shorebirds.

the beaches of Sand and Rose Islands. On Rose Island, we counted about 70 tracks and 127 pits of which some pits were from last year. On Sand Island, we counted 17 tracks and 48 pits. The number of tracks and pits were similar to those found on the October 1988 trip.

Table 3. Turtles tagged on Rose Island on 25 and 26 October 1988.

DATE	NMFS TAGS	TAG PLACEMENT	SEX	CARAPACE LENGTH
25 October	10632	Left front leg (distal)	Female	37.5"
	10633	Right front leg (proximal)		
	10634	Left front leg (proximal)		
26 October	10635	Right front leg (proximal)	Female	38.25"
	10636	Left front leg (proximal)		
	10637	Left front leg (distal)		

Trespass

We found no signs of recent trespass on the islands. Two steel boundary signs remain. The bolts were replaced by the crew of the Sausauimoana on their last trip. The redwood sign at the beach landing is holding up well, but the uprights are deteriorating and should be replaced in the next couple of years. The signs which contain the writing appear to be in good condition. Paul Pedro the captain of the Sausauimoana said the sign did have a roof, but it was lost in the hurricane. The roof does not seem necessary as birds do not roost on the sign. An interesting short coming of the sign is that "no trespassing" is written in four languages, but not in Samoan.

RECOMMENDATIONS

It appeared that except for Brown Noddies and possibly Sooty Terns most species were near the end of their nesting cycle. The nesting season appeared to be at least one to two months earlier than in 1988. I would suggest that a trip in late August would produce better estimates of populations of nesting birds. In the last two October trips we have only tagged two turtles on each trip. It does not seem to be worthwhile to plan trips for turtles when so few are found. I would suggest a trip in late August to census birds and another in November to tag turtles. In addition trips should be planned so that high tides occur at night in order to find more turtles on the beaches. It may also be worthwhile to bring two sets of turtle banding equipment and have two persons remain on Sand Island one night. Trips should also be planned so that at least three nights and three to four full days are spent on the island.

Bristle-thighed Curlew (Numenius tahitiensis)

I observed one flock of four birds on Rose Island. I think this was all of the birds on the island, but there may have been one or two additional individuals.

Wandering Tattler (Heteroscelus incanus)

We counted only one tattler on the coastal survey of Rose Island.

Ruddy Turnstone (Arenaria interpres)

Only two turnstones were counted on Rose Island.

Polynesian Rat (Rattus exulans)

Rats were as usual very abundant. We did not trap rats as time on the island was limited. We observed several rats eating eggs of Sooty Terns. A small group of thirty eggs was observed about 1200 hours on the first day and by midnight only six eggs remained. Several rats were observed eating eggs. The egg of one Brown Noddy nest about eight feet up a tree was also eaten. Rats were also observed eating flowers at the end of a Tournefortia tree. This would indicate that rats are capable of reaching all nests in trees and probably prey on eggs of most of the tree nesting species.

Fish and Reef Invertebrates

I dove at the pinnacles near Sand Island, in the outer channel, and about 400 m southwest of the channel outside the reef. The coral appears to be healthy and the populations of fish and clams about the same as in 1988. Three green turtles were observed while diving outside the reef.

Green Sea Turtle (Chelonia mydas)

Only two turtles were found on Rose Island. One turtle was found prospecting on the western shore and was tagged on its way back to sea without laying eggs. The second turtle was found digging a pit on the southern beach in the pre-dawn hours. This individual deposited about fifty eggs in the pit and was tagged after covering the pit (Table 3). Observers walked the perimeter several times each night, but there were extremely low tides at night during our visit so the animals did not appear to be coming ashore when they had to crawl across the reef flats.

In order to reduce confusion at night as to which tracks were new or old we raked out old tracks as we counted them on the survey. We also painted tracks and pits with spray paint to avoid having to follow tracks which were old. Figures 3 and 4 indicate where turtle tracks and pits were located on

the beaches of Sand and Rose Islands. On Rose Island, we counted about 70 tracks and 127 pits of which some pits were from last year. On Sand Island, we counted 17 tracks and 48 pits. The number of tracks and pits were similar to those found on the October 1988 trip.

Table 3. Turtles tagged on Rose Island on 25 and 26 October 1988.

DATE	NMFS TAGS	TAG PLACEMENT	SEX	CARAPACE LENGTH
25 October	10632	Left front leg (distal)	Female	37.5"
	10633	Right front leg (proximal)		
	10634	Left front leg (proximal)		
26 October	10635	Right front leg (proximal)	Female	38.25"
	10636	Left front leg (proximal)		
	10637	Left front leg (distal)		

Trespass

We found no signs of recent trespass on the islands. Two steel boundary signs remain. The bolts were replaced by the crew of the Sausauimoana on their last trip. The redwood sign at the beach landing is holding up well, but the uprights are deteriorating and should be replaced in the next couple of years. The signs which contain the writing appear to be in good condition. Paul Pedro the captain of the Sausauimoana said the sign did have a roof, but it was lost in the hurricane. The roof does not seem necessary as birds do not roost on the sign. An interesting short coming of the sign is that "no trespassing" is written in four languages, but not in Samoan.

RECOMMENDATIONS

It appeared that except for Brown Noddies and possibly Sooty Terns most species were near the end of their nesting cycle. The nesting season appeared to be at least one to two months earlier than in 1988. I would suggest that a trip in late August would produce better estimates of populations of nesting birds. In the last two October trips we have only tagged two turtles on each trip. It does not seem to be worthwhile to plan trips for turtles when so few are found. I would suggest a trip in late August to census birds and another in November to tag turtles. In addition trips should be planned so that high tides occur at night in order to find more turtles on the beaches. It may also be worthwhile to bring two sets of turtle banding equipment and have two persons remain on Sand Island one night. Trips should also be planned so that at least three nights and three to four full days are spent on the island.

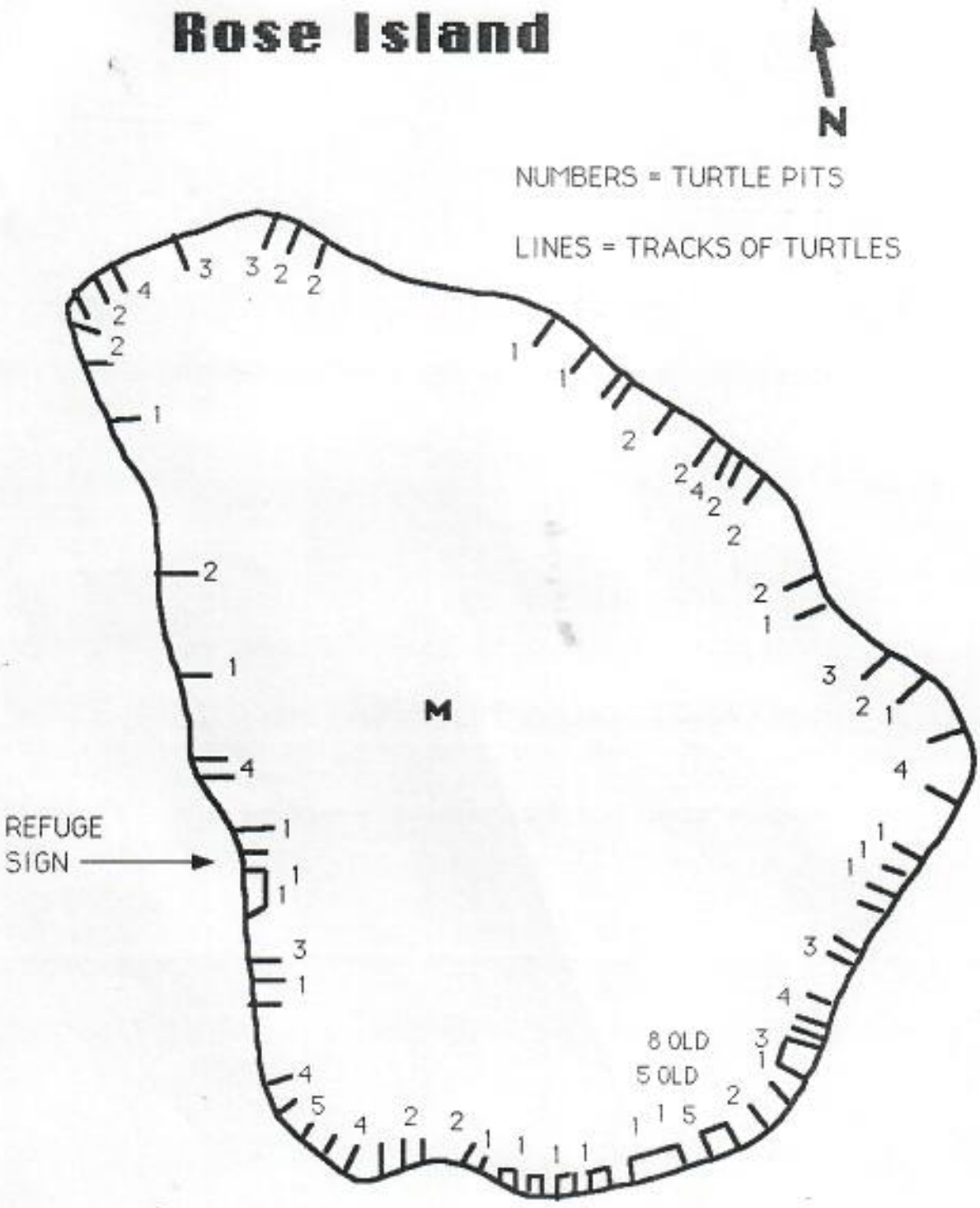


Figure 4. Tracks and pits of turtles observed at Rose Island on 24 October 1989.

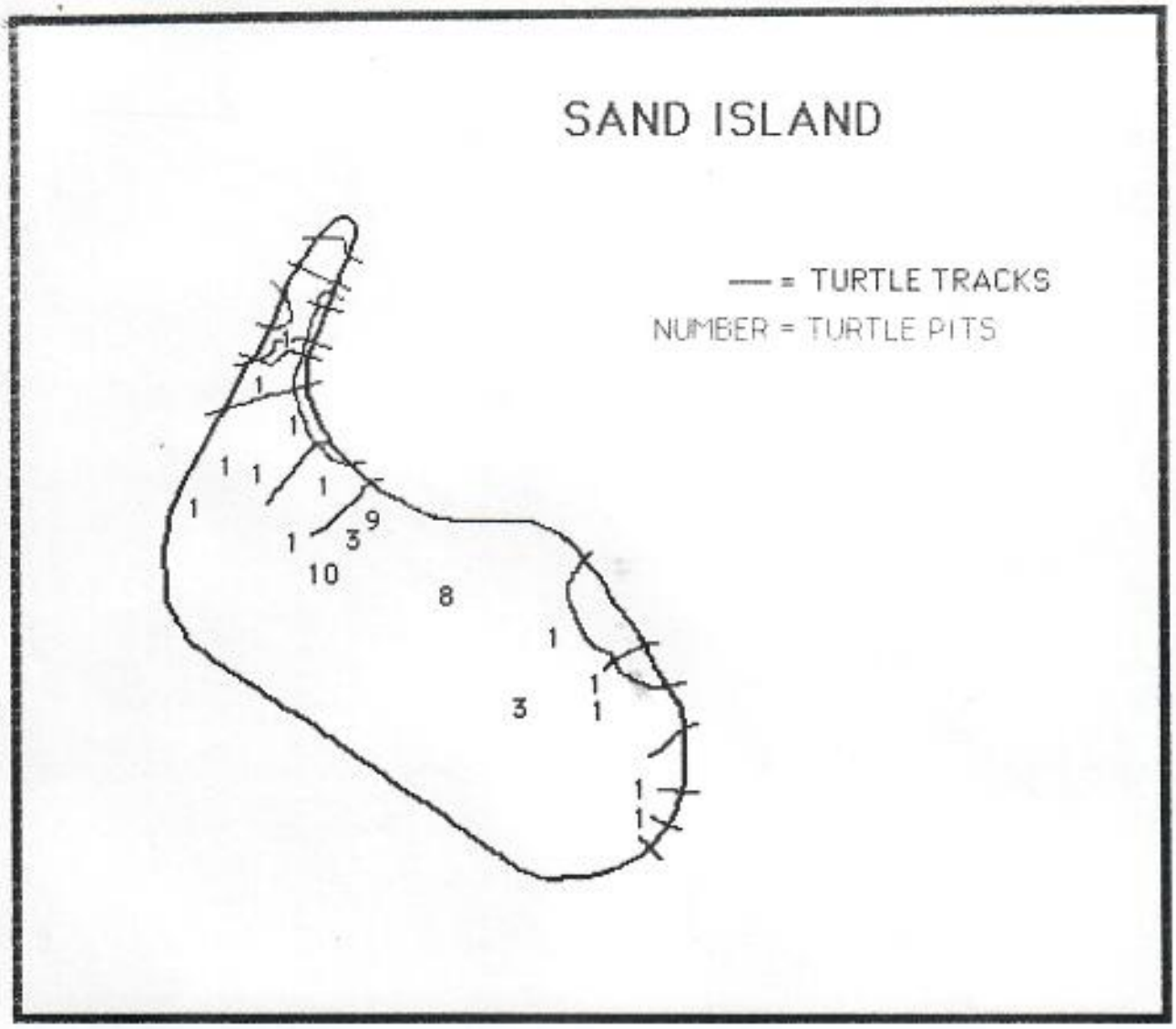


Figure 5. Tracks and pits of turtles observed on Sand Island, Rose Atoll during October 1989.

The greatest management concern of the atoll is the presence of the rats. I suggest we initiate the necessary paperwork to allow the use of several types of poisons and traps and seek the $10,000 to $20,000 necessary to fund a one month expedition to eradicate the rats. The work could possibly be accomplished by some of the Samoans through PR funds. The eradication of rats should be a priority of the Service. The Office of Marine and Wildlife Resources has indicated that they consider this a priority of their wildlife program and are willing to aid in the effort by providing transportation and possibly some labor. We should grasp this opportunity and proceed with the project.

Rose Island is extremely difficult to census due to heavy vegetation. As trees fall over it seems the habitat is undergoing change making the use of the Pisonia transect less representative and more difficult to extrapolate census results to the mixed Pisonia-Tournefortia habitat. Additionally, complete counts of the Tournefortia habitat would be quite difficult for one or two individuals. A 30 m grid of stations was laid out on the island by Rowland in February and by us on this trip. The eastern portion of this grid should be completed on the next trip. This grid facilitates complete counts by allowing one or two persons to census each grid and remain oriented in the thick forest. Additionally, if time is limited and complete counts are impractical a representative sample of grids within each habitat could be sampled. The grid markers could be used to select random plots conducted at the stations to facilitate consistent census.

Future surveys should also characterize vegetation within the grids to document changes on the Island. Should some stakes be lost, observers on Each trip should bring a few pieces of one inch PVC pipe, aluminum tags numbered from 1 to 100, and wire. Additionally, each stake should be sprayed with red enamel paint to help the next person locate the stakes. We cut paths with a machete along each line to facilitate measurement and locating the plots. We suggest these paths be maintained to aid those that follow.

The major activity of the crew of the Sausauimoana on these trips is bottom fishing and trolling outside the reef. This activity probably does not impact the fishery greatly, but could provide some valuable data on catches per unit effort and length-weight ratios from a fishery with little utilization. This data would seem valuable both to monitor the fishery at Rose Atoll and for comparison with data form the other Samoan Islands which has a fishery with an extremely high use. A fishery technician should be station on the ship to be sure the fishing effort is accurately recorded and to measure and weigh the fish when the ship is anchored during the day.

ACKNOWLEDGEMENTS

I wish to thank Paul Pedro and the crew of the Sausauimoana for their hospitality and help at the island. Fale Tuilagi and Edwin Seui aided greatly on the island with the collection of data which allowed us to do a much more thorough survey. I also wish to thank Peter Craig, Bonnie Ponwith, and Wayne Syron for their help and companionship during trip.

Table 4. Bands read on Rose Island on 24 - 25 October 1989.

SPECIES	BAND	AGE	SEX
Masked Booby	1367-55526	Adult	
Masked Booby	1367-33304	Adult	
Masked Booby	1117-93720	Adult	
Masked Booby	1117-93717	Adult	
Masked Booby	1117-92148	Adult	
Masked Booby	1117-92365	Adult	
Masked Booby	1117-92196	Adult	Female
Masked Booby	1117-93721	Adult	
Masked Booby	1367-51537	Adult	Male
Masked Booby	1367-51570	Adult	Female
Masked Booby	807-63568	Adult	
Masked Booby	1367-33304	Adult	
Masked Booby	1117-92194	Adult	
Masked Booby	1367-51543	Adult	Male
Masked Booby	1367-51545	Adult	Male
Masked Booby	1117-92153	Adult	Male
Masked Booby	1367-51527	Adult	Female
Masked Booby	1117-93741	Adult	Female
Masked Booby	1117-92264	Adult	
Masked Booby	1367-51541	Adult	Male
Masked Booby	1367-33314	Adult	
Masked Booby	1117-92198	Adult	
Masked Booby	1117-93811	Adult	
Masked Booby	1367-33313	Adult	Male
Masked Booby	1117-92202	Adult	Female
Masked Booby	1367-51529	Adult	Male
Masked Booby	807-63564	Adult	Male
Masked Booby	1117-92315	Adult	
Brown Booby	1367-51520	Adult	
Brown Booby	1367-34440	Adult	Female
Brown Booby	1117-92394	Adult	Male
Brown Booby	1117-93784	Adult	

Approval expires 04/30/89
OMB Approval # 1018-0006

Master Permit No. 09149 | **Banding Schedule** 3-860 (Rev. 1985) | **Master Permittee** Hawaiian Is NWR

—Banding Locations—

A Rose Atoll, American Samoa D

B E

C F

REPORT ONLY CONTIGUOUS BAND NUMBERS | THROUGH | INCLUSIVE BAND NOS. FROM 1307-29301

BAND PREFIX: 1307		COMMON NAME	AOU #	STATUS	AGE-SEX	REGION	LAT-LONG	LOC	DATE MO. DAY. YR.
293	01	MABO	114.0	3.00	L - U	096	1435-1680	A	10-22-89
	02								
	03	BRBO	115.0						
	04								
	05	MABO	114.0						
	06	BRBO	115.0						
	07								
	08								
	09								
	10								
	11	MABO	114.0		ATY				
	12				AHY				
	13	BRBO	115.0		L				
	14	RFBO	116.0		ATY				
	15	BRBO	115.0		L				
	16				AHY				
	17				ATY				
	18				ATY - M				
	19				I - F				
	20	MABO	114.0		L - U				
	21	BRBO	115.0		ATY - F				
	22	MABO	114.0		AHY - U				
	23	BRBO	115.0		ATY - M				
	24	MABO	114.0		AHY - U				
	25								
	26								
	27	BRBO	115.0		ATY - M				
	28	MABO	114.0		I - U				
	29				AHY - I				
	30	BRBO	115.0		ATY - F				
	31				I				
	32	MABO	114.0		M				
	33	BRBO	115.0		I				
	34				AHY - U				
	35				L				
	36				ATY - F				
	37				I - M				
	38				L - U				
	39	MABO	114.0		ATY -				
	40	BRBO	115.0		L				
	41				ATY - M				
	42				AHY - U				
	43				L -				
	44				AHY -				
	45				ATY - M				
	46				F				
	47				M				
	48	MABO	114.0		AHY - U				
	49	BRBO	115.0		L				
	50				ATY - M				

Master Permit No. 09149

BAND PREFIX: 1307 ←	COMMON NAME	AOU #	STATUS	AGE-SEX	REGION	LAT-LONG	LOC	DATE MO DAY YR
293 51 52	BRBO	115.0	3.00	L - U ATY - F	096	1435 - 1680	A	10-22-89
53 54								
55 56	MABO BRBO	114.0 115.0		ANY - ATY -				
57 58								
59 60								
61 62								
63 64								
65 66								
67 68								
69 70								
71 72								
73 74								
75 76								
77 78								
79 80								
81 82								
83 84								
85 86								
87 88								
89 90								
91 92								
93 94								
95 96								
97 98								
99 00								

REMARKS:

TRIP REPORT - ROSE ATOLL
March 13 - 20, 1989

by Craig M. Rowland
March 31, 1989

This report may be cited as follows: Rowland, C. M. 1989. Spring Survey of Rose Atoll, March 13 - 20, 1989. Administrative Report, U.S. Fish and Wildlife Service, Hawaiian and Pacific Islands National Wildlife Refuge Complex. 12 pp.

INTRODUCTION

This survey trip was a cooperative effort of the U.S. Fish and Wildlife Service and the Office of Marine and Wildlife Resources, American Samoa Government. Surveys were conducted of the vegetation, bird life, sea turtle nesting activity and the marine environment. This report contains the results of the vegetation, bird life and sea turtle nesting surveys. Information on the marine surveys conducted can be obtained through the Office of Marine and Wildlife Resources.

PERSONNEL

Craig M. Rowland, Biological Technician - Hawaiian Islands National Wildlife Refuge, U.S. Fish and Wildlife Service

Kiso S. Sooto, Assistant Wildlife Biologist - Office of Marine and Wildlife Resources, American Samoa Government

Betty Bookheim, Fisheries Biologist III - Office of Marine and Wildlife Resources, American Samoa Government

Situ Faresa, Fisheries Technician - Office of Marine and Wildlife Resources, American Samoa Government

Apelu Soaimailagi, Fisheries Technician I - Office of Marine and Wildlife Resources, American Samoa Government

ITINERARY

March 13: Flight left HNL at 0100 and arrived American Samoa at 0630 (0530 Samoa time). The fisheries team changed personnel and greatly reduced planned operations when told that the boat would only be at Rose for three days. The Sausauimoana left Pago Pago at 1400 with the above mentioned personnel as well as the captain, (Paul Pedro) and six crew members. There was a four foot swell and no wind.

March 14: Entered lagoon of Rose Atoll at 0850. Walked perimeter of Rose Island looking for turtle nests and tracks. Conducted Pisonia transects. Put in PVC grid stakes in a North-South line that passed next to the monument (stake numbers 313 thru 383). Walked perimeter of island, about half hour after sunset looking for turtle hatchlings or nesters. Conducted night Pisonia Transects. Major downpour caused cancellation of booby banding expedition.

March 15: Walked perimeter of island looking for new turtle nests or tracks. Completed marking pisonia transects with nylon line. This was started by Forsell in October of 1988. Conducted survey of nesting birds in Tournefortia. Conducted survey of Sand Island. Put in PVC grid stakes in a East-West line that passed next to the monument (stake numbers 341 thru 347). Cleared refuge and boundary signs of vegetation. Repaired boundary sign that was missing a bolt. Walked perimeter of island looking for turtle hatchlings or nesters. Banded and read bands from Brown and Masked boobies.

March 16: Walked perimeter of island looking for new turtle nests or tracks. Photographed Pisonia forest and Boerhavia meadow. Rechecked vegetation map produced by Forsell in October of 1988. Walked to Sand Island at low tide to photograph Rose Island and count shorebirds feeding on reef. Conducted transects of nesting birds along lines of PVC stakes, North-South and East-West, intersecting near the monument. Departed Rose Atoll at 1450, two foot swell, no wind.

March 17: Arrive Pago Pago 0700. Checked into hotel, cleaned gear, was taken on tour of South side of Tutuila Island.

March 18: R & R in Western Samoa.

March 19: R & R in Western Samoa.

March 20: Flight left American Samoa at 0745 and arrived HNL at 1250 (1350 Honolulu time).

SURVEY METHODS

Vegetation: General observations of the vegetation were made and the vegetation map drawn by Doug Forsell from data collected in October of 1988 (Forsell et. al, 1988) was checked for accurate distribution of species by on-site inspection of the different vegetated areas.

Birds: The following survey methods were use to monitor the bird populations at Rose Atoll.

Two line transects were completed through the Pisonia forest during the day, and two at night along permanently marked transects. These transects are marked with flagging tape and with nylon rope which is strung along the length of the transect.

A complete-coverage count of nesting birds was conducted in the Tournefortia area North of the monument.

Nesting Brown and Masked boobies were captured and banded or had their bands read.

Line transects were conducted along transect lines that were established on this trip in North-South and East-West directions, meeting near the monument. These transect lines are marked with PVC stakes every 30 meters.

Incidental observations of were made throughout the trip.

Turtles: All new nests and tracks were mapped on the morning of the first day on the island. Just after sunset and just after sunrise each day, the perimeter of the island was surveyed for signs of any new nesters or hatchlings.

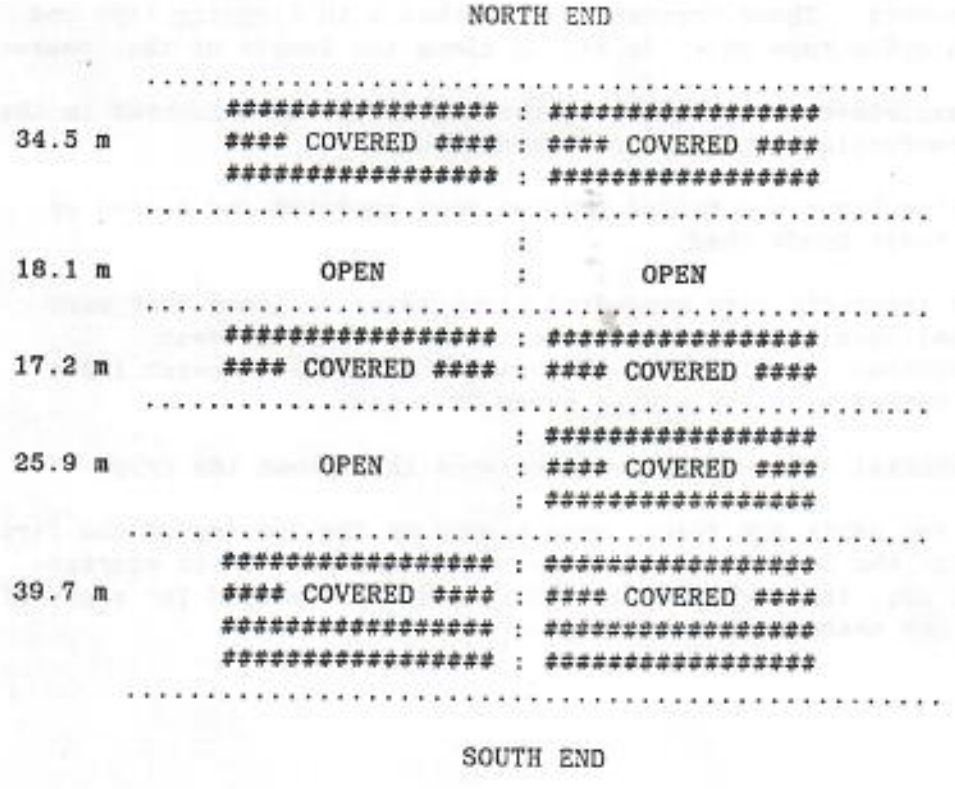
RESULTS

VEGETATION:

Except for the Pisonia, all vegetation seemed to be healthy, with no major changes since the October, 1988 trip. "Pisonia dieback" appears to be continuing as was noted on the last trip. A similar Pisonia dieback occurred in the mid seventies and lasted several years before the Pisonia regenerated itself and covered the barren portions of the forest (Amerson et al., 1982).

Two of the trees used to mark North-South Pisonia transect had tipped over since the last trip. The Pisonia transects are marked with nylon rope which is strung from tree to tree along the length of the transect. Two fallen trees along the North-South transect had the nylon transect rope wound around them indicating that they fell over sometime after October of 1988. Forsell's map appears to be a more accurate picture of the present vegetation on Rose Island than the map found in Amerson et al., (1982).

This map of the North-South Pisonia transect shows how much of the transect is covered by Pisonia, and how much is now open due to trees falling over. Also see figure 1.



Trees have also fallen over along the East-West Pisonia transect, but there are no major clearings like those found along the North-South transect.

A number of young coconut palms were noted at various locations on Rose Island. These were planted from Rose Island coconuts by employees of the Office of Marine and Wildlife Resources, American Samoa Government.

The forest floor beneath the Pisonia trees was not at all "completely devoid" of leaf litter as was reported for October of 1988. This may have had something to do with the number of rats on the island, which were said to be fewer than on previous trips. An estimated 10 to 20 Pisonia leaves were counted per square meter.

No plant species new to Rose Atoll were noted.

On Sand Island there were five live Tournefortia a few dead shrubs and a few young sprouts.

BIRDS:

Red-tailed Tropicbird (Phaethon rubricauda)

Six RTTR were seen in courtship flight over the island at one time. In addition to these birds, 11 RTTR were seen on eggs, and one stage 8 chick was seen. Most of these were seen during the complete-coverage counts of the Tournefortia. The two areas where some RTTR may have gone uncounted are the mixed Pisonia-Tournefortia forest Southwest of the monument, and the strip of Tournefortia between the Boerhavia meadow and the beach. Taking these areas into consideration, an estimate of 20 nesting pairs of RTTR on Rose Island would be accurate.

Masked booby (Sula dactylatra)

15 Masked booby nests were counted during the complete-coverage count of the Tournefortia. This includes MABO nesting in the Boerhavia meadow. one MABO nest was counted in the area covered by the across-island transects that cross at the monument. MABO nests were only seen in the Boerhavia meadow and in a few clearings in the Tournefortia at the North end of the Island. Estimated number of nesting pairs: 18.

Two nesting MABO were banded using the following bands:

1307-28718
1307-28720

The following band numbers were read from nesting MABO:
1117-93720, 1117-92303, 1117-93717, 1117-92264, 1117-92161, 1117-93721
1117-93738, 1117-93810, 1117-93811, 1117-92153, 1117-92196, 1367-51503

One stage 9 chick which was banded in October of 1988 was recaptured. The band number of that chick was 1367-51503.

Brown booby (Sula leucogaster)

111 Brown booby nests were counted during the complete-coverage count of the Tournefortia. This number includes BRBO nests in the Boerhavia meadow. BRBO nests were found under both Pisonia and Tournefortia around the perimeter of the island and the perimeter of the Boerhavia meadow. Estimated number of nesting pairs: 125.

A total of 25 nesting BRBO were banded using the following bands:

1307-28701 thru 28717
1307-28719
1307-28721 thru 28727

The following bands were read from nesting BRBO:
1117-92387, 1117-93784, 1117-92285, 1117-92357, 1367-51548
1367-34427, 1367-51524, 1367-34413, 1367-51564, 1367-34450

Red-footed booby (Sula sula)

Red-footed boobies were seen nesting over the entire island. 56 RFBO nests were counted along the Pisonia transects. RFBO were present but not counted in the complete-coverage count done in the Tournefortia. 37 nesting RFBO were counted during the new across-island line transects. Most RFBO nests are too high up in trees for an observer on the ground to determine the contents of the nest. There was a lot of sky-pointing and nest material gathering observed, indicating that a majority of the population was at the beginning of the nesting cycle.

About 90 percent of the RFBO seen were white-tailed brown morphs.

An accurate estimate of the number of breeding RFBO pairs is hard to make. There appeared be 200 to 300 nesting pairs on Rose Island but this is a rough estimate.

Lesser frigatebird (Fregata ariel)

Four adult LEFR were seen flying over Rose Island but no Frigatebird nests of any kind were seen. By climbing a Tournefortia tree on the East side of the island, I was able to count all the frigatebirds present over the island.

Greater frigatebird (Fregata minor)

No nests were seen. Eight individuals were seen flying over Rose Island.

Lesser golden-plover (Pluvialis dominica)

Three LEGP were seen together in a flock with two Ruddy turnstones. LEGP were seen on the beaches as well as in the Pisonia forest. The greatest number seen at one time was three but an estimate of 10 to 15 seems to be accurate.

Bristle-thighed curlew (Numenius tahitiensis)

Two Bristle-thighed curlews were seen together on Rose Island. On other occasions single BTCU were seen. All BTCU seen were on the beaches or flying over the reef flat. I don't think there were many more birds present than those that were seen.

Wandering tattler (Heteroscelus incanus)

Seven WATA were seen at one time feeding on the reef flat. These birds were seen in the same locations and numbers as the Lesser golden-plover. They were also seen foraging on the reef flat at low tide.

Ruddy turnstone (Arenaria interpres)

Two RUTU were seen together with three Lesser golden-plovers flying over the reef flat. I don't think there were many more RUTU present than what was seen.

TURTLES:

No turtles were seen on this trip. A number of tracks and pits which were thought to be recently made were recorded and appear in figure 1.

On Sand Island two turtle tracks were seen, one leading to a pit.

Sooty tern (Sterna fuscata)

About 200 SOTE were seen in a clearing in the Pisonia forest. About 200 eggs were seen and five stage 5 chicks. All these chicks seemed to have something wrong with their wings; broken, droopy or otherwise nonfunctional. These chicks appeared to be still getting food from their parents. 100 of the above eggs appeared to be abandoned.

On Sand Island there were approximately 100 SOTE eggs. About 300 SOTE were flying overhead and looked as if they would be nesting soon.

Estimated number of breeding pairs on Rose Island: 100, on Sand Island:100, total for Rose Atoll: 200.

Brown noddy (Anous stolidus)

4 BRNO nests were counted during the Pisonia transects. It is often difficult to determine if a noddy up in a Pisonia tree is a Brown or a Black. The factors that were used to determine which species was present were the following: BRNO - nests in crotch of trees with little nest material, BRNO call. BLNO - more substantial nests located higher up in branches, BRNO call. An estimate of 25 nesting pairs is based on the number seen in the Pisonia transects and amount of the island that is covered by Pisonia.

On Sand Island there were about 200 BRNO nests, all eggs or stage 3 chicks.

Black noddy (Anous minutus)

31 BLNO nests were counted during the Pisonia transects. An estimate of the number of nesting BLNO would be hard to make because the BLNO tend to nest much higher up than the BRNO and many nests must go undetected. Using the number of BLNO counted in the Pisonia transects and the amount of the island covered by Pisonia, an estimate of the number of breeding pairs comes out to be around 180. I think an estimate of 300 to 400 would be closer to the true number of pairs due to the difficulty of detecting BLNO nests in the tops of trees. The BLNO nests observed on Rose Island were not spaced as close together as those seen in the Northwest Hawaiian Islands.

White tern (Gygis alba)

46 WHTE were counted during the night Pisonia transects with approximately 10 of them on eggs or small chicks. Some stage 3 WHTE chicks were also seen off of the transects throughout the Pisonia forest.

RATS:

50 snap-traps were set by Mr. Sooto on both nights that were spent on Rose Island. 48 and 46 rats were caught on the 14th and 15th respectively.

About 30 rat-predated Sooty tern eggs were seen. Four were collected along with a booby egg with rat teeth marks on it.

The rat population seemed to be lower on this trip than on previous trips. This statement is based on the fact that the floor of the forest had leaf litter and egg shell fragments on it and the numbers of rats seen on previous trips was described as being much higher than what was observed on this trip.

Paul Pedro volunteered to make some large rat traps to use for catching rats on Rose Island. He suggested that we contact the OMWR two weeks prior to the next trip and have them buy the materials so that Paul and his crew can have the traps ready in time.

OTHER ITEMS:

Weather:

The weather was good throughout the trip except for the heavy downpour on the night of the 14th. During the rest of the trip there was little or no wind and highly overcast sky.

Refuge Signs:

The refuge and boundary signs were cleared of vegetation. The boundary signs appeared to be in good shape but they may need to be replaced within the next year or so. The signs are bolted to wooden 4x4 posts. Paul Pedro volunteered to build and install a new refuge sign if the U.S. Fish and Wildlife Service would tell him what the wording should be. This seems to be a good idea as the present sign is being made less visible by expansion of the Tournefortia. A Samoan version of the no trespassing message should be added to the present messages.

Trespass:

There were no signs of trespass observed on either island of the atoll.

Clams:

The fisheries crew was asked by Paul Pedro (captain of the Sausauimoana) to collect 10 clams for his crew. They collected six clams for the crew which were taken back to Pago Pago.

New transect stakes:

Two transect lines were put in, one running N-S and the other E-W crossing at number 343 at one corner of the monument (See figure 1). Both of these transects were walked noting any nesting species within 10 meters of the line. 15 one foot x one inch schedule 40 PVC stakes were left near the camping area, under a tree that has a refuge boundary sign in it.

Pisonia transect trees:

Pisonia transects were run between the following trees:

	# on start tree		# on end tree
S-N transect	500,561,611	to	304,554,493
E-W transect	112,303,553,?13	to	551,490

This data is provided in an effort to check that the complete transects were covered. The Pisonia transects conducted on this trip were shorter than those that were done by Hu in 1986. Each transect was short by about 20 meters. The map on page four of Hu (1986) should be included with other instructions for trips to rose. The nylon rope marking the transects needs to be extended to cover the complete length.

Increase in size of Sand Island:

I was told by OMWR employees that Sand Island is growing in the direction of the channel.

Cats on Swain's Island:

Was also told by OMWR employees that they introduced cats to Swain's Island in an effort to control rats. I told them this might not have been such a good idea and whatever they did, they should NOT introduce cats to Rose Atoll.

Boobies used as food:

Learned from a number of sources that Masked and Red-footed boobies are eaten by the people living in the village of Vatia in American Samoa.

ACKNOWLEDGMENTS:

I would like to thank the Office of Marine and Wildlife Resources including the captain and crew of the Sausauimoana. I would also like to thank Kiso Sooto for aiding in the collection of biological data and the rest of the field crew for all their help.

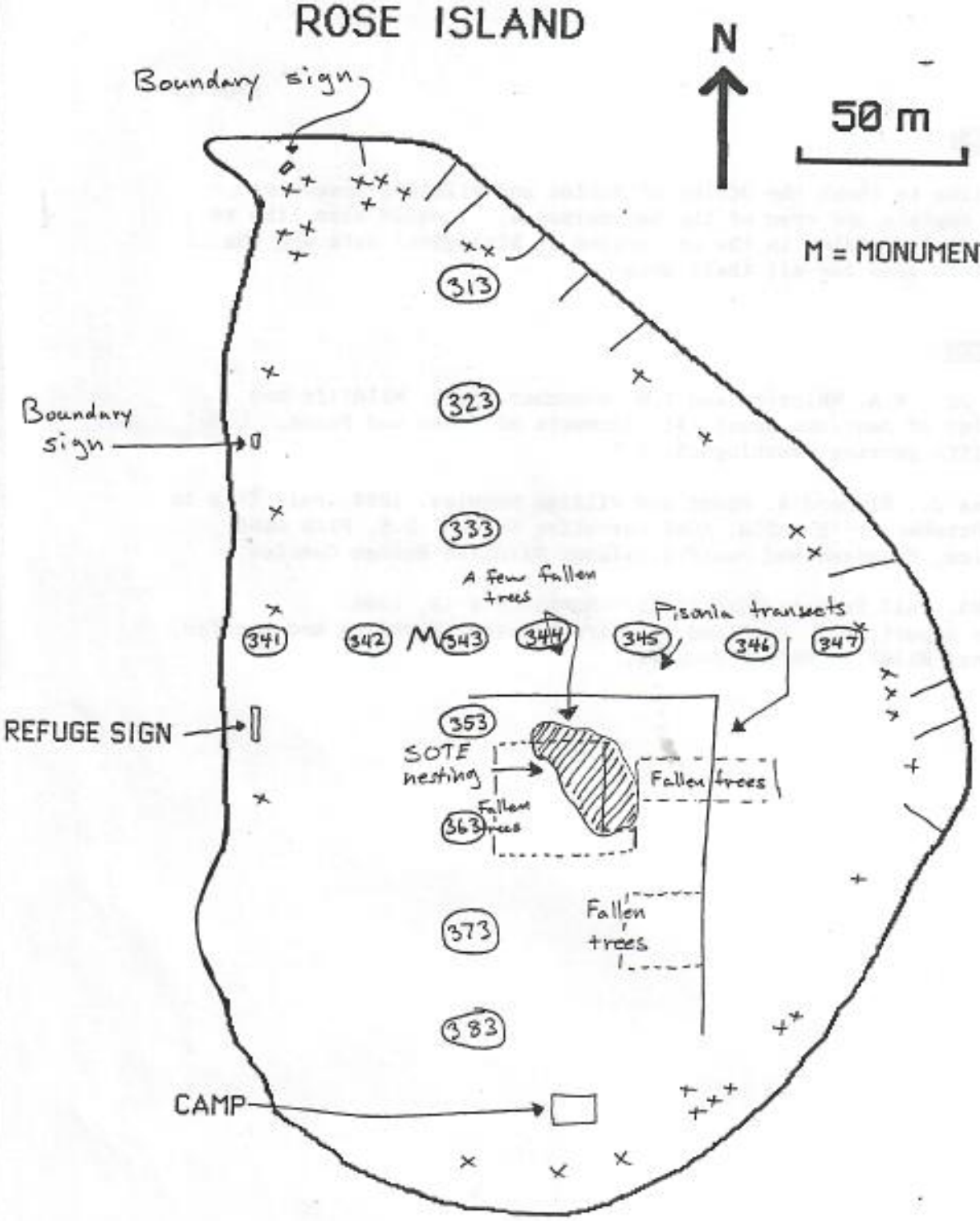
LITERATURE CITED:

Amerson, A.B. Jr., W.A. Whistler and T.D. Schwaner. 1982. Wildlife and Wildlife Habitat of American Samoa. II. Accounts of Flora and Fauna. U.S. Fish and Wildlife Service, Washington, D.C.

Forsel, Douglas J., Richard A. Bauer and William Knowles. 1988. Fall Trip to Rose Atoll - October 11-15, 1988. Administrative Report, U.S. Fish nand Wildlife Service, Hawaiian and Pacific Islands Wildlife Refuge Complex.

Hu, Darcy. 1986. Fall Trip to Rose Atoll - November 4-12, 1986. Administrative Report, U.S. Fish and Wildlife Service, Hawaiian and Pacific Islands National Wildlife Refuge Complex.

ROSE ISLAND



x = turtle pit

— = turtle track

(343) = PVC stake

UNITED STATES GOVERNMENT

Memorandum

FISH AND WILDLIFE SERVICE
HONOLULU, HAWAII

TO : Rose Atoll NWR Files

DATE: DEC 11 1984

FROM : Supervisory Wildlife Biologist, RWR,
Honolulu, HI

SUBJECT: Rose Atoll Expedition October 21-25, 1984
Fagatele Bay Expedition October 27, 1984

Personnel

Stewart Fefer, Supervisory Wildlife Biologist, RWR, Honolulu, HI
Richard Wass, Refuge Manager, Remote Islands, Honolulu, HI
Richard Radtke, University of Hawaii, Honolulu, HI
Janice Bell, University of Hawaii, Honolulu, HI
Cindy Hunter, University of Hawaii, Honolulu, HI
David Itano, American Samoa Government, Office of Marine Resources, Pago Pago, American Samoa
Crew of Sausauimoana

Introduction

Rose Atoll NWR was visited on October 21-25, 1984, by biologists representing the U.S. Fish and Wildlife Service, Office of Marine Resources of the American Samoa Government and the University of Hawaii (National Geographic Society Grant). The primary objectives of the trip were to assess the status of the seabird, green sea turtle and giant clam populations. This report focuses on the seabird and green sea turtle work conducted. Dr. Radtke will provide a report on the clam studies in association with his SUP (ROS-2-84).

Itinerary

Oct. 19, 1800 hours, depart Honolulu for Pago Pago
Oct. 20, 0600 hours, depart Pago Pago for Ofu Island
Oct. 21, 0430 hours, depart Ofu for Rose Island
Oct. 21, 1500 hours, arrive Rose Island
Oct. 22, turtle survey
pisonia transects for seabird populations and phenology
clam survey
banding bird recovery of banded boobies
Oct. 23, turtle survey
seabird survey in tournefortia
clam transect survey
Oct. 24, turtle survey
estimate of population and phenology of sooty tern colony
clam collection
Oct. 25, turtle survey
clam transect
Oct. 26, 1100 hours, depart Rose Island
Oct. 27, 0100 hours, arrive Pago Pago
Oct. 27, Fagatele Bay visit and dive with OMR personnel

Oct. 28, pack gear for return trip
visit Pala Lagoon with OMR, CZM personnel
Oct. 29, 1300 hours, depart for Honolulu
2100 hours, arrive Honolulu

The weather was very favorable throughout the trip. The seas enroute to Rose were relatively rough. While on Rose, we had infrequent evening rain showers but on the whole the weather was warm and conditions were sunny with a mild breeze. We made camp in the pisonia forest on the south end of the Island. There were no signs of human use of the Island on our arrival. Bird breeding activity was minimal on Rose Island except for sooty tern population which were abundant. This is described further in the species accounts below.

Time spent on Rose Atoll was divided between diving and conducting the clam survey and surveying seabird and turtle populations. Pisonia transects were repeated during daylight and nighttime hours as described in earlier Rose Atoll trip reports. The transects were conducted by day for breeding population estimates of black noddies, brown noddies as well as ground nesting boobies and tropicbirds. Incidental observations of nesting red-footed boobies and greater and lesser frigatebirds in the pisonia canopy were also sometimes possible. Pisonia transects were run at night for an estimate of white tern breeding populations.

Two transects were run in the tournefortia transects closest to the pisonia forest for the red-footed and brown booby survey. Most boobies had already fledged. As a large sooty tern colony was using the habitat for nesting and disturbance would have had a major negative effect on the terns, transects were not completed through this area.

Masked, brown and red-footed boobies were captured at night. Band schedules and recovery report forms are attached and have been forwarded to the Bird Banding Lab.

Green sea turtle surveys were conducted during early morning and late evening hours. Results are included in the species account below.

The six shrubs and two small tournefortia seedlings on Sand Island, Rose Atoll were still healthy.

Species Account

red-tailed tropicbird: Observed three adults in flight over Rose on 10/24/84. Five nests were observed all with Stage 10 chicks, one was in pisonia, two in tournefortia and one was on the beach adjacent to a large coral boulder under pisonia cover.

white-tailed tropicbird: None observed on Rose Atoll.

masked boobies: Observed juvenile and adult masked boobies at-sea within 20 miles of Rose. Nesting was at the tail-end for this species this season. One nest with eggs and one with a Stage 5 chick was observed in openings in tournefortia forest. No nests were observed in pisonia. Only four other nests were observed, two Stage 6C and two Stage 8. Other local fledgling masked boobies were observed flying. Nine masked boobies were banded and ten previously banded were recaptured. Masked boobies were abundant on the Island at night, especially in Beerhavia Meadow when they returned to roost.

brown boobies: Juvenile and adult brown boobies were observed throughout our passage between Tutuila and Rose. Brown boobies were at the tail-end of their nesting season. Only eight brown booby chicks were observed, one Stage 7, six Stage 8, and one Stage 9. Juvenile brown boobies from this year's production were observed roosting in tournefortia and pisonia. Twelve brown boobies were banded including six adults, four AHY and two local birds. One brown booby adult was recaptured.

red-footed booby: Nests were observed in crowns of pisonia and tournefortia though nesting was near complete for the season. Thirty (30) chicks were observed in tournefortia ranging from Stage 6B-8. No eggs or younger chicks were observed. Five chicks of this species were also observed in pisonia crowns. 300-400 juvenile and adult red-foots were observed roosting on the Island. A total of 50-75 nests were active on the Island during this visit. Two adult red-foots were banded. Several additional adults were caught but 7B bands were too large.

great frigatebird: This species was observed soaring over the Island and roosting in the tops of pisonia. A maximum of 150 birds of this and the lesser species were observed. No active breeding displays were observed. Two nests were observed in the pisonia canopy with bird chicks of Stage F. Greaters outnumbered lessser by a 4:1 ratio.

lesser frigatebird: No nests were observed but it was very difficult to observe the nests in the tops of trees from below. No more than 30 birds observed.

reef herons: One light-phased reef heron observed on south end of Island at an ebbing tide.

lesser golden plover: Observed on reefs, beaches and interior of Island. 30-40 present.

ruddy turnstone: Present on beaches, reef and interior of Island. No more than 25-30 present on Island.

wandering tatler: Five tatlers present on beaches.

sanderling: Two were observed.

bristle-thighed curlew: About 15 curlew were present on Island both on beaches and in tournefortia and pisonia.

gray-backed terns: One fledgling and two pair observed on Sand Island.

sooty terns: About 50-75 roosting on Sand Island but none nesting on Rose Island, sooty terns were on eggs, Stage 2 and Stage 3 chicks. Two fledglings were observed on Sand Island. Approximately 1/3 of tournefortia covered portion of the Island was covered with roosting sooties. Five plots of 2 x 2m were established to determine egg densities. Approximately 7-10 eggs occurred in the plots. The total area of sooty tern nesting was estimated as 10,000 m^2. This would extrapolate to 25,000 nests of sooty terns. Sooty tern nests were under the tournefortia. They avoided open areas. They provide shade from direct sunlight but restrict access.

brown noddy: Three nests were observed on pisonia transects. All had eggs, two were observed in tournefortia with eggs. Six nests were found on beach coral rubble above high tide line. These were laid during a visit. On Sand Island, 122 nests were observed; 88 with eggs, 35 Stage 2 chicks of dark and light color phases.

black noddy: Nests were found in pisonia. 102 nests were observed in pisonia transect. Most were apparently not active. Of nests where contents could be observed eight (8), three had eggs and five were empty. Approximately 350-365 nests were present on Rose (extrapolation from transect count, 4000 m^2 transect - 15000 m^2 pisonia habitat).

white tern: White tern were on eggs at this time. 75 white terns on eggs and 11 pairs were observed during night when pisonia transects were run. A total of 325 pairs of white terns were present on Rose Island.

long-tailed New Zealand cuckoo: One bird was seen in tournefortia habitat on two occasions.

Polynesian rat: Rats were not as dense near the campsite as in previous two trips. Many eggs preyed upon in sooty colony. Eggs that were preyed upon were strewn throughout the Island in pisonia forest. Several pregnant females observed. Perhaps rat populations were at a low period. The population cycle due to effect of storm, season, etc..

green sea turtle: At approximately 0530 hours, each morning, we circled the Island on the beach to count fresh turtle tracks indicative of nesting attempt during the night. For some mornings the counts are probably lower than the actual number of attempts as it is likely that some tracks were obliterated by incoming tides. This is certainly true for the morning of the 23rd when the high tide occurred simultaneously with the survey, thus, erasing all tracks. Counts for the other mornings were as follows:

October 22 - 4
October 24 - 7
October 25 - 11
October 26 - 11

The period of our survey coincided with the new moon and very high tides. These are probably optimal conditions for nesting and likely account for the relatively large amount of nesting activity observed.

Nest pits were counted on both Rose and Sand Islands. Only those pits that appeared to be relatively fresh (less than three months old) were counted and if one turtle had obviously made several pits, all were counted as one. A total of 73 pits were counted on Sand Island and 100 pits on Rose Island (84 pits on the ocean side and 16 pits on the lagoon side).

Five turtles were double-tagged during our stay. One was tagged on the evening of the 23rd after knocking down a tent erected on the beach. An attempt had been made to turn it away from the tent by tugging on its flipper, and lights had been flashed in its eyes. Three days later, this same turtle was observed laying eggs and successfully nesting. A second was also tagged one evening when it was discovered returning to the water after an unsuccessful attempt at nesting. The other three were tagged just after daybreak as they were returning to the water. Tagging data are as follows:

Date	Time of Day	Right Tag No.	Left Tag No.	Carapace Length (curved-line method)
10-23-84	1930	6877	6876	102.5mm
10-24-84	2100	6879	6878	106 mm
10-26-84	0600	6880	6881	110 mm
10-26-84	0615	6882	6883	102 mm
10-26-84	0630	6884	6885	92 mm

coconut crab: Juvenile coconut crabs were again observed at night at the campsite as they were attracted to lights. A search under the coconut trees in the middle of the Island revealed no burrows or sign of adult crabs but a large juvenile (about 1/4 lb.) was seen in a tun shell that it had almost outgrown.

Fagatele Bay: See attached letter.

Dept. Marine and Wildl. Resources
Box 3730
Pago Pago, American Samoa 96799
November 20, 1989

G. Balazs
NMFS
2570 Dole St.
Honolulu, HI 96822-2396

Dear George:

Thanks for the papers and discussions about sea turtles. I did follow up with a letter to Fullerton about a possible Recovery Plan for our area.

Did I mention that we also contracted the school teacher at Swains Island to make weekly surveys for turtles there?

The only turtle tags that we have that I'm aware of are 13 tags left here for us by Doug Forsell (tag #s 10638-10650) after we tagged 2 turtles at Rose Atoll last month.

As I mentioned, I'm not yet sure what level of effort DMWR will be expending on sea turtles, but we will be holding a workshop in a few months to develop a 5-year plan for DMWR's wildlife program. At that time we'll review what projects can actually be accomplished by our small staff.

Sincerely,

Peter

Peter Craig
Chief Biologist

(18) 10,632-10,650

(20) 3980-4000

+ Applicators

38 TOTAL

Given to Doug Forcell Oct. 17, 89 for Rose

ROSE ATOLL TRIP REPORT

September 5 to October 3, 1991

D.A. Williamson

October 11, 1991

United States Department of the Interior

FISH AND WILDLIFE SERVICE

NAF - MIDWAY ATOLL NWR

FPO San Francisco, California 96614

MEMORANDUM

October 11, 1991

To: Trip Report Files

From: Don Williamson, Refuge Biologist, Midway Atoll NWR

Subject: Trip Report: Rose Atoll NWR, September 5 - October 3, 1991

CITATION:

Williamson, Don A. 1991. Trip Report: Rose Atoll NWR, September 5 - October 3, 1991. Administrative Report, U.S. Fish and Wildlife Service, P.O. Box 50167, Honolulu, Hawaii 96850.

PERSONNEL:

Don Williamson, Wildlife Biologist, U.S. Fish and Wildlife Service, Midway Atoll National Wildlife Refuge, P.O. Box 1 Midway Atoll, FPO AP 96516.

Bonnie J. Ponwith, Fisheries Biologist, Department of Marine and Wildlife Resources, American Samoa Government, P.O. Box 3730, Pago Pago, American Samoa 96799.

Kiso So'oto, Biological Technician, Department of Marine and Wildlife Resources, American Samoa Government, P.O. Box 3730, Pago Pago, American Samoa 96799.

OBJECTIVES:

1. Continue Rat Eradication Project
2. Collect Vegetative Plot Data
3. Tag Nesting Green Sea Turtles
4. Monitor Seabird Populations and Phenology

ITINERARY:

September 5 0900-1130 NAF Midway to Honolulu (MAC)
September 8 1545-2030 Honolulu to Pago Pago, (Hawaiian Air)
September 11 1200 - September 12 0800 Pago Pago to Rose Atoll (F/V *Tasi Lua*)
September 27 1530 - September 28 1000 Rose Atoll to Pago Pago (F/V *Tasi Lua*)
September 30 0700 - 0800 Pago Pago to Apia (Samoa Air)
October 2 0050 - 0645 Apia to Honolulu (Hawaiian Air)
October 3 0450 - 0810 Honolulu to Midway (MAC)

SUMMARY:

We visited Rose Atoll, American Samoa (Lat 14°33'S, Long 168°W) September 12-27, 1991 to continue a program to eradicate Polynesian rats *(Rattus exulans)* from Rose Island. We relieved James G. Murphy of USDA Animal Damage Control, Honolulu, Hawaii and Thomas E. Morrell, Department of Marine and Wildlife Resources, Pago Pago, America Samoa who were there the previous two weeks. In conjunction with rat eradication, we sampled 25 vegetation plots to document changes in plant community composition and structure with cessation of rat herbivory. Standard sea turtle watches were conducted and untagged turtles were tagged. Although seabird counts were not conducted, species presence/absence and chick phenology data were collected.

OUTLINE: (Rose Atoll Trip Report, September 5 - October 3, 1991):

I. Logistics

I travelled from NAF Midway to Hickam AFB, Honolulu HI via the weekly Military Air Command (MAC) C-141 flight. From Honolulu International Airport, I took Hawaiian Air to Pago Pago, Tutuila Island, America Samoa. Bonnie Ponwith met me at the Pago Pago Airport and provided ground transportation there. I stayed at the Rainmaker Hotel. We provisioned for the trip and split costs of food purchases. Boat transportation between Pago Pago and Rose Atoll was aboard the chartered F/V *Tasi Lua* as the American Samoan government boat, M/V *Sausauimoana*, was down for repairs. Last minute disputes with the skipper, Mike Crook, about untimeliness of past payments created uncertainties about our departure but we did leave close to arranged time. We provided our own food, water and sleeping pads on the overnight boat trip. Mike demanded to spend one day fishing outside Rose Atoll thus delaying return of Jim Murphy and Tom Morrell from Rose Island.

Upon return of the *Tasi Lua* to Rose Atoll for our trip to back to Pago Pago, agreement was reached with the skipper as to the time of loading gear and departure the next day. But the boat was over two hours late for loading after a night and morning of fishing. Loading was accomplished on a low, outgoing tide. Each trip in the skiff became more difficult with decreasing depth of water over the reef. Again we provided our own food, water and sleeping pads during the boat trip. I flew from Pago Pago to Apia, Western Samoa two days before my scheduled return flight so that I could visit there before meeting the same Hawaiian Air flight at Apia en route from Pago Pago to Honolulu. My return to NAF Midway from Honolulu was again via a MAC C-141.

II. Rat Project

Methodology and results of the overall eradication project will be discussed in greater detail in a separate report. This report only addresses the project for the two weeks covered by this trip.

Poison bait stations, live traps and snap traps were already deployed along the existing 30-meter grid system. With some exceptions, live traps were set at grid intersections and half-way between intersections along north-south lines. Snap traps were set at half-way points along east-west lines. Due to lack of additional live traps, all defective traps were replaced with snap traps. Poison bait stations (foot-long sections of 3" diameter PVC pipe elevated about 4-6" on wooden dowels) were generally deployed at some intersections and half-way points along north-south lines. Live and snap traps were baited daily with coconut meat and peanut butter. Poison stations were loaded with two Talon-G bait blocks. Blocks were replaced if moldy, missing, or worn down by ants or crabs. When a rat was captured, additional snap traps were deployed at the diagonal centers of adjacent grid squares. Traps were checked, reset and baited as needed each morning starting about 0700 so as avoid disturbance in the bird colonies during mid-day. Ponwith set 1 snap and 2 live traps for 4 nights at Sand Island.

Three rats were captured by snap trap on Rose Island during three nights in the latter half of the two-week period (one had been captured by snap trap during the previous two weeks). None were caught by live trap, nor was any definite rat sign seen at bait stations. No baits showed definitive rat marks. All baits missing from stations were found in the immediate vicinity (less than 1 m away) and were assumed to be removed by crabs (most had definite crab marks). No rats were captured on Sand Island.

The captured rats consisted of one immature male, one young-adult pregnant female (5 embryos were found) and an adult male. All three were near the north-south central zone of the island but were spread across the island in a east-west fashion near stations 71, 53 and 36 (fig. 1). The rat caught in the previous two weeks was also in this general area near station 53

We received direction via radio from Peter Craig, Ponwith's supervisor at the Department of Marine and Wildlife Resources, to deploy all remaining poisons when we left. Rather than leave the poison blocks unprotected, we constructed additional bait stations from plastic water bottles by cutting rat-size holes in them. The bottles were tied with line at each grid intersection and half-way point along the north-south lines. New and existing stations were filled with five or six bait blocks the afternoon of September 26. All live traps were also

checked and removed that afternoon. All snap traps were checked and pulled the morning of September 27.

III. Vegetation Plots

The grid marker system was mostly intact with discernable paths north-south and east-west along the grid lines due to the effects of daily traversing of personnel running the trap lines and bait stations. Vegetation plot centers had previously been marked with 1 inch PVC pipe stakes 10 meters southwest of randomly selected grid markers. Where missing (stations 73, 76), new stakes were used to mark the plot centers. The missing stake for the vegetation plot near station 10 (beach plot) was not replaced due to the probability of beach erosion.

Vegetation data were collected for 25 previously selected plots. Each plot was a circle 3 meters in radius as measured from the plot stake. Rooted vertical stems were identified as to species, classified as vegetative or seed origin, measured for diameter and seedlings were measured for height. Percent ground cover and canopy cover was derived by first giving three independent ocular estimates and then reaching a consensus based on the estimates. Table 1 contains results of the vegetation enumeration and ground and canopy cover estimates.

Seedlings of *Pisonia grandis* and *Tournefortia argentea* were observed in 9 plots. This is in marked contrast to previous sampling which found no seedlings. *Boerhavia tetranda* meadows were reported expanding and several smaller patches occurred in vegetation plots.

We found one individual of an unidentified flowering plant different from the four plant species recently identified on Rose Island (Flint 1990). A sample was taken and left in Pago Pago. Specimens of *Portulaca lutea* were again observed only on one of the larger coral rocks on the reef flats east of Rose Island.

IV. Marine Organisms

Marine Turtles: Results of our turtle tagging work will be treated in more detail in a separate report by Ponwith so I only summarized our two weeks of activities here. We continued a rotating schedule of beach searches as initiated by Murphy and Morrell. At the beginning, one observer walked the perimeter of Rose Island each night every two hours from 2100 to 0500. Later, near the full moon with high tides around dusk and dawn, we added an additional walk at 1900.

We tagged 6 green sea turtles (*Chelonia mydas*), recaptured previously tagged ones from both our and the previous two weeks work, and missed at least one other turtle which came ashore and left between shifts.

Marine Mammals: A cow and calf humpback whale (*Megaptera novaeangliae*) was observed at the entrance to the channel near Sand Island as the *Tasi Lua* entered the Rose Atoll lagoon the morning of September 12. Presumable the same pair was seen spouting, breaching, flipper-lifting or fluke-pounding along the north, east, south and west sides of Rose Atoll over the next few days. No whales were observed inside the lagoon.

V. Birds

Sea Birds: While total counts were not conducted, opportunistic observations were recorded of presence/absence and phenologic stage of chicks, if present, by Williamson and Ponwith. Chicks were assigned to growth stage by species groups based on standard descriptions for the refuges (table 2). Table 3 provides results of the observations. Species accounts follow:

Wedge-tailed Shearwater, WTSH (*Puffinus pacificus*) - Single individuals were heard calling from Rose Island on three separate nights. One bird was seen flying on the leeward side of the Island on a windy day near noon.

Christmas Shearwater, CHSH (*P. nativitatis*) - Single individual was seen on ground at close range at vegetation's edge on east side of Rose Island during a 0300 turtle walk.

White-tailed Tropicbird, WTTR (*Phaethon lepturus*) - Two birds were seen on nests atop broken snags near grid stations 76 and 43. One was about 7' off the ground; the other was about 20' up. The lower nest was confirmed to have an egg.

Red-tailed Tropicbird, RTTR (*P. rubricauda*) - Nests were found at all stages from egg and stage 1 downy chicks to fully feathered stage 9 near-fledglings. Aerial courtship was limited to a few occasions of 2-4 birds.

Masked Booby, MABO (*Sula dactylatra*) - Two nests were observed containing 1 and 2 eggs (the latter disappeared during the second week). Stage 9 chicks, juveniles and immature birds were observed in *Boerhavia* meadows and on the beaches along the east side of the island. No earlier stage chicks were observed. Adults were seen flying and on the ground in the meadows and east-side beaches.

Brown Booby, BRBO (*S. leucogaster*) - Stage 9 chicks, fledglings and juveniles were common on ground and low limbs of vegetation along the beach. Juveniles would often spend much of the day on exposed reef rocks and return ashore in the evening. Adults were usually seen returning to the island in late afternoon or evening.

Red-footed Booby, RFBO (*S. sula*) - Stage 6a through 10 chicks and juveniles were in taller shrubs and low trees throughout the island. Chicks were most plentiful among taller *Tournefortia* while adults roosted there and in adjacent *Pisonia*.

Great Frigatebird, GRFR (*Fregata minor*) - Adult and subadult GRFR's were more numerous than adult and subadult LEFR's. Frigatebird chicks from stage A2-I were present and no attempt was made to differentiate chicks of the two species. Frigatebird chicks were in taller *Tournefortia*; adults roosted there and in *Pisonia*.

Lesser Frigatebird, LEFR (*F. ariel*) - Adult and subadult LEFR were observed but were less numerous than GRFR. Stage A2-I chicks were probably present but all frigatebird chicks were lumped together. Roosting by adult and subadult birds was similar to GRFR.

Sooty Tern, SOTE (*Sterna fuscata*) - Adults were seen on Rose and Sand Islands. Eggs, one stage 3 chick, several stage 6 near-fledglings, and juveniles were

observed on Rose Island, especially in the open Pisonia of the south end of the island. Although not quantified, frequent loss of SOTE eggs occurred as evidenced by predated egg shells. Neither examination of the shells nor observations of the main colony (south end of Rose Island) provided conclusive evidence as to the source of the loss.

Grey-backed Tern, GRAT (*S. lunata*) - None were seen on Rose or Sand Islands.

Brown Noddy, BRNO (*Anous stolidus*) - Although a few adults were seen on Rose Island, all nests found were on Sand Island. Adults, eggs but no chicks were present there.

Black Noddy, BLNO (*A. minutus*) - Whereas many adults were observed in large *Pisonia* trees on southern part of Rose Island, repeated searches found no nests.

White Tern, WHTE (*Gygis alba*) - Many adults were seen throughout the large open *Pisonia* trees. Although pairing was obvious with mutual preening and courtship-like behavior, repeated searches found no eggs, chicks or incubating postured adults.

Migrants and Vagrants:

Lesser? Golden Plover, LEGP (*Pluvialis dominica?*) - Plovers occurred over most of Rose Island. Mixed groups of shorebirds were often seen on nearby exposed reef rocks.

Bristle-thighed Curlew, BTCU (*Numenius tahitiensis*) - Individual curlews were seen along the beach and in the interior of Rose Island. Groups of up to six occurred on exposed reef rocks near the island, sometimes in the company of other shorebirds. No color bands were observed. Two birds were found alive with their heads caught in live traps. Both were emaciated and had abrasions on one or both wings from trying to escape. Both were released. One was resighted the next day with drooping wings and was not seen again.

Wandering Tattler, WATA (*Heteroscelus incanus*) - Tattlers were regularly seen on and around the island. They were usually feeding alone on the beach or were in the company of tattlers or other shorebirds on exposed reef rocks. One group of eight was seen with other shorebirds on a rock.

Ruddy Turnstones, RUTU (*Arenaria interpres*) - Small groups of turnstones were regularly observed along the shore and on exposed rocks. One group of 25 was seen.

Pacific Reef Heron, REHE (*Egretta sacra*) - A single white-morph heron was repeated sighted on the reef or beach around Rose Island. The bird was shy and easily flushed if approached.

Long-tailed Cuckoo, ? (*Eudynamis taitensis*) - Although only one bird was seen at any one time, it is thought that at least 4 individuals occurred on Rose Island. Alarm calls were regularly heard at four sites along the western side of the island. The birds were secretive, occurred in dense *Tournefortia* and would flee after giving an alarm.

VI. Recommendations

1. Anyone planning travel that includes a chartered boat in American Samoa should take necessary precautions to insure that the boat has an adequate number of PFD's and a properly installed EPIRB. They should not assume that anything will be provided while en route. Adequate rations of their own food and water should be accessible after gear stowage as well as pads or other sleeping gear needed for sleeping on an open deck. Everything should be in waterproof containers since no place in the boat may remain dry in rough water. The earlier Rose Atoll crew had water, fuel and battery acid sloshed on stowed gear.

2. Travelers to remote sites in the tropics, such as Rose Atoll, should include hydrogen peroxide and topical antibacterial ointments in their medical kits to avoid infection of small cuts. Antibiotic medications, if available, are a good emergency backup if systemic infection occurs.

3. The need to implement procedures for ensuring the prevention of the importation of plant seeds in camp gear becomes more critical as seedlings are beginning to occur with the elimination of rats.

4. Investigation of possible nesting by Long-billed Cuckoos should be considered since consistent site fidelity as shown by the bird(s) who alarm calls were heard could indicate territoriality.

5. An attempt should be made to quantify and determine the source of Sooty Tern egg loss.

Table 1. Rose Island Vegetation Plots, September 14 - 20, 1991. Vertical stems were classified as vegetative (v) if they had obvious originated from a prostrate stem of an existing plant and were rooted. Otherwise stems were classified as seed origin (s). Twenty-five plots were sampled.

Plot Number	Species	Stems #	Diameter cm	Veg/Seed (v/s)	Ground Cover %	Canopy Cover %	Comments
02	B	3	6 (patch)	s	50 coral rubble	80	
	B	1	10 "	s	40 dead wood		
	B	1	35 "	s	10 leaves		
	B	1	4 "	s			
	B	1	12 "	s			
	B	1	8 "	s			
	B	1	9 "	s			
	B	2	2 "	seedling			
	B	1	1 "	seedling			
	B	1	85 "	s			mostly out of plot
10	T	21	<.3	seedlings	80 coral rubble	20	≤.5 cm hgt. beach zone
					10 leaves		
					10 sand		
15	T	1	40	s	60 coral rubble	100	no seedlings
	T	1	100	s	30 dead wood		
					10 leaves		
23	T	4	<.3	seedlings	65 dead wood	80	1 cm height
	T	3	<.3	seedlings	20 humus		2 cm height
	T	1	<.3	seedling	12 coral rubble		3 cm height
	T	1	<.3	seedling	3 leaves		1 cm height
	B	1	25 (patch)	s			
	B	2	10 "	s			
	B	1	4 "	s			
	B	1	3 "	s			
	B	1	100 "	s			
	B	2	15 "	s			
	B	3	30 "	s			
	B	1	35 "	s			

Table 1 continued:

Plot	Species	Stems	Diameter	Veg/Seed	Ground Cover	Canopy	Comments
24	T	2	6	v, s	75 dead wood	100	
	T	2	25	v	20 leaves		
	T	1	9	v	5 coral rubble		
	T	3	10	v			
	T	1	20	v			
	T	1	30	v			
	T	1	40	v			
	T	1	15	v			
	T	1	12	s			
	T	1	3	v			
25	T	1	50	s	55 humus	70	no seedlings
	B	3	4 (patch)	s	25 wood		
	B	3	15 "	s	20 leaves		
	B	2	8 "	s			
	B	2	3 "	s			
	B	1	5 "	s			
	B	1	20 "	s			
	B	1	10 "	s			
	B	1	9 "	s			
	B	1	7 "	s			
	B	1	6 "	s			
	B	1	30 "	s			mostly out of plot
31	T	1	10	s	75 coral rubble	80	no seedlings
	T	1	8	s	20 dead wood		
	T	1	5	v	5 leaves		
33	T	1	<.3	seedling	75 coral rubble	70	2 cm height
	P	3	7	v	15 leaves		
	P	2	4	v	10 dead wood		
	P	1	8	v			
	P	1	6	v			
	P	1	1	v			
	P	1	<.3	v			

Table 1 continued:

Plot	Species	Stems	Diameter	Veg/Seed	Ground Cover	Canopy	Comments
37	T	1	25	v	60 humus	85	no seedlings
	T	1	20	s	30 dead wood		
	T	1	10	v	10 leaves		
	B	2	10	s			
	B	1	60	s			
	B	1	75	s			
	B	1	80	s			
41	T	1	500	s	55 coral rubble	60	no seedlings
					30 leaves		
					15 dead wood		
42	T	2	35	v, s	75 dead wood	100	no seedlings
	T	1	30	s	20 leaves		
	T	1	25	s	5 humus		
	T	1	10	v			
45	P	2	40	s	65 humus	80	no seedlings
					25 consolidated coral		
					5 dead wood		
					5 leaves		
47	T	1	80	s	85 dead wood	100	no seedlings
	T	1	40	v	8 leaves		
	T	1	30	v	7 humus		
	T	1	8	v			
48	T	2	10	v	55 coral rubble	97	no seedlings
	T	1	20	v	40 dead wood		
	T	1	15	v	5 leaves		
	T	1	7	v			
56	P	2	>.3	seedlings	60 leaves	100	3 cm height
	P	1	110	v	25 humus		
	P	1	125	v	12 leaves		
	P	1	120	v	3 coral rubble		

Table 1 continued:

Plot	Species	Stems	Diameter	Veg/Seed	Ground Cover	Canopy	Comments
57	-	-	-	-	90 *Boerhavia* 5 coral rubble; 5 humus	0	no stems *Boerhavia* meadow
58	T	2	15	v	45 dead wood 40 coral rubble 15 leaves	100	no seedlings
	T	2	10	v			
65	B	1	25 (patch)	s	40 humus	80	
	B	1	10 "	s	30 leaves		
	T	1	>.3	seedling	15 dead wood		5 cm height
	P	1	>.3	seedling	10 coral rubble		5 cm height
	P	1	50	v	5 consolidated coral		
	P	1	40	v			
	P	1	30	v			
	P	1	5	v			
	?	1	30 (patch)	s			unknown Sp.
73	P	4	3	v	50 leaves 35 dead leaves 12 consolidated coral 3 humus	100	no seedlings
	P	2	5	v			
	P	2	2	v			
	P	1	30	v			
	P	1	20	v			
	P	1	15	v			
75	P	1	>.3	seedling	55 leaves 30 humus 15 dead wood	95	2 cm height
	P	1	20	v			
	P	1	15	v			
	P	1	10	v			
	P	1	5	v			
	P	1	2	v			
	P	2	.5	v			
	P	1	>.3	v			
76	P	1	155	v	75 leaves 20 humus 5 dead wood	100	no seedlings
	P	1	140	v			
	P	1	31	v			

Table 1 continued:

Plot	Species	Stems	Diameter	Veg/Seed	Ground Cover	Canopy	Comments
84	-	-	-	-	60 humus 30 leaves 10 dead wood	50	no stems open *Pisonia*
85	P	1	>.3	seedling	65 leaves 20 dead wood 12 humus 3 consolidated coral	80	3 cm height
93	-	-	-	-	100 sand	0	below high tide
94	P P	3 1	>.3 >.3	seedling seedling	42 humus 25 dead wood 20 leaves 10 consolidated coral 3 coral rubble	50	2 cm height 5 cm height

Table 2. Chick Growth Stages.

BOOBIES

(1) Naked or w/ fine hairs
(2) Down appearing on back
(3) Down beginning to cover whole body
(4) All downy approx. ½ adult size
(5) All downy approx. adult size
(6A) Primaries and rectrices visible; no scapulars
(6B) Scapulars visible; down still present on back
(6C) Scapulars unite in midline; down still on wings
(7) Wings and back almost clear of down; thick down remaining on head, neck, flanks belly and breast variable
(8) Fully feathered but not flying; thin or wispy down may persist on radio-ulna, neck and flanks, head
(9) Fully feathered

FRIGATEBIRD

1 (NE) Naked
2 (NE) All downy
3 (NE) Scapulars erupted, < 3cm
4 (SE) Scapulars >3cm; primaries and secondaries not erupted
5 (PE) Primaries and secondaries erupted; rectrices erupted, <3cm
6 (RE) Rectrices >3cm; down just clearing head and wing
7 (DE) Down half gone, clear from head and wings
8 (DE) Down on throat and breast only
9 (DE) Traces of down only
10 (FE) All down gone

TROPICBIRD

(1) All downy
(2) Scapular feathers in pin stage
(3) Scapular pins burst
(4) Secondary and tertiary wing feathers appear
(5) Ventral tracts come in
(6) Primary feathers and rectrices first appear
(7) Dorsal feather tract comes in
(8) Down on neck, lower back, and flanks only
(9) Traces of down on lower back only
(10) Fully feathered

TERNS

(1) All downy with egg tooth (obsolete)
(2) All downy
(3) Scapulars and dorsal feathers in pin stage
(4) Back feathered, no down; down on ventral and flanks
(5) Chest feathered; down on lower belly and flanks only
(6) Fully feathered; no down

Table 3.

FIELD OBSERVATION FORM - PHENOLOGY

Island: Rose & Sand Islands*

Observer(s): D. Williamson, B. Ponwith

Date: ~~XXXXX~~from 9/12/91 to 9/27/91

Moon:

Weather:

SPECIES	EGGS		CHICK GROWTH STAGES												COMMENTS
	1	2	(1)	(2)	(3)	(4)	(5)	(6)	(6A)	(6B)	(6C)	(7)	(8)	(9)	(10)	Adults
SOTE	+				+			+								+ (adults on both islands)
WHSH																+
BLNO																+
BRNO	+															+ (nests on Sa
MABO	+	+												+		
BRBO														+		
RFBO									+	+	+	+	+	+		
LE/GRER				+	+	+	+	+	+	+	+	+	+	+	+	
RTTR	+		+	+	+	+	+	+	+	+	+	+	+	+	+	
WTTR	+															+ (2 nests)
CHSH																+

Comments: * Rose Atoll, America Samoa. All reports apply to Rose Island only unless otherwise noted. WHSH was heard on 3 occassions, seen on one. CHSH was seen on one occassion. Two WTTR seen on nests, one confirmed on

ROSE ISLAND SAMPLING GRID

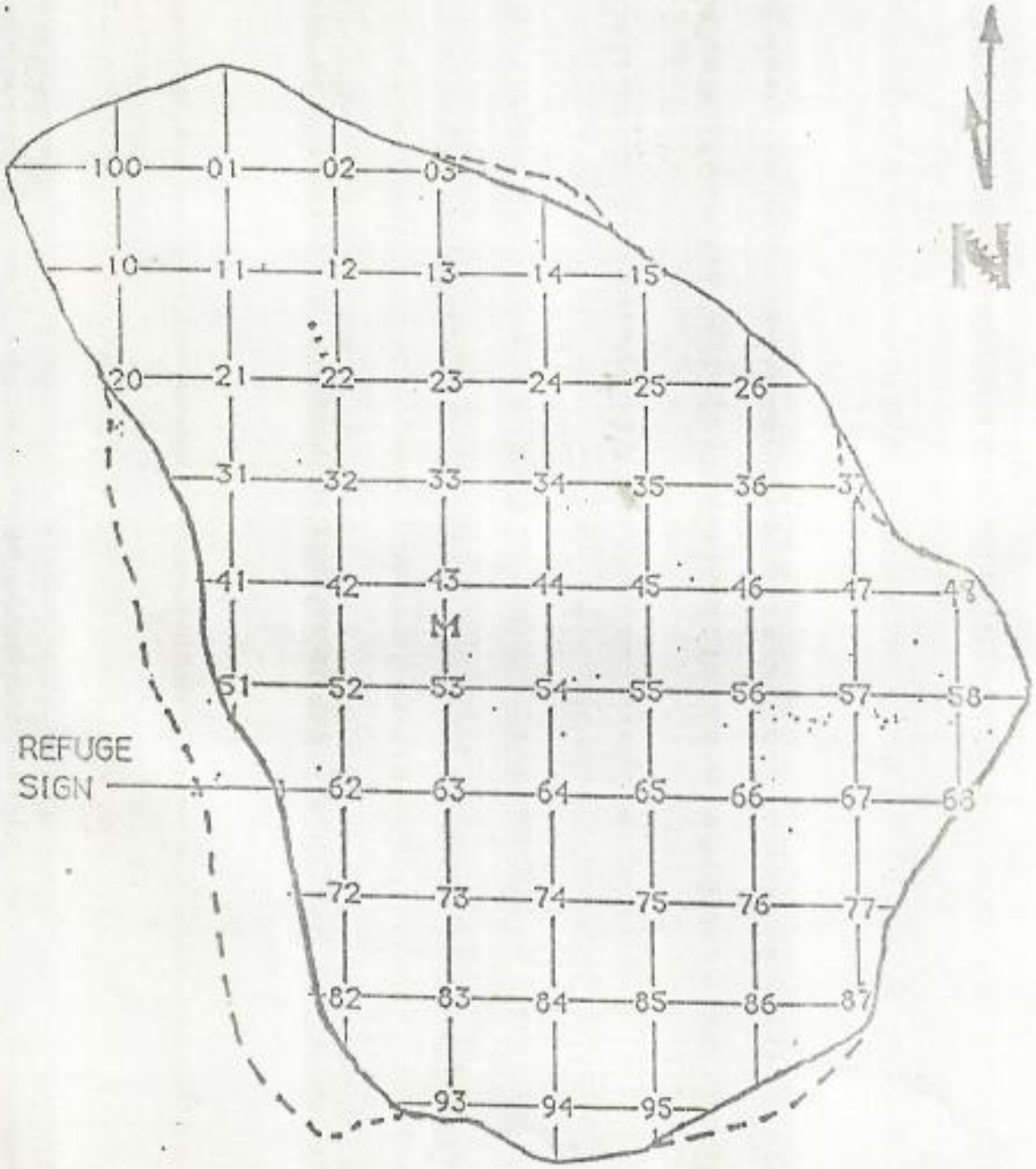


Figure 1. Rose Island vegetation sampling plots. From Flint 1990 (Rose Atoll Trip Report 14 October to 5 November 1990).

Paradise of the Pacific 51(4): 9, 25-26 1939

Rose Atoll, U. S. A.

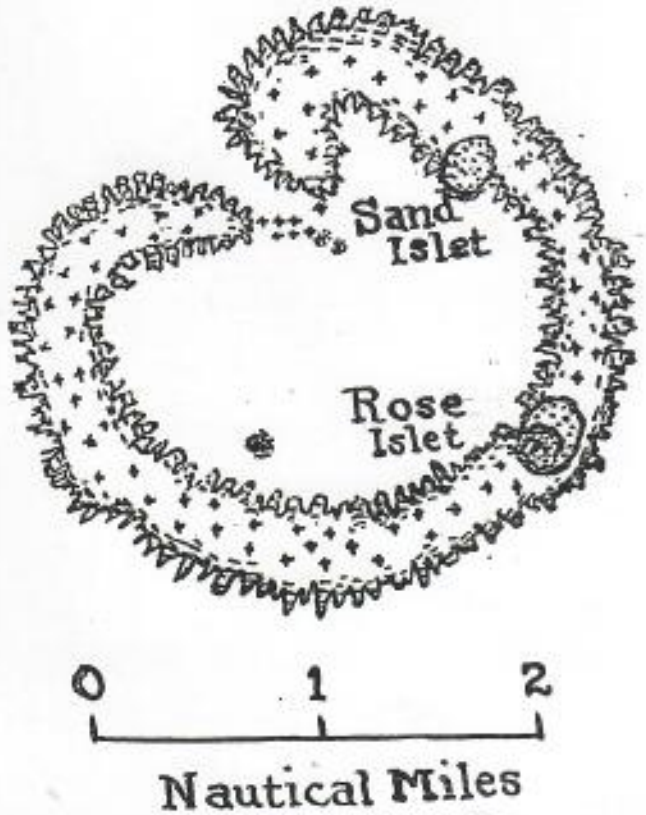
By E. H. Bryan, Jr.

ONE of the little-known islands in the south Pacific, which recently has found its way into the headlines, is Rose Atoll, easternmost outpost of American Samoa. It consists of a flat circle of reef, about 500 yards wide, surrounding a lagoon about two miles in diameter. On this rim are two small islets, one of bare sand and broken reef fragments, the other with a thick stand of "buka" trees. It is seventy-eight miles east of Tau Island, and about one hundred fifty miles east of Pago Pago.

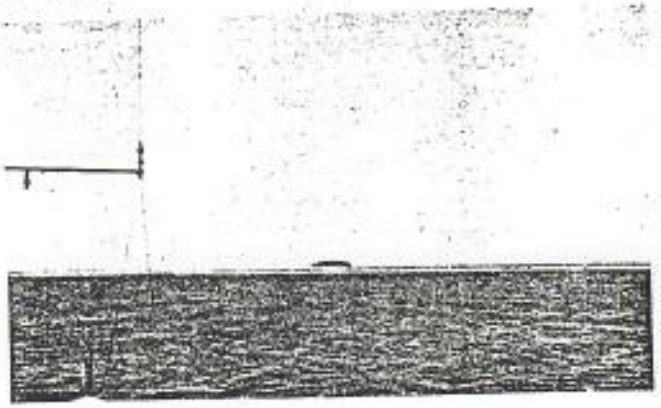
Our first sight of Rose Atoll, on August 4, last summer, from the deck of the U.S. Coast Guard cutter *Taney*, was a low hump on the horizon, appearing like a loaf of bread as we approached. Then we could make out a curve of white surf against pink reef. Finally, when we were but a mile or so away, from the flying bridge we could see the entire circle of flat, pink reef, within which nestled a jade lagoon, on the far side of which, like twin settings of a ring, were a spot of white sand and a higher spot of dark green trees. Through glasses we could make out a small break in the reef at the northwest curve.

Going ashore in the motor boat, we passed through this break without difficulty, finding it about sixty yards wide, but partly blocked at its inner end by a shoal with numerous rocks and heads. Further into the lagoon, in line with the entrance, were two large reef heads, circular in outline and just beneath the surface. Otherwise the lagoon appeared free from obstructions. The deepest sounding is about fifty feet.

As we steered a course for Rose Islet, we passed Sand



Rose Atoll—Drawn by E. H. Bryan, Jr.



Rose Atoll—E. H. Bryan, Jr., Photo, Courtesy Bishop Museum

Islet, low and barren, on our left. It being near low tide, the reef was scarcely awash and was covered with numbers of rocks of all sizes, up to a dozen feet across and four or five feet high.

Rose Islet lies on the east side, occupying the inner two-thirds of the reef rim. A sandy shoal separates it from the deep water of the lagoon, one having to hop out of a boat in knee-deep water and wade ashore. The island measures about a thousand feet along the reef, by seven hundred fifty feet wide. The northern half is a sand flat, with broken chunks of reef material and shells, between which are scattered herbs of Boerhaavia and Portulaca. The southern half is covered by a continuous canopy of "buka" trees (*Pisonia grandis*), with a row of coconut palms, eight large and half a dozen smaller ones, planted by Governor Warren J. Terhune, the U.S. Naval Governor of American Samoa, in 1920. Everywhere were great numbers of birds: wideawake terns, boobies, frigates, a few love (white) terns, even reef herons (one blue and one white) and some migratory wandering tattlers.

Rose Atoll was discovered by Louis de Freycinet on October 21, 1819, on his voyage around the world in the *Uranie* and *Physicienne*. He named it Rose Island "for a lady especially dear" to him (*Paradise of the Pacific*, November 1936, 19), and recorded quite a description of its appearance, as well as a profile and chart, the imperfections of which are readily explained by the fact that he did not approach closer than one and a half miles. He noted that the island appeared to be covered with trees and inhabited only by sea birds.

Otto von Kotzebue was the next to make recorded observations of the islet, having passed it in 1824. Not knowing that Freycinet had already discovered and named it, he called it Kordinkoff Island, in honor of his first lieutenant.

Dumont D'Urville passed it on September 23, 1838, in the corvette *l'Astrolabe*. He described it as a heap of sand covered with a "bouquet" of green, very fresh and pleasing. He estimated the circumference of the reef as between six and seven miles, and noted the break in the northwest curve of the reef, which gave access to the lagoon within.

The first recorded landing on Rose Islet was made by

(Continued on Page Twenty Five)

WAKE ISLAND

(Continued from Page Six)

had been informed by Captain Hooper, of the Revenue Cutter *McCullough*, that a passage on the south side of the Island was feasible for boats, and that a boat had been landed there from the steamship *China*, and that General F. C. Greene had hoisted an American flag on the island at that time. [On January 17, 1899] I approached the southern outlet with the *Bennington* within a quarter of a mile * * * .

"With the navigator at the masthead we then steamed slowly along the eastern and southern sides of the island * * * I did not circumnavigate the island, but, after rounding Heel Point and seeing from the ship that the outlet on the northern side of the island was barred * * * I returned to the lee southern side of the island.

"At one o'clock, * * * the gig and the whaleboat were lowered and pulled ashore. The landing was made within a hundred yards of the west end of the outlet where the surface was moderate. I then examined the spit and made a selection for the flagpole * * * . On the eastern side of the island from the ship, imbedded in the sand halfway from Peacock's Point to Heel Point, an anchor was seen, and also what appeared to be the wreck of a lower mast higher up on the beach.

"When the flagstaff was in place the men were landed and formed into two ranks, facing seaward and the staff, where, having called all present to witness that the island was not in the possession of any other nation, at 3:22 p.m., I ordered the flag to be hoisted by Ensign Wettengell. Upon its reaching the truck, the flag was saluted by 21 guns from the *Bennington*. The position of the flagstaff, as determined by Ensign Campbell from observations from the ship, was latitude 19:17:50 North, longitude 166:31 East.

"After the salute was fired the flag was nailed to the masthead with battens, and a brass plate with the following inscription was screwed near the base of the flagstaff:"

United States of America
William McKinley, President;
John D. Long, Secretary of the Navy.
Commander Edward D. Taussig, U. S. N.,
Commanding U. S. S. *Bennington*
this 17th day of January, 1899, took
possession of the Atoll known as Wake
Island for the United States of America.

"What the United States government want with this Island is difficult to say," wrote Bancroft in his *New Pacific*, "unless it be to give it to the Germans, who are not above taking anything."

The U. S. S. *Supply*, in 1912, stopped at Wake Island. A whaleboat landed some men who planted some coconut trees carried there from Guam.

The *Tanager Expedition* visited Wake Island in the summer of 1923, and gave the three islands the names they bear today.

In 1935, by Executive Order, Wake Island was placed under the jurisdiction of the Navy Department. And in the same year the Pan-Pacific Airways established a commercial airbase on the island.

Yes, Wake Island has reached maturity.

STORY OF MID-PACIFIC INSTITUTE

(Continued from Page Seven)

the school. Morning cleanup duties are divided among the entire group—no pupil is excepted. The girls elect members of a governing student council, members of which meet with Miss Lois Bruce, dean of girls, to decide upon problems of discipline. In a like manner, the boys' senate meets weekly wth Mr. Anderson. Outstanding in all of this participation in government is a spirit of democracy and fair-play. It is little wonder that a remarkably high percentage of Mid-Pacific graduates are outstanding citizens of the territory.

Besides a full selection of regular high school subjects, Mid-Pacific offers its pupils all forms of wood-working instruction under the skilled supervision of Cecil C. Martin, and practical horticultural work supervised by Richard C. Tongg. Physical education facilities include a modern, well-equipped gymnasium, an outdoor swimming pool, and a large athletic field.

A big week of every school year is spent at camp. For a seven-day period early each spring, all the occupants of the girls' department go to the Waialua Fresh Air Camp, while the boys and the men teachers entrain for Camp Harold Erdman. During this time school friendships are further cemented, and everyone enjoys a period of general outdoor relaxation. Swimming, hiking, fishing, coral and shell collecting are a few of the camp choices of occupation.

In keeping with the religious spirit in which Mid-Pacific Institute was founded, a short devotional period begins each school day, and on each Sunday of the school year, every pupil attends the Christian church of his choice. This training is another part of the school life which very naturally becomes parts of the lives of the alumni.

Thus is the Mid-Pacific pupil prepared for a full and worthwhile life, whether he be Hawaiian, Chinese, Japanese, Filipino, or Korean, and whatever may have been his home and previous training.

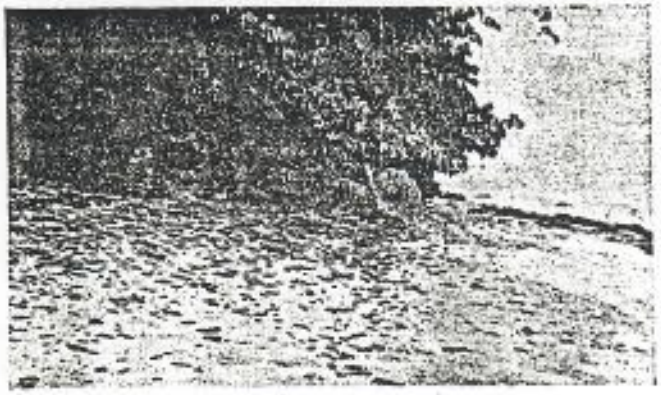
ROSE ATOLL, U.S.A

(Continued from Page Nine)

the United States Exploring Expedition, under Commodore Charles Wilkes, October 7, 1839. Part of a day was spent in making a survey and observing the geology and natural history. Even then there were but three kinds of land plants, two herbs and the Pisonia trees.

About twenty-five years later, Captain Rantzau, making explorations for German interests, made several expeditions to Rose Atoll and even took his small schooner through the shallow entrance and anchored in the lagoon. He produced a chart of the atoll, and an account of his observations is given by Eduard Graeffe in a German article on the topography of Samoa, published in 1873.

In January 1920, Commander W. J. Terhune, the naval governor of American Samoa, visited Rose Atoll and erected a concrete monument which reads: "Rose Island/ American Samoa/Trespassing prohibited/Warren J. Terhune/Governor/Jan. 10, 1920." In June 1920 he decided to revisit the atoll, and this time took with him Alfred Goldsborough Mayor, a noted marine biologist. Dr. Mayor



Rose Atoll—E. H. Bryan, Jr., Photo, Courtesy Bishop Museum

the island, chief of which appeared in the Proceedings of the American Philosophical Society for 1921 (vol. LX, pp. 62-70) and publication 340 of the Carnegie Institution of Washington, 1924. Dr. Mayor's visit also inspired and furnished much data for the extensive account of Rose Atoll by Dr. William A. Setchell (Carnegie Publication 341, 1924), from which some of this article is condensed.

As Dr. Mayor points out, this island should not be called a "coral atoll" but a "lithothamnium atoll" for its reef is composed mainly of this calcareous algae and not of coral. The pink color of the circle of reef is due to the veneer of living Porolithon, a pink lithothamnium. The composition of this material is about 75 per cent calcium carbonate and 19 per cent magnesum carbonate. Dr. Mayor suggests that the hundreds of boulders scattered over the surface of the reef are the remnants of reef material which formerly stood six to eight feet higher, having been laid down at a time when the sea stood about ten feet above its present level. There is evidence for such a stand of the sea in other parts of Samoa.

The grove of Pisonia trees grows upon a portion of Rose Island which is made up of raised reef rock or coquina, the surface of which is about eleven feet above sea level. Beneath the trees, the upper soil is rich in humous from the fallen leaves and rotten branches, and with considerable phosphorous from the droppings of many sea birds. Lizards and native rats are the only four-legged animals on the island.

A comparison of charts made by the various explorers shows that, while the outline of the reef has remained fairly constant, the size and shape of the two islets has been constantly changing, as storms wash the sand and broken reef rock here and there. It is quite evident that storms wash completely over Sand Islet; but the continued presence of the "buka" trees on Rose Islet shows that this part of the rim is apparently not so subject to inundation.

The present value of Rose Atoll lies in its sheltered lagoon. This would make a much more satisfactory landing-place for sea-planes than the steep-walled basin of Pago Pago harbor, with its treacherous and variable winds.

"This statue of King Kamehameha IV, last of the Hawaiian kings, is featured on the Hawaiian pavilion," reads a caption under a cut of a statue of Kamehameha I, lo-

EFFICIENT SERVANT OF HONOLULU

(Continued from Page Eleven)

schedule designed to help the traveling public and not to skim-the-cream on certain routes and at certain peak-hours. Rapid Transit traffic-net covers the city like a huge fishing net made of sturdy and dependable material; comfort and convenience of passengers aboard Rapid Transit vehicles are supreme; seats are comfortable and the coach-interior is not cramped; vehicles are clean, sanitary and well-ventilated, not dingy and ancient with dirty-paint, broken-glass and shabby upholstery; passengers do not have to stoop almost double to avoid bumping their heads and receiving other injuries when entering and leaving; vehicles are almost noiseless, not rattling tin-cans; drivers do not create apprehension in passengers by dashing madly through traffic; coaches and buses do not stop anywhere and everywhere, contrary to law, to grab passengers; smoking-passengers are actually limited to the designated parts of the vehicles; drivers are clean, smartly uniformed, and do not smoke surrepticiously; the equipment and methods of the Honolulu Rapid Transit Company are modern; they are a blessing to Honolulu.

Public officials, representing the interests of the traveling public, should insist that only the most efficient transportation operates in Honolulu. The People, particularly those who cannot afford automobiles, deserve the best practicable service.

The romantic story of rapid Transit in Honolulu could be told—how the Hawaiian Street Tramways was started in the Eighties, how the H.R.T. franchise was approved in July of 1898 by the Legislature and President Sanford B. Dole, how the United States Congress ratified it in 1900, how the first car was put into operation the following year, how the Hawaiian Tramways was purchased in 1903, how the various officials succeeded each other with A. L. Castle becoming president in 1922 and A. E. Kirk appointed Manager in 1928, how—and how and how; but the People are more interested in the safe, convenient, swift and economical streetcar service that the Honolulu Rapid Transit Company is providing them with today. Safe—convenient—speedy—comfortable—economical—everywhere—hums the turning wheels of these Servants of the People, all over Honolulu.

Looking backward today the People see two sturdy figures moving toward them. One of them is Public Transportation, while the other represents the Conditions of the same period. The transportation of Honolulu People, in the March of Time, has always been in perfect step with the ever-changing Conditions.

Old Hawaii moved about Honolulu in outrigger canoes, by swimming, by hiking, on horseback, pulled by men in funny wagons called Hawaiian ricshas by some, carriages, horse and mule omnibuses, stage coaches, horse and mule cars on rails. Then came electric trolley-cars on rails, buses and trackless trolleys.

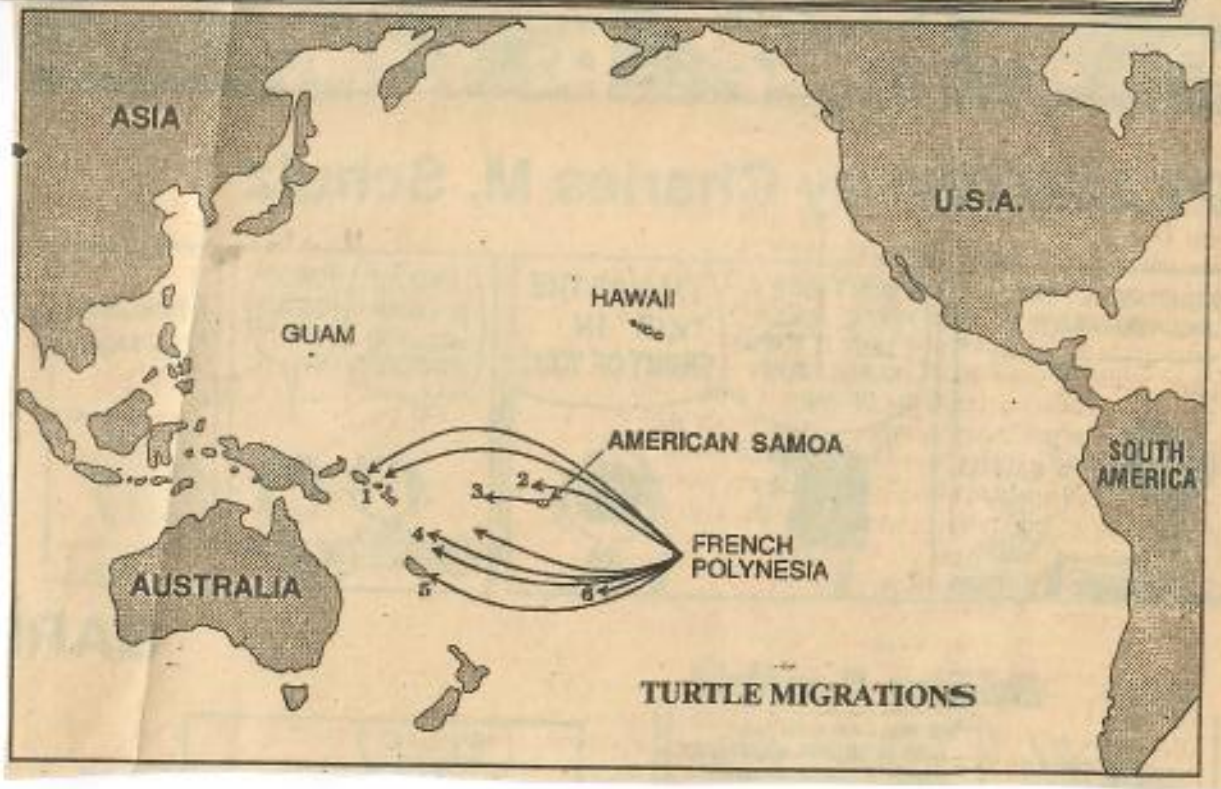
Rapid Transit, in New Hawaii, is abreast of the most modern transportation conditions, and its past and present alertness is a token that it will ever continue to Serve the People in the most modern and efficient manner. Public interests demand that no obstacles be placed in its con-

"Ua mama lava le va'a o Ti'a ia Ti'a"

samoa news

ENVIRONMENTAL REPORTS

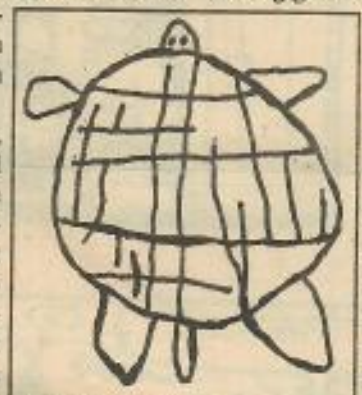
Sponsored by Le Vaomatua



Sea Turtles in Serious Trouble

In Samoan folklore, sea turtles were believed to have the power to save fishermen who were lost at sea by bringing the fishermen safely to shore. The Samoan word for sea turtle, I'a sa, translates literally to "sacred fish", presumably because of this ability.

Samoans have traditionally harvested sea turtles for food, and the shell was often made into bracelets, combs, fishing hooks, and also was used in the headpiece worn by a princess during important dance ceremonies. Turtles were incorporated into Samoa songs and art, and there is even a turtle petroglyph (rock carving) in Faga'itua.



TURTLE PETROGLYPH

And, of course, there's the legend about the Turtle and Shark that appear in the sea at Vaitogi when villagers sing a special song. It therefore seems extra unfortunate that the abundance of turtles in Samoa has declined significantly from historic levels. Biologists now estimate that there are only about 120 nesting females per year in the whole Territory. This decline parallels the worldwide decline of sea turtles that has resulted from overharvest, loss of nesting beaches, and "incidental" kills in fishing gear.

The biggest problem here in Samoa is that many villagers still eat turtles and turtle eggs.

Two turtle species occur in our local waters. The laumei uga or hawksbill (Eretmochelys imbricata) is usually the species that nests on Tutuila and Manu'a beaches. This is a solitary nester, and on average, only 2 or 3 laumei uga females now use a given beach. Once they have laid their first group of eggs, they will return at 2-week intervals to lay more eggs. The laumei uga is occasionally poisonous. In the late 1950s, many people from Aunu'u got very sick after eating a poisonous laumei uga (hawksbill).

The other species here is the green turtle (Chelonia mydas). It is also found in our coastal waters, but it nests primarily at Rose Atoll.

These turtles undertake surprisingly long migrations during their lifetime. After hatching on one of our local beaches, they swim to feeding grounds that may be thousands of miles away.

For example, two turtles were tagged in American Samoa and recovered (and eaten) in Fiji. Other tagging data from the central South Pacific region reveal even more impressive movements (see diagramabove story).

After the turtles mature, which takes about 20-25 years, they return back to the same beach where they were hatched, and lay their own eggs .This pattern of large-scale movements between a turtle's nesting area and feeding area means that turtle populations in the South Pacific Ocean are all mixed together. While some of "our" turtles were caught in Fiji, the reciprocal is also true. Turtles that feed in our waters probably originated from islands elsewhere in the South Pacific.

This mixing greatly complicates conservation efforts. It means that region-wide cooperation among the island countries of the South Pacific is essential; otherwise, while we may try to protect turtles in Samoa, our turtles may be killed later when they migrate to other islands.

Federal and territorial laws currently exist to protect turtles and their eggs in Samoa. Because sea turtles are an endangered species, there is a $10,000 penalty for killing a turtle or importing any turtle products into the Territory (shells, stuffed turtles, turtle combs, etc.).

But many Samoans are unaware of such laws, so our first task must be to teach the public about both the turtle's plight and the laws already on the books. To help get the message across (and obtain valuable biological information), the Department of Marine and Wildlife Resources (DMWR) presents a T-shirt or a $10 reward for turtles that are turned in to the department.

Public concern about killing turtles is growing. On several occasions, villagers have notified DMWR that turtles have been caught in their village. When this happens, DMWR will confiscate the turtle, tag it, and release it alive.

However, because villagers like to eat turtle meat and eggs, turtle conservation faces an uphill challenge. The point to remember, however, is that there are fewer and fewer turtles remaining in our waters. It is a sad commentary that many young Samoans have never even seen a live sea turtle.

What can be done? We must first turn around the public's perception of sea turtles being food for the taking. Turtles are a part of Samoa's heritage that needs to be fully protected, or it may be lost altogether. A nesting turtle, and the hatching of turtle eggs, should be viewed as special wonders of life, not as things to eat.

Times have changed since "the old days", so it is also time to rethink our view about the world around us.

Peter Craig, Chief Biologist, Department of Marine & Wildlife Resources

Am. Samoa

November 19, 1996

Meryl Goldin
P.O. Box 4423
Pago Pago, AS 96799

Fax: **011 (684) 699-2105**

George Balazs
National Marine Fisheries Service
Honolulu Lab
2570 Dole Street
Honolulu, HI 96822-2396

Dear Mr. Balazs:

Enclosed please find a copy of an annotated topographic map showing turtle tracks I have observed over the last several months.

Please contact me if you need additional information regarding same.

Sincerely,

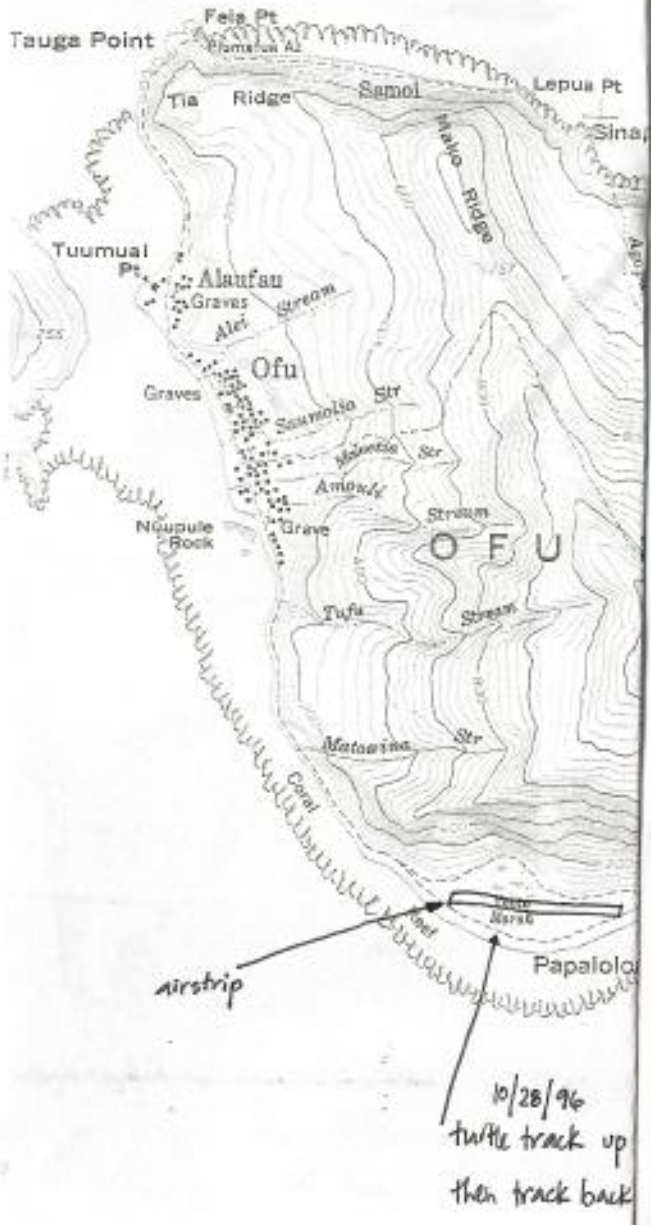
meryl

Meryl Rose Goldin

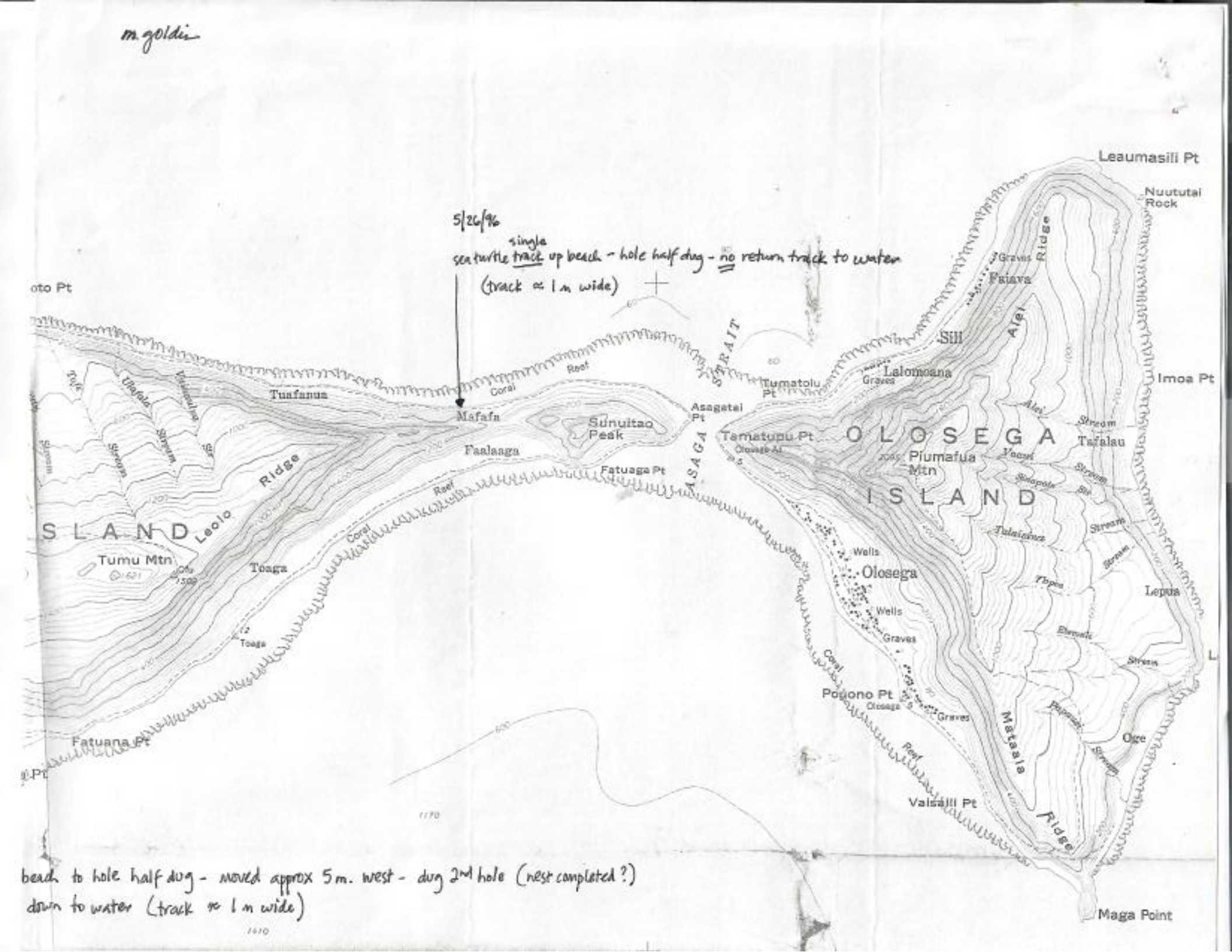
Also, if you tell me which data are meaningful, I would be happy to record it where possible.

For example, I see hawksbill turtles almost everytime I snorkel at this particular lagoon ... anything of interest to you?

Topographic Map of the
MANU'A ISLANDS,
AMERICAN SAMOA
1:24,000



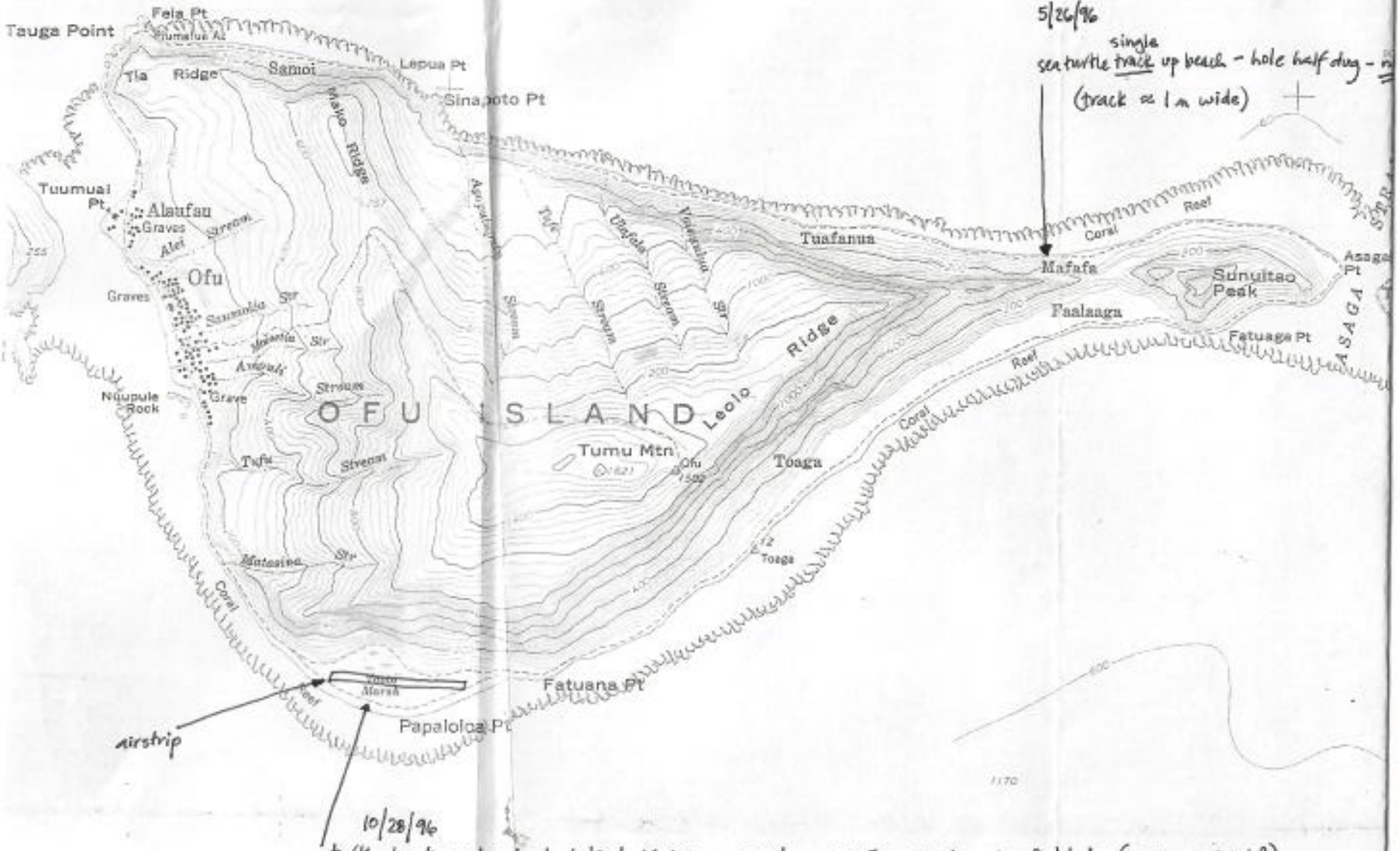
m goldie



beach to hole half dug - moved approx 5 m. west - dug 2nd hole (nest completed?)
down to water (track ≈ 1 m wide)

Topographic Map of the
MANU'A ISLANDS,
AMERICAN SAMOA
1:24,000

m. goldie



DEPARTMENT OF MARINE & WILDLIFE RESOURCES

AMERICAN SAMOA GOVERNMENT
P.O. BOX 3730
PAGO PAGO, AMERICAN SAMOA 96799

TEL: (684) 633-4456
FAX: (684) 633-5944

PETER T. COLEMAN
Governor

GALEA'I P. POUMELE
Lt. Governor

HENRY SESEPASARA
Director

PHILIP LANGFORD
Deputy Director

9/91

Dear George: We tagged 3 greens during the first 2 weeks of our 4-5 week visit to Rose. Yes, we made it out there. We also observed an untagged green during a snorkle outing. I will forward you any additional info that Bonnie brings back from her stay.

Thanks for the plastic containers for our "Turtle tagging apparatus."

During your visit you mentioned that you might have some Turtle slides that we could

me to start our educational efforts in the schools. Does the offer still stand? Any other "stuff" you might have (i.e., brochures, where to have badges made, addresses for Turtle videos) that might help us get an E+I effort going would be great as well. Thanks.

Sincerely,

Tom

P.S. Would you also like us To provide you with a map of where nesting sites on Rose Ake observed?

FACSIMILE TRANSMISSION

DEPARTMENT OF MARINE AND WILDLIFE RESOURCES
P.O. Box 3730
Pago Pago
American Samoa 96799
Phone: Office - (684) 633-4456
FAX: (684) 633-5944

TO FAX: (808) 943-1290

DATE : 1 October, 1991

FOR : George Balazs, NMFS

FROM : Bonnie Ponwith, DMWR BP

RE : **ROSE ATOLL TURTLE SUMMARY, SECOND SHIFT**

Hi George,

The pages that follow are the data collected at Rose during the second shift, 12 September to 26 September 1991. We had some busy nights during the full moon high tides just before we left! I paddled to Sand Island to check for signs of activity as well and the results are as follows:

DATE	OBSERVATIONS
9/13	8 pits, one not fresh. Difficult to tell how many may contain eggs.
9/15	No new activity
9/18	No new activity
9/19	No new activity
9/23	Two sets of tracks with what appeared to be one false and one actual nest each
9/24	One new track with 2 false pits, one possible nest
9/25	Two new tracks with several false pits and two possible nests
9/26	No new tracks

During paddles inside the lagoon, adult green turtles were seen on several occasions. I was treated to an interesting aquatic ballet on one such occasion. One turtle floated on the surface, while a second turtle swam in a gradually tightening spiral around the first. The floating turtle would spin on a pivot point at the pace

it was being circled. When the second turtle finally closed in on the first, it swam straight away from it about 10 to 20 meters and started over again. What was really wild was that by the time the swimming turtle got close, the spinning turtle was doing about 10 rmp!

This process went on for a good half hour until the swimmer went out a little farther than usual and encountered my boat. It circled me twice and then swam right under my bow, seemingly unintimidated. After that, I lost it in the glare so paddled on.

Wanting to watch without disturbing them, I was not able to do a gender check from the distance I was from the turtles. Is this possibly courtship? Have you seen anything like this before, or is this yet another mystery in the wonderful world of turtles?

Also, turtle N152/N153 had a growth just above it left, front flipper. It was about the size and shape of my thump and was healthy, normally scaled tissue. I hope this is just the reptilian version of a skin tag and not the precursor to those nasty tumors you're experiencing up there.

Hope all is well in your neck of the jungle!

Take Care,

Brian

SEA TURTLE TAGGING FORM

tag 151 lost

ID numbers of new tags attached and any old tags already present[1]		Species[2] and sex (if known)	Date and time	Place-name location (or latitude and longtitude)	Activity of the turtle[3]	Curved carapace length[4]
Left front flipper	Right front flipper					
recap N221	N22a	C mydas	20Sept 91 0530	Rose Stake 01	N Nesting	96 cm
recap N222	N223	C mydas	21 Sept 91 1915	Rose Stake 93	came up to nest, returned to sea w/out laying eggs	99 cm
RECAP N222	N223	C. MYDAS	22 SEPT 91 2110	ROSE STAKE 73	CAME UP TO NEST, RETURNED TO SEA W/O LAYING EGGS	(99 cm)
RECAP N222	N223	C. MYDAS	22-23 SEPT 91 1100-0400	ROSE STAKE 00	DUG PITS, LAID EGGS?	(99 cm)

[1] *If old tags are present, please carefully record the ID number and the complete address inscription. Indicate if the tag is made of metal or plastic. Use the back of this form if more space is needed to provide details on each turtle handled. Two tags should be applied to all turtles handled.*

[2] *CM = Chelonia mydas (green turtle), EI = Eretmochelys imbricata (hawksbill), CC = Caretta caretta (loggerhead), LO = Lepidochelys olivacea (olive ridley), DC = Dermochelys coriacea (leatherback), ND = Natator depressa (Australian flatback).*

[3] *Activities include (for example) nesting on the beach, swimming or resting in the sea, injured or found sick, etc.*

[4] *Measured with a flexible tape along the curvature of the midline of the upper shell (carapace).*

Name and address of person filling out this form: _____

_____

_____

_____

RETURN TO: G. BALAZS

HONOLULU LABORATORY
Southwest Fisheries Center
2570 Dole Street
Honolulu, HI 96822-2396

SEA TURTLE TAGGING FORM

ID numbers of new tags attached and any old tags already present[1]		Species[2] and sex (if known)	Date and time	Place-name location (or latitude and longtitude)	Activity of the turtle[3]	Curved carapace length[4]
Left front flipper	Right front flipper					
N152	N153	♀ ± ≤ cm	24 Sept 91 2112 ± 2200	Rose near # 10	dug two false pits & returned at 2208 near #83 dug 2 more false pits & left	109cm over →
N155	N154	♀ ± ≤ cm	25 Sept 91 1900-2200	Rose near #96	Dug several false pits then gave up t/o laying eggs	106cm
RECAP N152	N153	CM ♀	25 Sept 91 1930	ROSE NEAR # 10	DUG ONE PIT & RETURNED TO SEA	
N156	N157	≤ cm ♀	25 Sept 91 2200-0124	between 03 & 04 Rose	Dug several pits & DID not lay eggs returned to sea	95cm

[1] *If old tags are present, please carefully record the ID number and the complete address inscription. Indicate if the tag is made of metal or plastic. Use the back of this form if more space is needed to provide details on each turtle handled. Two tags should be applied to all turtles handled.*

[2] *CM = Chelonia mydas (green turtle), EI = Eretmochelys imbricata (hawksbill), CC = Caretta caretta (loggerhead), LO = Lepidochelys olivacea (olive ridley), DC = Dermochelys coriacea (leatherback), ND = Natator depressa (Australian flatback).*

[3] *Activities include (for example) nesting on the beach, swimming or resting in the sea, injured or found sick, etc.*

[4] *Measured with a flexible tape along the curvature of the midline of the upper shell (carapace).*

Name and address of person filling out this form: _____

_____

_____

_____

RETURN TO: G. BALAZS

HONOLULU LABORATORY
Southwest Fisheries Center
2570 Dole Street
Honolulu, HI 96822-2396

part of rear left flipper missing
skin tag above front left flipper

SEA TURTLE TAGGING FORM

ID numbers of new tags attached and any old tags already present[1]		Species[2] and sex (if known)	Date and time	Place-name location (or latitude and longtitude)	Activity of the turtle[3]	Curved carapace length[4]
Left front flipper	Right front flipper					
N159	N158	♀ ± cm	9/26/91 9:45 PM	ROSE NEAR #3	LAID EGGS	100 cm
N161	N160	♀ cm	9/27/91 0020	Rose Near #4	DUG TWO PITS NO EGGS	112 cm
N162	N163	♀ ± cm	27 Sept 91 1200-0300	Rose near #3	Dug 3-4 false pits Laid eggs	101 cm

[1] *If old tags are present, please carefully record the ID number and the complete address inscription. Indicate if the tag is made of metal or plastic. Use the back of this form if more space is needed to provide details on each turtle handled. Two tags should be applied to all turtles handled.*

[2] *CM = Chelonia mydas (green turtle), EI = Eretmochelys imbricata (hawksbill), CC = Caretta caretta (loggerhead), LO = Lepidochelys olivacea (olive ridley), DC = Dermochelys coriacea (leatherback), ND = Natator depressa (Australian flatback).*

[3] *Activities include (for example) nesting on the beach, swimming or resting in the sea, injured or found sick, etc.*

[4] *Measured with a flexible tape along the curvature of the midline of the upper shell (carapace).*

Name and address of person filling out this form: _____

_____

_____

_____

RETURN TO: G. BALAZS

HONOLULU LABORATORY
Southwest Fisheries Center
2570 Dole Street
Honolulu, HI 96822-2396

SEA TURTLE TAGGING FORM

ID numbers of new tags attached and any old tags already present[1]		Species[2] and sex (if known)	Date and time	Place-name location (or latitude and longtitude)	Activity of the turtle[3]	Curved carapace length[4]
Left front flipper	Right front flipper					
N225	N224	♀ CM	8/30/91 9-10:30 pm	Rose Atoll	Dug 1 False Pit - returned To ocean	94 cm
N222	N223	♀ CM	9/8/91 2230	"	Turtle had dug A number of false pits ⇒ 9/9/91 observed laying eggs	98 cm
N-221	N-220	♀ CM	9/8/91 0100	"	laid eggs	95 cm

[1] *If old tags are present, please carefully record the ID number and the complete address inscription. Indicate if the tag is made of metal or plastic. Use the back of this form if more space is needed to provide details on each turtle handled. Two tags should be applied to all turtles handled.*

[2] *CM = Chelonia mydas (green turtle), EI = Eretmochelys imbricata (hawksbill), CC = Caretta caretta (loggerhead), LO = Lepidochelys olivacea (olive ridley), DC = Dermochelys coriacea (leatherback), ND = Natator depressa (Australian flatback).*

[3] *Activities include (for example) nesting on the beach, swimming or resting in the sea, injured or found sick, etc.*

[4] *Measured with a flexible tape along the curvature of the midline of the upper shell (carapace).*

Name and address of person filling out this form:

Tom Morrell
Dept Marine & Wildlife Resources
P.O. Box 3730
Pago Pago,

RETURN TO: G. BALAZS

HONOLULU LABORATORY
Southwest Fisheries Center
2570 Dole Street
Honolulu, HI 96822-2396

SPC-NMFS/Turtles/WP.15
11 December 1979
ORIGINAL : ENGLISH

SOUTH PACIFIC COMMISSION

JOINT SPC-NMFS WORKSHOP ON MARINE TURTLES
IN THE TROPICAL PACIFIC ISLANDS

(Noumea, New Caledonia, 11 - 14 December 1979)

COUNTRY STATEMENT - AMERICAN SAMOA

Two sea turtles are known to occur in American Samoa: the green turtle (Chelonia mydas) and the hawksbill turtle (Eretmoclelys imbricata).

1. Tutuila Island.

The hawksbill turtle commonly occurs around Tutuila. It is the most populated island, however, so there are few deserted beaches on which it can nest.

2. Manu'a Islands.

Again, the hawksbill is the common species. It is generally captured during November, December and January, which is also the breeding season. The Samoans use the meat for food and the shell for jewelry and decoration.

3. Swains Island.

This island is a small atoll about 210 miles north of Tutuila. The lagoon is completely surrounded by land with lots of sandy beaches. The green turtle is harvested for food when they come up on the beach to nest during November and December. The eggs are also dug up and eaten.

4. Rose Atoll.

This uninhabited atoll was established as a Federal Wildlife Refuge in 1973. No one is allowed to enter the lagoon or set foot on the two small islands without permission from the U.S. Fish and Wildlife Service and the American Samoa Government. Yearly trips are made to the atoll to survey the wildlife resources. In addition, surveillance flights are conducted every two months, primarily to check for trespassers, but also to count turtles and turtle tracks. Turtle data obtained during the flights and on-site surveys are incomplete due to the variety of observers and lack of a consistent data collection format. The most informative survey was conducted during the night of November 21, 1974 when eleven (11) large green turtles were observed coming onto Rose Island. One was seen to lay eggs. Six (6) green turtle hatchlings were observed. Two were attacked by Polynesian rats. The hawksbill turtle has also been observed at Rose Atoll.

principal object of the study was to find the effect on flicker of various "wave-forms" of light distribution throughout the intermittent cycle. Rotating discs were used, cut to various simple shapes and openings, and rotated in such relation to a light source that the illumination of the observing target could be interrupted gradually, abruptly, partially, or for varied fractions of the total cycle or period of intermittence. The speeds were found at which the sensation of flicker disappeared ("critical speeds"). These vary in a systematic manner with the change of wave-form, but in a different manner from their course at high intensities. A strikingly simple mathematical expression has been found to represent the critical speed-wave-form data. If the wave-form is represented by its expansion in a Fourier series, the critical speed is directly proportional to the logarithm of the coefficient of the first periodic term of the expansion, divided by the average value.

The effect of tension on the electrical resistance of some of the more unusual metals: P. W. Bridgman. In this investigation those metals have been examined which are abnormal in that their electrical resistance increases under hydrostatic pressure. It is normal for the resistance of a metal to increase under tension. The point at issue was whether the metals which are abnormal in their pressure coefficients would also be abnormal in their tension coefficients. Five metals are known whose pressure coefficients of resistance are abnormal; these are bismuth, antimony, lithium, calcium, and strontium. It was found in this investigation that the tension coefficients of only two of these, namely bismuth and strontium, are abnormal, whereas that of the other three are normal in that the resistance increases under tension. Taken in conjunction with the view of the nature of metallic resistance which I have developed recently elsewhere, these facts are taken to indicate that the mechanism of conduction in lithium is by a passage of electrons between the atoms, whereas in bismuth the conduction is mainly by the passage of electrons through the atoms. In strontium it is probable that both types of conduction are present, in calcium that the conduction is mainly of the first type, and in antimony mainly of the second. The alloys manganin and "therlo," whose pressure coefficients are abnormal, have also been investigated, and their tension coefficients found to be normal. This is also in accord with the theory.

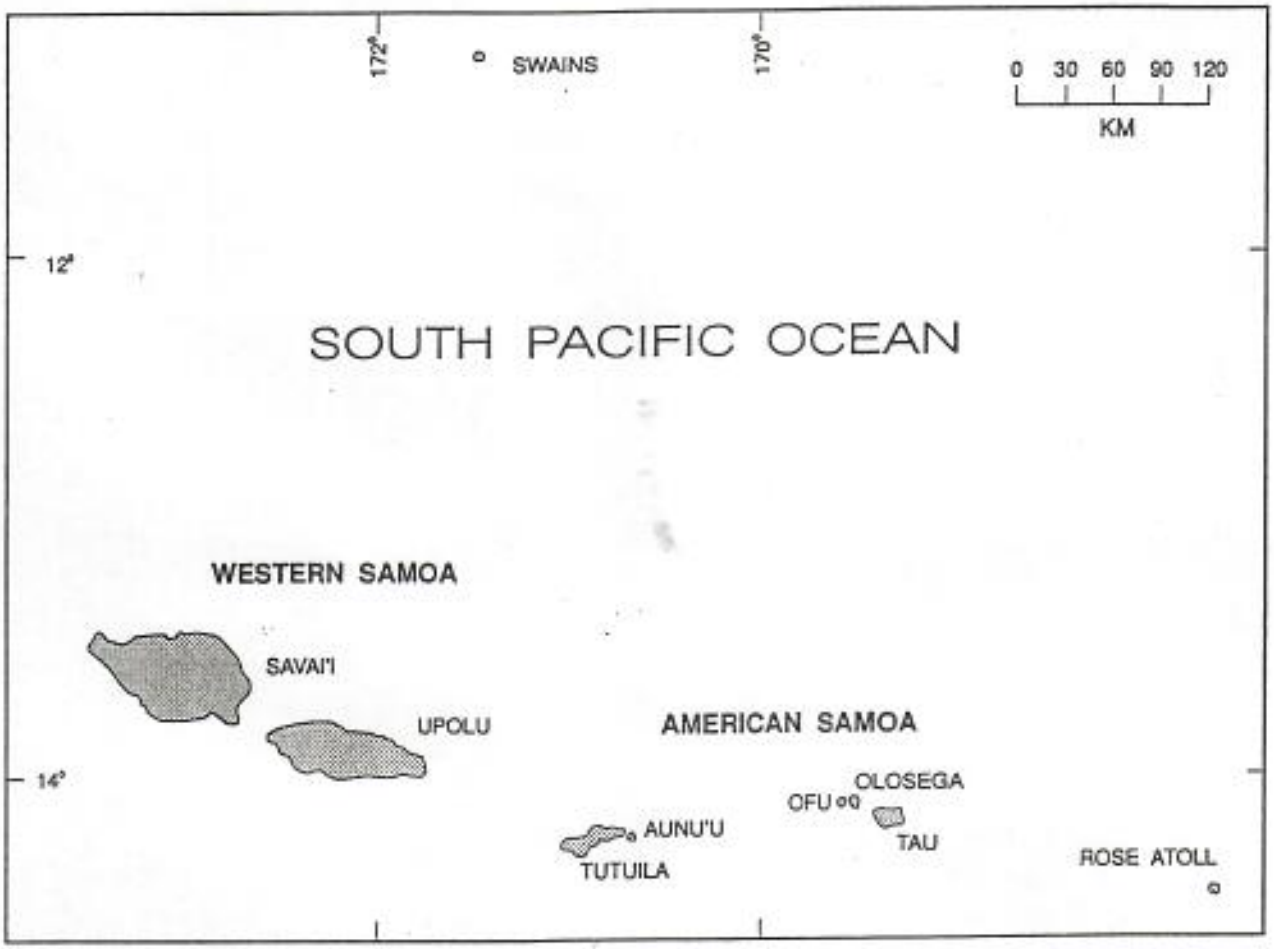
The conductivity of mixtures of nitrogen and chlorine in a flaming arc: W. A. Noyes. For about seven years the author of the paper and his assistants have attempted to secure the direct combination of nitrogen and chlorine by methods similar to those which are used in the preparation of the oxides of nitrogen by the use of the electric discharge. Some of the early experiments seem to indicate that nitrogen and chlorine combine in the electric arc, but after a very careful elimination of every trace of oxygen and of moisture from the apparatus no combination could be established. Less than 0.3 of a milligram of combined nitrogen was found in an experiment which was conducted for 51 hours. When air was subjected to the same conditions several grams of the combined nitrogen were obtained.

Rose Atoll, Samoa, in its relation to recent change in sea level: Alfred G. Mayor. This rarely visited atoll proves to be composed of lithothamnion rather than coral. The atoll rim was once about 8 feet higher than at present, and has been cut down nearly to present sea level after the ocean subsided to this extent in recent times. The extreme isolation of the atoll is shown by the fact that there are only three species of plants upon the island; a *Pisonia* forming a beautiful grove of trees, a small yellow-flowered *Portulaca*, and a creeping pink-flowered *Boerhaavea*. A rat allied to a Malayan form, and widely distributed over Polynesia is the only mammal on the island. It is interesting to see that all the islands of American Samoa indicate that the sea was once at least 8 feet higher than at present, and Rose Atoll leads us to infer that the climate was tropical when the sea level was highest, for fossil corals and lithothamnion are found in the atoll rim above present sea level.

"Turtle Oreodon Layer" or "Red Layer," a contribution to the stratigraphy of the White River oligocene (results of the Princeton University 1920 expedition to South Dakota: W. J. Sinclair. This paper describes the lowest member of the Oreodon beds in the Big Badlands of South Dakota, a pinkish gray clay with several zones of rusty nodules at its top. Although it has supplied abundant fossil bones to collectors for over seventy years, very little has been published about it, and the present paper endeavors to give some details regarding its nature, the origin of the sediments, conditions under which they were laid down and so on, and to tie up certain of the changes both in sediments and faunas to a climatic factor. The first fresh-water algal limestones to be identified in any of our continental tertiary formations are described.

Fig.

Good map!


172°
SWAINS
170°
0 30 60 90 120
KM
12°
SOUTH PACIFIC OCEAN
WESTERN SAMOA
SAVAI'I
UPOLU
AMERICAN SAMOA
14°
OLOSEGA
OFU
TAU
AUNU'U
TUTUILA
ROSE ATOLL

FAXED 11-4-94 7:20 PM

TRANSMITTAL SHEET

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

Commercial: (808) 943-1221
Telefax: (808) 943-1290

TELEFAX FOR: MIKE MOLENA, US FWS
CC ELIZABETH FLINT

DATE: 3 NOVEMBER 1994

FROM: GEORGE BALAZS
MARINE TURTLE RESEARCH PROGRAM

TELEPHONE EXT: 943-1240

NUMBER OF SHEETS TRANSMITTED (including this page) ONE

MESSAGE:

Dear Mike: Thank you again for sending me a copy of your draft report covering the Nov.1993 impact assessment of the longliner collision on the reef at Rose. The summation was of benefit to my recent trip to the site on 25-29 Oct. 1994. While most of my time was spent on the island, on the morning of 28 Oct. I had the opportunity to do a series of scuba dives in the western portion of the lagoon. Marc Rice, one of my diving partners to hand-capture turtles here in Hawaii, accompanied me on the dives at Rose. Our objective was to locate, capture, and tag any turtles that might be using the lagoon for resting or feeding. We searched 10 pinnacles over a 2 hour period, but were limited to a single bottle each during this time. Nevertheless, we located 3 green turtles which we captured and brought ashore for careful inspection and tagging prior to release. According to my records for sea turtles at Rose, these are the first immature green turtles ever captured at this location. This may not represent an absence of such immatures in the lagoon, but rather earlier research divers not being focused on specifically searching for the turtles as Marc and I tried to do.

The curved carapace lengths of the 3 turtles we captured were 50.0, 51.0, and 56.5 cm. I was suprised to find that 2 of the turtles had sunken plastrons indicative of emaciation. One of the turtles was quite severe with degeneration of plastron and carapace cartilage having occurred. This same turtle was found to have white mineral deposits lodged in both eye sockets. These were extracted with some difficulty (but to the benefit of the turtle's vision) and found to measure about 2 mm in diameter each. There appeared to be some disfunction of the salt grands, or associated ducts, that caused this abnormality. I retained these stony deposits and will try to have them properly analyzed for exact chemical structure. It is worthwhile to note that one of the effects of petroleum exposure to sea turtles is salt gland damage (according to studies done by Peter Lutz in Florida).

Our other accomplishments with turtles while at Rose included deployment of satellite transmitters on two adult nesters (the only 2 ashore during our 4 nights on the island), and the collection of small (6 mm) skin biopsies from each turtle (5 total) for DNA analysis to determine how the Rose green turtle population fits with others Pacific-wide.

Best regards,

United States Department of the Interior

FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS OFFICE
3 Waterfront Plaza
500 Ala Moana Blvd, Suite 580
Honolulu, Hawaii 96813
(808) 541-3441
Fax: (808) 541-3470

FAX TRANSMISSION

DATE 10-17-94

TO: GEORGE BALAZS
NMFS - SWFC
HONOLULU

FROM: MICHAEL MOLINA
USFWS - PIO
HONOLULU

PHONE: 943-1221
FAX: 943-1290

SUBJECT: ROSE ATOLL TRIP : NOVEMBER 1993

NUMBER OF PAGES: 25

REMARKS: GEORGE — I DID NOT INCLUDE THE FOLLOWING:

APPENDIX A - CONTAMINANTS IMPACT WORK PLAN
" B - RAW DATA TABLES & FIGURES

THE RESULTS OF OUR SURVEY WORK ARE CONTAINED IN THE TEXT OF THE REPORT. CALL IF YOU'D LIKE ME TO SEND APP. A & B, WHICH I CAN DO TOMORROW. BON VOYAGE

Mike

MEMORANDUM

To: Chip Demarest, Chief, Branch of Environmental Contaminants

Through: Karen Evans, Chief, Branch of Wetlands

From: Michael Molina, Fish and Wildlife Biologist, Branch of Wetlands

Subject: Initial Preliminary Assessment of Injury to Fish and Wildlife Resources by Chemicals Spilled from the Longline Vessel, Jin Shiang Fa, after Grounding at Rose Atoll National Wildlife Refuge, American Samoa.

CITATION: Molina, Michael. 1994. Trip Report: Rose Atoll National Wildlife Refuge, American Samoa; October 31 to November 8, 1993. Administrative Report, U.S. Fish and Wildlife Service, Honolulu, Hawaii.

INTRODUCTION

Rose Atoll lies approximately 241 kilometers (km) east-southeast (ESE) of Pago Pago Harbor, which is located on the island of Tutuila in the U.S. Territory of American Samoa. On July 5, 1973, Rose Atoll National Wildlife Refuge (NWR) was established to preserve the native land and marine fauna and flora of the atoll for scientific study, environmental education, and protection of aesthetic values. The refuge is administered jointly by the U.S. Fish and Wildlife Service (USFWS) and the Department of Marine and Wildlife Resources (DMWR) of the American Samoa Government. The atoll encompasses approximately 650 hectares (ha) within the boundary roughly defined by the extreme low-tide line on the seaward side of the barrier reef. Two low, sandy islets exist on the atoll's barrier reef: Rose Island, which is approximately 7 ha with a 1 km shoreline, and Sand Island, which is approximately 0.8 ha with a 0.5 km shoreline. The atoll barrier reef is roughly square in shape with a single channel (ava) opening to the sea. The reef encompasses a lagoon that is approximately 2 km wide and 14 meters (m) deep.

On October 14, 1993, a Taiwanese tuna longline fishing vessel named the Jin Shiang Fa ran aground on the seaward reef front on the southwestern (SW) side of Rose Atoll. At the time of grounding, the vessel was carrying approximately 100,000 gallons of diesel fuel, 500 gallons of lube oil, and 2,500 pounds of refrigeration system ammonia. As a result of

the grounding, these chemicals were released into the marine environment. As of October 30, 1993, the vessel was still aground on the reef and spilling petroleum products. On October 31, 1993, a multidisciplinary team was assembled in American Samoa for the purpose of making an initial preliminary assessment of injuries caused to living resources and habitats at the atoll by the spilled chemicals. This report summarizes the results of the marine surveys that were conducted as part of that assessment.

OBJECTIVES

The coordinated objectives of visiting Rose Atoll NWR were (a) to make an initial preliminary assessment of injuries caused to living resources and habitats at the atoll by the chemicals spilled from the vessel, Jin Shiang Fa, after its grounding; (b) to tag green sea turtles (*Chelonia mydas*) with satellite tracking transmitters; and (c) to place coordinate bench marks at various locations on the atoll and at the site of the vessel grounding. Objective (a) was accomplished by a team composed of USFWS, NMFS, and DMWR personnel with Flint designated as Principal Investigator. An employee of Beak Consultants, Inc. (BEAK), the environmental consulting company representing the grounded vessel's insurance company, also participated in the marine surveys. Objectives (b) and (c) were accomplished by NMFS (Balazs) and NOAA (Harbison), respectively, and their results are not included in this report. Given the considerable constraints of time, personnel, logistics, and safety, it was our intention that this initial assessment focus on the most readily documented injuries to the most valuable resources.

PERSONNEL

The overall initial preliminary assessment was coordinated by Chip Demarest (USFWS) and John Cubit of the National Oceanic and Atmospheric Administration (NOAA). The survey team members who participated in the assessment included the following individuals:

Elizabeth Flint, USFWS, Hawaii
Michael Molina, USFWS, Hawaii
John Naughton, National Marine Fisheries Service (NMFS), Hawaii
George Balazs, NMFS, Hawaii
Kevin Harbison, NOAA, Washington
Peter Craig, DMWR, American Samoa
Fale Tuilagi, DMWR, American Samoa
Gil Grant, DMWR, American Samoa
Pepper Trail, DMWR, American Samoa
John McConnaughey, DMWR, American Samoa
Jerry Russo, DMWR, American Samoa
Andrew Kindig, Beak Consultants, Inc., Washington

The individuals who participated in the marine resource surveys included Molina, Naughton, and Kindig with assistance from Flint, Tuilagi, McConnaughey, Craig, and Russo.

ITINERARY

10-31-93 Departed Honolulu via Hawaiian Airlines and arrived late in Pago Pago. Attended overall assessment briefing by USFWS and NOAA staff.

11-01-93 Attended background and logistics meetings with staff of the DMWR, the USCG, and the Captain of the survey vessel. Bought supplies, loaded the survey vessel, and departed Pago Pago Harbor around 5:30 pm.

11-02-93 Arrived Rose Atoll around 8:00 am. Conducted reconnaissance of the southwestern (SW) barrier reef flat immediately surrounding the wreck site. Planned specific marine resource surveys to be conducted during the assessment.

11-03-93 Conducted reconnaissance of marine resources on the SW lagoon terrace and lagoon pinnacles near the wreck site. Conducted quantitative surveys of burrowing sea urchins, entrapped oil, giant clam and other mollusc mortality, hard coral bleaching, and algal turf bloom on the SW barrier reef flat SE of the wreck site.

11-04-93 Conducted qualitative survey of general marine life on the SW barrier reef front and reef slope below the wreck. Measured dimensions of grounding scars on the reef front. Conducted quantitative surveys of giant clams on the SW lagoon terrace. Conducted surveys of entrapped oil, giant clam and other mollusc mortality, hard coral bleaching, and algal turf bloom on the SW barrier reef flat northwest (NW) of the wreck.

11-05-93 Conducted quantitative survey of coralline algal bleaching on the SW barrier reef flat surrounding the wreck. Measured dimensions of sandbar on the reef flat. Conducted qualitative surveys of general marine life on the NW barrier reef front and reef slope just west of the ava and around the NW corner of the atoll. Completed quantitative surveys of entrapped oil, giant clam and other mollusc mortality, hard coral bleaching, and algal turf bloom on the SW barrier reef flat NW of the wreck site.

11-06-93 Conducted qualitative survey of giant clam mortality on the NW lagoon pinnacles and lagoon terrace. Departed Rose Atoll at 1:00 pm.

11-07-93 Arrived Pago Pago Harbor around 3:00 am. Offloaded survey vessel and had a meeting at DMWR to coordinate survey data sharing among the USFWS, NMFS, DMWR, and BEAK. Departed Pago Pago via Hawaiian Airlines around 11:30 pm.

11-08-93 Arrived Honolulu at 5:45 am.

METHODS

The specific marine surveys that were conducted at Rose Atoll during the assessment were chosen based on information acquired during (a) the assessment briefing given by USFWS and NOAA staff on 10-31-93, (b) the background meeting held at the USCG office on 11-01-93, and (c) the results of our initial reconnaissance of the wreck site on 11-02-93. Based on this information, the following surveys were chosen:

a. Survey of coralline algae bleaching on the SW seaward reef margin and outer reef flat.

The extent of coralline algae bleaching on the SW seaward reef margin and outer reef flat was surveyed by visually assessing changes in the color of the reef along a transect oriented roughly parallel to the barrier reef margin. The transect extended away from the wreck in both directions. Measurements were made of the distances from the bow of the wreck to the points on the reef at which the coralline algae coloration appeared normal. Photos of the reef framed by a 0.5-m^2 quadrat, which was placed on the substrate, were taken at 100-m intervals along the transect. Observations and consensus agreement on the visual extent of bleaching were made by Molina, Naughton, and Kindig.

b. Survey of sea urchin mortality on the SW outer reef flat.

Sea urchin mortality on the SW outer reef flat was quantified by placing a 0.5-m^2 quadrat on the reef substrate at 10-m intervals along a transect oriented roughly parallel to and positioned approximately 10 m lagoonward of the barrier reef margin. At each 10-m station, a count was made of the number of occupied and unoccupied boring sea urchin holes occurring on the reef within the quadrat. The transects extended away from the wreck in both directions until 100% occupancy was recorded. Data were recorded by Molina, Naughton, and Kindig.

c. Survey of entrapped petroleum products, giant clam and other mollusc mortality, hard coral bleaching, and turf algal bloom on the SW reef flat.

Five transects, which extended roughly parallel to one another and to both the seaward and lagoonward reef margins, were used to quantify the extent of entrapped petroleum products, giant clam and other mollusc mortality, hard coral bleaching, and turf algal bloom on the SW reef flat in both directions away from the wreck. All five transects were done simultaneously. The numbers of dead giant clams and other molluses and the presence of entrapped petroleum products, bleached hard corals, and turf algal bloom were recorded for every 10-m section of each transect. The transects were terminated when it became apparent that none of the above conditions were being encountered on any of the transects. Data were collected by Molina, Naughton, Kindig, Flint, and McConnaughey.

d. Survey of giant clam mortality on the SW and NW lagoon terraces.

The extent of giant clam mortality on the SW lagoon terrace was quantified by five snorkelers who surveyed the terrace in both directions away from the wreck. The snorkelers spaced themselves across the width of the terrace and swam roughly parallel to one another and to the lagoonward reef margin. The survey was terminated when dead giant clams were no longer encountered. The numbers of live and dead clams observed by each snorkeler were tallied and percent mortalities were calculated. These five percentages were averaged to represent the whole area surveyed. Data were collected by Molina, Naughton, Kindig, Flint, and McConnaughey. The extent of giant clam mortality on the NW lagoon terrace was surveyed in a similar manner, but with only three snorkelers. Data on the NW terrace were collected by Molina, Naughton, and Kindig.

e. Survey of general marine life on selected SW and NW lagoon pinnacles.

The general condition of marine life on selected SW and NW lagoon pinnacles were assessed by snorkelers during random swims over and around the pinnacles. Particular attention was paid to the presence of dead or stressed giant clams and bleached hard corals. Observations were made by Molina, Naughton, and Kindig.

f. Survey of general marine life on the SW and NW seaward reef slopes.

The general condition of marine life on the SW and NW seaward reef slopes were assessed by scuba divers during random swims over the reef. Particular attention was paid to the presence of bleached hard corals. Observations were made by Molina, Naughton, Tuilagi, McConnaughey, and Craig.

RESULTS

USFWS/NOAA Briefing

This briefing covered the objectives and associated logistics of the initial preliminary assessment as outlined in a workplan that is attached to this report as Appendix A.

DMWR Briefing

During the briefing at the DMWR office, we went over the logistics of our trip to Rose Atoll with regard to transportation and sleeping arrangements, equipment and supply availability, and food costs. We were told that the Manuatele III, skippered by Captain Alama, was to be our home and working platform during the trip. Two smaller boats (a whaler and an inflatable) with outboard engines would be transported aboard the Manuatele III for use during daily field work. Also, approximately 20 scuba tanks would be available on the Manuatele III.

USCG Briefing

During the briefing at the USCG office, we viewed a video of the wreck that was made during overflights of the atoll after the grounding. The video showed an oil slick emanating from the vessel. The slick appeared to flow away from the atoll in NW and SE directions on different days, while consistently moving with waves and currents across the barrier reef flat and into the lagoon. This suggested that the spilled chemicals had spread along the seaward reef slope on the SW side of the atoll, across the SW barrier reef flat, and into the lagoon. A sandbar composed of light-colored sediments appeared to have formed on the reef flat adjacent to the ship. Also, an area of green-colored water extending down the middle of the reef flat and parallel with the reef margins was visible. Finally, at least two prominent light areas on the seaward reef front were visible behind the stern of the grounded vessel, which suggested that the ship had impacted patches of reef before coming to rest.

Reconnaissance

Prior to anchoring at Rose Atoll, the Manuatele III made a brief pass by the Jin Shiang Fa and we noted that the orientation of the grounded vessel was almost parallel with the SW seaward reef margin. The ship's hull was keeled over toward its port side and its bow was pointing north-northeasterly (NNE). The complement of line baskets, floats, and other fishing gear frequently stored on the stern deck of a longliner was not present. A large amount of tangled longline and other debris was hanging from the ship's port-side railings, and an oil slick was moving away from the wreck toward the NW. The smell of diesel was strong as we passed the wreck, heading toward the ava where the captain wanted to anchor the Manuatele III.

A ground reconnaissance of the SW barrier reef flat surrounding the wreck was made, with particular attention being paid to finding marine organisms that would be good indicators of the aerial extent of the chemical impacts associated with the grounding. On the way to the wreck site in one of the small boats, we entered the lagoon through the ava against a very strong and turbulent current. At the site, we immediately observed a large amount of debris (e.g., cotton and nylon longlines, stainless steel snaps and swivels, fishing aprons, shirts, pants, shoes, 12-volt battery, radio direction finder, pieces of broken plastic and wood from the wreck, pots and miscellaneous items from galley, towels, video and audio tapes, etc.) from the wreck that was strewn across reef flat. Most of this debris appeared to be spread away from the wreck toward the lagoon in a generally NNE direction. There was a strong smell of diesel in the air. Longlines, clothing, towels and other porous debris items were soaked with diesel. All debris items were oily to the touch.

A sandbar composed of calcareous sediments deposited by waves refracting around the wreck had formed between on the reef between the wreck and the lagoon. This was the same sandbar visible in the video we viewed at the USCG office prior to departing Pago Pago. Although the sandbar had a convoluted perimeter, it was measured to be

approximately 15 m wide and 60 m long with its lagoonward edge approximately 100 m away from the wreck. The sandbar, which appeared to be migrating toward the lagoon with some lateral spreading, had scoured the reef flat between itself and the wreck. Also, the sandbar sediments had filled in numerous cracks and fissures in the reef flat substrate. We dug into the sandbar and found that the subsurface sediments had gone anaerobic, exhibiting a characteristic black color and strong hydrogen-sulfide smell.

The outer reef flat and reef margin of the barrier reef at Rose Atoll are extensively encrusted with the coralline alga, *Lithothamnion*, which exhibits a rosy pink color when healthy. However, over a relatively wide portion of the SW outer reef flat and reef margin surrounding the wreck the coralline algae was observed to be very faded in color. Near the wreck site, totally and partially bleached corals (mostly *Favia*, some *Pocillopora*, and a few *Acropora*) were present. These corals appeared faded near the wreck, and they gradually regained their normal color with greater distance away from the ship.

Numerous boring sea urchins (*Echinometra mathaei*) had colonized the SW seaward outer reef flat and reef margin. Near the wreck, the urchin holes had been filled in by calcareous sands from the sandbar, but farther away from the wreck the holes were empty. Still farther away, sea urchins began appearing in some of the holes, and eventually nearly all of the holes examined contained urchins. Also, small clumps of a benthic, calcareous green alga (*Halimeda*) and small coral heads (*Pocillopora*) were sparsely scattered over the seaward portion of the outer reef flat. The *Halimeda* was absent from the scoured area immediately adjacent to the wreck and was present, but bleached or partially bleached (tips only) farther away from the wreck. The bleached *Halimeda* clumps lagoonward of the wreck had been colonized by a brownish/greenish turf algae.

A depressed, trough-like area near the middle of the reef flat was examined. A brownish/greenish colored algae (very low turf) was present over much of the substrate. This was the same area of green-colored water visible in the video we watched at the USCG office in Pago Pago. Recently bleached corals of the genera *Favia*, *Acropora*, and *Montastrea*, recently dead giant clams (*Tridacna maxima*) and numerous recently dead molluscs (i.e., *Cypraea moneta*, *Morula uva*, *Strombus* sp.) were seen within the depressions. Recently dead giant clams with decomposing tissue were observed. Scars on nearby rocks where the clams were previously attached were clearly visible. During the reconnaissance, four dead giant clams that were between 5.5 and 7.5 inches in valve length were observed.

An oily sheen was visible on the surface of water over the trough-like area near the middle of the reef flat. The sheen appeared to be caused by slowly releasing oil entrapped in holes, cracks, and other interstices in the rocks and sediments within the reef depressions. Turning over rocks and disturbing accumulated sediments, consistently caused oil to rise to the surface of the water. The amount of oil that was still present in the environment at the site was surprising. All of the debris we encountered during the reconnaissance was diesel-soaked, and the smell of diesel was strong in the air over the reef.

Numerous dead tests of the burrowing heart urchin (*Lovenia elongata*) were seen lying amidst oil-soaked wreck debris on the sand/rubble substrate of the SW lagoon terrace. The debris seen on the terrace was similar to that seen on the adjacent reef flat. Also, several recently dead giant clams with decomposing tissue were seen near rock outcrops. Scars from the formerly attached clams were often very obvious on the nearby outcrops. On some of the outcrops only dead giant clams were present, but on other outcrops both live and dead clams were present. This suggested that giant clam mortality was patchy. During most of the survey, the smell of diesel was very strong. Diesel fumes could be felt when breathing, and fuel could be tasted in the water.

After the reconnaissance, Molina, Naughton, and Kindig began planning more specific surveys to be conducted during the rest of the trip. We decided to focus the surveys on the SW barrier reef surrounding the wreck site, including the seaward reef slope, lagoon terrace, and lagoon pinnacles. Based on (a) the apparently greater injury to reef-flat marine resources NNE of the wreck, (b) the general NNE spread of the majority of wreck-associated debris on the reef flat, (c) an observation by McConnaughey of longline gear on the reef near Sand Island, which is located near the ava, and (d) the strong current exiting the lagoon through the ava, we concluded that the NW side of the atoll was down-current from the wreck site. Therefore, we decided to also survey for injuries to marine life on the seaward reef slope, lagoon terrace, and lagoon pinnacles on the NW side of the atoll.

Survey of Coralline Algae Bleaching on the SW Seaward Reef Margin and Outer Reef Flat.

The coralline algae (*Lithothamnion*) bleaching transect began 650 m SE of the wreck, extended to the wreck, and terminated 550 m NW of the wreck. At 650 m SE of the wreck, the coralline algae exhibited a normal rosy coloration. Between 650 m and 200 m SE of the wreck, schools of reef fishes (i.e., Scaridae and Carangidae) were seen traversing the reef flat. At 200 m SE of the wreck, the coralline algae started to appear yellowish-brown, and it continued to fade to a dirty cream color closer to and immediately surrounding the wreck. This faded condition persisted along the transect NW of the wreck, but normal coloration gradually returned with increasing distance from the wreck. The color of the coralline algae appeared normal at a distance of 450 m NW of the wreck.

Survey of Sea Urchin Mortality on the SW Outer Reef Flat.

The burrowing sea urchin (*Echinometra mathaei*) mortality transect extended 200 m SE and 200 m NW of the wreck. Immediately adjacent to the wreck, the middle 20 m of the transect crossed reef that had been scoured and filled in by the sandbar sediments. On both sides of this zone the transect traversed approximately 40 m of reef that had been scoured but not filled in. No sea urchins were seen within these combined sections of the transect. At 50 m either side of the wreck, sea urchins began appearing in some of the holes. One hundred percent sea urchin occupancy of the holes was first recorded at 160 m SE and 170 m NW of the wreck.

Survey of entrapped petroleum products, giant clam and other mollusc mortality, hard coral bleaching, and turf algal bloom on the SW reef flat.

The five parallel transects extended from 200 m SE to 500 m NW of the wreck. The presence of oil entrapped in the reef was recorded between 190 m SE and 440 m NW of the wreck. A consistent presence of oil was recorded within the trough area in the middle of the reef flat between 120 m SE and 440 m NW of the wreck. Recently dead giant clams were recorded between 40 and 310 m NW of the wreck. Approximately 60% of the giant clam mortality occurred between 160 and 220 m NW of the wreck, and 50% of the mortality occurred within the trough area. Other recently dead molluscs were seen between 190 m SE and 430 m NW of the wreck. Approximately 55% of the mollusc mortality occurred between 100 and 300 m NW, and 71% of the mortality occurred within the trough area. Recently bleached hard corals were recorded between 200 m SE and 460 m NW of the wreck. Approximately 71% of the coral bleaching occurred between 10 and 280 m NW of the wreck, and 68% of the bleaching occurred within the trough area. The presence of a brownish/greenish turf algal bloom was observed between 200 m SE and 500 m NW of the wreck, with the area of densest concentration judged to be between 190 m SE and 370 m NW.

Survey of giant clam mortality on the SW and NW lagoon terraces.

Giant clam mortality was surveyed on the SW lagoon terrace between approximately 20 m SE and 400 m NW of the wreck. The number of giant clams observed per surveyor within this area ranged from 16 to 80, and giant clam mortality observed per surveyor ranged from 54% to 94%. The average giant clam mortality on this part of the SW lagoon terrace was approximately 75%. The last dead clam found during the survey on this part of the SW lagoon terrace was approximately 400 m NW of the wreck.

The NW lagoon terrace was surveyed from the ava to the large pinnacles in the NW corner of the lagoon. The amount of debris (cardboard pieces, clothing) on the lagoon substrate increased noticeably as we approached the corner. The NW reef showed clear signs of having been severely impacted by past hurricane waves (e.g., very large coral blocks that were toppled over), but for the most part the reef appeared to be relatively healthy. I observed an estimated 550 live, giant clams during the swim between the ava and the NW corner of the lagoon. Six recently dead clams were seen on terrace outcrops not far from the ava. The attachment scars from these dead giant clams were visible on the outcrops and they appeared very similar those observed on the SW lagoon terrace. We circled around the large NW pinnacles and continued the survey back to the ava, but closer to the reef flat. On the way back to the ava, part of a green sea turtle skeleton was found near one of the larger pinnacles. Two live, green sea turtles (one male and one female) were seen between the ava and the NW corner of the lagoon.

immature

Survey of general marine life on selected SW and NW lagoon pinnacles.

In general, marine life on the double pinnacle ESE of wreck appeared relatively healthy. Visual signs of oil impacts to marine biota on the double pinnacle were not seen. Giant clam abundance on the double pinnacle was impressive (> 750 clams), but reef fish abundance was surprisingly low. No sharks were seen. One young green sea turtle was observed near the base of the double pinnacle. No recently dead giant clams or debris from the wreck were seen on the double pinnacle or on the surrounding lagoon floor. The absence of large-sized reef fishes at the double pinnacle was striking.

No visual signs of oil impacts to marine biota were seen on the single pinnacle NE of wreck. However, wreck-associated debris (e.g., mattress, clothing, cardboard) on the lagoon floor surrounding the single pinnacle was observed. A large pile of old giant clam shells from past harvesting was present at the base of the single pinnacle. Fish biomass surrounding the single pinnacle was lower than expected. A large amount of wreck-associated debris (i.e., cardboard pieces, wood shards, clothing, mattresses, fishing gear, bags, plastic, etc.) was spread across the lagoon floor between the single pinnacle and the lagoon terrace.

On one of the large pinnacles in the NW corner of the lagoon, five recently dead giant clams were observed. In general, the marine life on the NW lagoon pinnacles appeared stressed. The water in this corner of the lagoon was very turbid. The biomass of reef fishes surrounding the larger pinnacles was greater than the biomass seen near other lagoon pinnacles closer to the wreck site. Nevertheless, the overall reef-fish biomass still appeared unexpectedly low in view of the protected status of the atoll. One large barracuda (*Sphyraena barracuda*), several moderately-sized bluefin trevallevs (*Caranx melampygus*) and snappers (i.e., *Lutjanus gibbus, L. monostigmus, L. bohar, Monotaxis grandoculis*), and schools of small snappers (i.e., *Guathodentex aureolineatus*) and goatfishes (i.e., *Mulloides vanicolensis*) were seen. Surgeonfishes (Acanthuridae) and butterflyfishes (Chaetodontidae) were among the most common fishes seen.

Survey of general marine life on the SW and NW seaward reef slopes.

Molina, Naughton, Tuilagi, and McConnaughey made a scuba dive on the SW seaward reef slope at the wreck site, with Kindig and Russo assisting in the dive boat. We entered the water behind the stern of the wreck to measure the reef scars created by the grounding. The water was choppy and the drop point for the dive relative to the position of the first scar (the one farthest behind the grounded vessel) was an educated guess. On the way down, a large, male green sea turtle was observed cruising in midwater over the reef dropoff.

Our observations indicated that the vessel hit the reef while traveling parallel to it and then skipped across two spurs (depth 3-4 m) before coming to rest on a third spur. Molina and Tuilagi measured the two scars farthest behind the vessel to each be approximately 40 m

long and 15-20 m wide. There was a natural reef groove that was approximately 12 m wide between these two scarred spurs. The scar ending at the stern of the wreck appeared deeper and more rounded than the first two scars, and it also contained a narrow depression that was created by the vessel's keel. The tops of the scarred spurs were relatively flat and smooth, apparently as a result of the vessel shearing off and pulverizing the upper layer of reef, including its veneer of living biota. The scarred substrate was beginning to be colonized by algal turf. Numerous juvenile surgeonfishes (especially *Acanthurus olivaceus*) were seen grazing on the turf.

The wreck was rocking with the swells and making eerie, creaking sounds as we cautiously made a visual inspection of the reef surrounding its hull. A tremendous amount of debris was piled on the reef below the vessel and was hanging into the water off the vessel's stern and port railings. The hanging debris was mostly tangled longlines with other items caught within the tangles. Debris on the reef included many coils of longline (cotton and monofilament), stainless steel tubs and sieves, fishing tools, miscellaneous galley items, clothing, boots, aprons, video tapes, zinc anodes, metal, fiberglass, wood, and other items. No fishing hooks were seen, which was surprising. Two main areas of coral rubble (pulverized reef) extended down the reef slope below the vessel hull to a depth of approximately 10 m. These rubble piles had buried benthic marine organisms and a large amount of vessel debris, as evidenced by the numerous pieces of fishing line and other items observed sticking out of the rubble.

Coral and algal cover on the reef near the vessel appeared lower and higher than expected, respectively. Much of the reef substrate had been colonized by turf and fleshy algae. Overall fish abundance was lower and individual fishes were smaller than what was expected. Large carnivorous fish were relatively scarce. A few species of herbivorous fish were relatively well-represented. Time did not allow the compilation of a species list, but the dominant fishes included fairy basslets (*Pseudanthias pascalus*), surgeonfishes (*Acanthurus olivaceus, Naso lituratus*), and damselfishes (*Chromis acares*). No sharks were seen, which also was surprising.

Molina, Naughton, Tuilagi, and Craig made a scuba dive on the seaward reef slope near the NW corner of the atoll. Russo dropped us into the water east of the NW corner and we drifted around the corner toward the wreck site. When we ended the dive we were nearly half way to the wreck from the NW corner. Our main objective for this dive was to investigate the biomass of reef fish inhabiting the upper reef slope away from the wreck in an attempt to gain some perspective on our earlier observations of surprisingly low numbers and individual sizes of many reef fishes seen in the lagoon and on the reef slope below and immediately surrounding the wreck.

A plastic fisherman's apron, similar to ones seen on the SW barrier reef flat and lagoon terrace, was seen very early during the dive. The apron was caught on a coral head on the reef slope in about 7.5 m of water. Overall, fish biomass on this part of the reef slope appeared greater than the biomass observed near the wreck, although many fishes were still

relatively small and not abundant, especially among common food-fish species. Surgeonfishes (e.g., *Acanthurus achilles, Naso literatus*) were among the most abundant and ubiquitous fishes seen, and many small groupers (e.g., *Cephalopholis argus, C. urodeta, Gracila albomarginata, Anyperodon leucogrammicus*) were present. A few moderately-sized midwater snappers (e.g., *Aprion virescens, Lutjanus bohar*), a large wrasse (*Coris aygula*), and two large milkfish (*Chanos chanos*) were seen. A small group of jacks (*Carangoides orthogrammus*) and three large, male green sea turtles were observed. No sharks were seen during this dive.

Molina, Naughton, Craig, and Tuilagi made a scuba dive on the NW seaward reef slope immediately west of the ava. Numerous fishes were observed in and near the ava, especially a large school of the twinspot snapper (*Lutjanus bohar*) and a large school of the big-eye trevally (*Caranx sexfasciatus*). Immediately west of the ava, the reef face appeared to be favorably oriented away from the damaging effects of frequent storm wave assault. Coral growth on this part of the reef slope appeared relatively healthy, especially within the protection afforded by a series of natural reef grooves. A large colony of plate coral (*Turbinaria reniformis*) was seen in one large groove that extended to a depth of approximately 27 m. Overall, it appeared that the reef slope in this area had been spared the widespread hurricane damage that was still visible at other areas of the atoll. Hurricane damage on the reef slope became evident, however, after the reef curved west of this relatively protected section and assumed a more exposed orientation. Reef-fish abundance was noticeably greater near the ava and within the relatively protected section of reef. We observed a large school of blackspot barracuda (*Sphyraena forsteri*) spiraling up to the surface from a depth of about 40 ft and a large school of big-eye trevalley (*Caranx sexfasciatus*) circling by in midwater. One male, green sea turtle was seen resting on the bottom at a depth of approximately 17 m.

SUMMARY

The results of the initial preliminary assessment of chemical injuries caused to marine biota and habitats at Rose Atoll NWR as a result of the grounding of the Taiwanese tuna longline vessel, Jin Shiang Fa, include the following:

1. Bleaching of coralline algae (*Lithothamnion*) over a distance of 650 m on the seaward reef margin and outer reef flat along the SW side of the atoll;

2. Sea urchin (*Echinometra mathaei*) mortality over a distance of 330 m on the seaward outer reef flat along the SW side of the atoll;

3. Giant clam (*Tridacna maxima*) mortality over a distance of 270 m on the reef flat along the SW side of the atoll;

4. Other mollusc (miscellaneous gastropods) mortality over a distance of 620 m on the reef flat along the SW side of the atoll;

5. Hard coral (primarily *Favia*) bleaching over a distance of 660 m on the reef flat along the SW side of the atoll;

6. Turf algal bloom over a distance of 700 m on the reef flat along the SW side of the atoll;

7. Approximately 75% mortality of giant clams over 420 m on the lagoon terrace along the SW side of the atoll;

8. Less than 5% giant clam mortality on the NW lagoon terrace and the pinnacles at the NW corner of the lagoon;

Also, the amount of oil trapped in holes, cracks, and other interstices in rocks and sediments over a distance of 570 m on the reef flat along the SW side of the atoll was surprising. It appeared that oil had been driven into the reef by wave action. It was evident that oil had been soaked up by porous wreck debris and taken to the reef bottom over a widespread area as the debris sank and was distributed by lagoon currents. The effects of a slow, persistent release of entrapped oil may cause further injuries to marine biota and habitats over time. The observed absence of sharks and the low abundance of reef fishes near the wreck site may have been related to the presence of chemicals in the water. Fishing pressure does not appear to be the primary cause of the observed low reef fish abundance because of the Rose Atoll's protected status, relative isolation, and restricted accessibility through its single, narrow, and shallow ava.

Finally, during the time spent at Rose Atoll, the raw survey data collected by individual team members were tabularized (by Molina) and graphed (by Kindig). After returning to Pago Pago, copies of the tables and figures were made for USFWS, NMFS, DMWR, and BEAK personnel. Copies of these raw data tables and figures are attached to this report as Appendix B. A copy of Molina's field notes from the trip is attached as Appendix C.

APPENDIX A

(Survey workplan)

APPENDIX B

(raw data tables/figures)

APPENDIX C

ROSE ATOLL CHEMICAL DAMAGE ASSESSMENT - FIELD NOTES

Michael Molina, U.S. Fish and Wildlife Service, Pacific Islands Office, Honolulu

10-31-93

Traveled from Hawaii to American Samoa with Beth Flint (USFWS), John Naughton and George Balazs (NMFS), Andy Kindig (Beak)

Arrived Pago Pago during heavy rain squall at approximately 9:30 pm (AS time). After picking up baggage, we met with Chip Demarest (USFWS) and John Cubit (NOAA) and Kevin Harbison (NOAA) and Fale Tuilagi (DMWR) for briefing on logistics and objectives of the Rose Atoll damage assessment survey work. Flint was made Principal Investigator in charge of the surveys. The coordinated objectives of our visit to Rose Atoll National Wildlife Refuge (NWR) included (a) assess the damage caused to atoll resources and habitats by the chemicals spilled from the tuna longline vessel Jin Shiang Fa after its grounding; (b) tag green sea turtles with satellite tracking transmitters; and (c) place coordinate bench marks at various locations on the atoll and at the site of the vessel grounding. Objective (a) was to be accomplished by a multidisciplinary team composed of USFWS, NMFS, DMWR and Beak personnel with Flint designated as Principal Investigator. Objectives (b) and (c) were to be accomplished by Balazs and Harbison, respectively.

Spent the night at the Rainmaker Hotel in Pago Pago. Slept well.

11-01-93

Myself, Flint, Naughton, Harbison and Kindig had morning meetings with Craig, Trail, Grant, McConnaughey, and Tuilagi at the DMWR office. During the meeting, we went over the logistics of our trip to Rose Atoll with regard to transportation and sleeping arrangements, equipment and supplies, and food costs. We were told that the Manuatele III, skippered by Captain Alama, was to be our home and working platform during the trip. Two smaller boats (a whaler and an inflatable) with outboard engines would be transported aboard the Manuatele III for use during daily field work. Also, approximately 20 scuba tanks would be available on the Manuatele III.

We also met with Lt. Cdr. Rick Kaser of the USCG at his office. We watched a video made during overflights of the vessel and atoll after grounding. We were told that the vessel was carrying approximately 100,000 gal. of diesel, 500 gal. of lube oil, and 2500 lbs. of ammonia. No other types of toxic substances were identified as being on board. The vessel had departed Pago Pago after refueling just prior to the grounding. No repairs were made to the vessel while it was in port.

The video showed an oil slick extending away from the ship in both south and northwest directions, the predominant direction appearing to reverse on different days. The slick could be seen over portions of the barrier reef flat and in the lagoon. A sandbar/berm had begun to form on the reef flat adjacent to the ship, and area of green-colored water that extended parallel to the ship over the middle of the reef flat was visible.

Rick explained that the vessel that the Manuatele III was a 110-ft mud boat built in Seattle. I asked Rick if the vessel was in good working order, especially with regard to engines, radios, and safety equipment. We were told that the USCG had inspected the Manuatele III and had found some problems, but that the problems had been corrected and the vessel was currently in safe and seaworthy condition. After this meeting, we went to the Manuatele III to meet with the captain and crew to make sure they understood that no harvesting of marine life was allowed in the Rose Atoll NWR. Most of the crew had not returned to the ship from their lunch break, but we spoke to Capt. Alama and explained the harvesting restriction. After the brief meeting, we had lunch at the Rainmaker and then prepared to load the ship.

We loaded the ship and departed Pago Pago harbor around 5:30 pm. We were well stocked on board, including scuba tanks and two small dive boats (whaler and inflatable), which were loaded onto the afterdeck for transport to Rose Atoll. Passengers included myself, Flint, Naughton, Balazs, Harbison, Kindig, Craig, Tuilagi, Trail, Grant, McConnaughey, and Jerry Russo (SPC masterfisherman). Before dark, we saw numerous seabirds out around the bank area south of Tutuila and Aunuu islands. Crashed on floor in wheelhouse until space available in lounge below. Weather was not the best - winds 25-30 kts ESE, swells 10-12 ft, water rough. Bumpy ride for all, some got seasick. Engine problem during the night.

11-02-93

Rough weather continued into today. Rose Island in sight around 7:45 am. Engine problem corrected overnight, but now SSB radio not working (receiving only) to contact USCG at planned time of 8:00 am. At approximately 9:00 am, a C-130 overflew us and we were able to make contact with the plane via VHF radio. We explained our radio problem and asked that the plane relay info to USCG back at Pago Pago. It was a relief to see the C-130 overhead, but it was a little discouraging to see it "buzz" Rose Island and the subsequent aerial chaos that seemed to ensue among the seabirds on the island.

After the call, the team met to go over survey objectives and roles everyone was expected to play in achieving them. Approached wrecked longliner around 9:30 am, noting it was grounded in an orientation parallel with the seaward reef margin, bow pointing NW, and keeled over toward port. As we approached, it became easier to see oil slick moving NW away from it, large amount of tangled longline and other debris hanging from the ship. It appeared as if the majority of the longlines/floats normally stored on the stern deck were no longer on board. The smell of diesel was strong.

At around 10:00 am tried to anchor just outside of the atoll's only channel (ava) where there was a strong current exiting the lagoon. The crew dropped the anchor and a pin popped out of an anchor chain shackle and the anchor was lost. Captain Alama decided to drift while the small boats were put over the side, tied off, and loaded for a shore run. The shore party loaded the whaler and went in at around 11:00 am. The inflatable followed soon after. Later, some of the crew attempted to locate the lost anchor, but were not successful. Tuilagi found a different older anchor firmly buried in sediments that he used for tieing off the Manuatele III. Anchor depth was about 85 ft.

At approximately 2:15 pm Naughton, Kindig, Craig, Tuilagi (boatman), and I took the inflatable through the ava and across the lagoon to near the wreck site. The inflatable was very slow with the five of us and our gear. We tied the boat to rock outcrop on lagoon terrace and walked onto barrier reef flat to do visual recon of the wreck and shallow portion of reef around it. We immediately noted a large amount of debris from wreck strewn across reef flat (cotton and nylon longlines, stainless snaps and swivels, clothing (fishing aprons, pants, shirts, shoes etc.), battery, RDF, plastic and wood pieces of ship, pots and miscellaneous items from galley, towels, video and audio tapes, etc. Strong smell of diesel in the air. Longlines, clothing, towels etc. were soaked with diesel. All debris was oily to the touch.

There were depressed areas in the middle of the barrier reef flat where we found recently bleached corals (*Favia, Acropora, Montastrea*), recently dead giant clams (*Tridacna maxima*) and numerous recently dead molluses (*Cypraea moneta, Morula uva, Strombus* sp.). An oily sheen, which we saw on the surface of the water over this depressed area, appeared to be coming from oil trapped in holes, cracks, and other interstices in the rocks and rubble within the depressions.

A sand/rubble berm between the wreck and the lagoon had formed from sediments deposited by waves/currents refracting around the vessel. This was same sandbar/berm visible in video tape we viewed at USCG office prior to departing Pago Pago. The berm was approximately 15 m x 60 m and its lagoonward edge was about 100 m away from the wreck. Subsurface sediments in the berm had gone anaerobic (H_2S smell and black appearance).

Reef flat substrate between the berm and the wreck appeared recently scoured. The coralline algae (*Lithothamnion*) on the outer reef flat surrounding the wreck was very faded in color (appeared bleached). Numerous holes created by burrowing sea urchins (*Echinometra mathaei*) were seen all along the seaward portion of the outer reef flat. The holes nearest the wreck appeared either empty or filled in with calcareous sediments. Small clumps of a benthic, calcareous green alga (*Halimeda*) and small coral heads (*Pocillopora*) were sparsely scattered over the seaward portion of the outer reef flat. The *Halimeda* clumps lagoonward of the wreck appeared bleached and had been colonized by brownish/greenish turf algae.

Near the wreck site, we noted bleached (total and partial) corals (mostly *Favia*, some *Pocillopora*, and few *Acropora*). These corals appeared faded near the wreck, and they gradually regained their normal color with greater distance away from the ship. The reef is extensively encrusted with coralline algae (*Porolithon*), which normally exhibits a rosey pink color. However, the outer reef flat, and especially the seaward reef margin, immediately surrounding the wreck appeared very faded (dirty cream color).

We walked along the outer reef flat southeast of and away from the wreck and noted that the seaward reef margin had been colonized by numerous boring sea urchins. Near the wreck the urchin holes had been filled in by calcareous sands, but farther away from the wreck the holes were empty. Still farther away, we began to see urchins (*Echinometra*) in some of the holes, and eventually all the holes appeared to contain urchins. We noted also that the macroalga (*Halimeda*) was absent from the scoured area and present but bleached or partially bleached (tips) farther away from the wreck. We walked at least 100 m to the SE and then returned to the wreck site and continued walking down the outer reef flat near the seaward reef margin away from the wreck to the NW.

We timed this visit to the wreck site with the low tide period. By the time we started walking NW from the wreck, the tide was starting to flood. We noted a brownish/greenish colored algae (looked like slime or very low turf) over much of the substrate in this direction. We walked at least 350 m before we noted that the color of the substrate began to return a more natural reef color. We could see a sheen on the surface of water that had collected within a depressed trough area near the middle of the reef flat, and we walked in to check it on the way back to the boat. As we got close, we noticed recently dead giant clams (*Tridacna maxima*) that still had rotting meat in them. We could see the nearby scars on the rocks where the clams were previously attached. We noted 4 dead clams that were between approximately 5.5 and 7.5 inches in valve length.

We turned over rocks and dragged our feet through sediment piles and consistently saw oil sheens rise to the surface of the water. We were surprised that so much oil was still present in the environment at the site. All debris we encountered was diesel-soaked and the smell of diesel was strong in the air over the reef. We walked back to the boat and returned to the Manuatele III at approximately 5:00 pm.

When we approached the Manuatele III, I noticed several crewmen and Capt. Alama handline fishing from the ship. They were catching primarily jacks (*Caranx lugubris, Carangoides orthogrammus*), snappers (*Aphareus furca, Lutjanus gibbus*), and groupers (*Cephalopholis urodeta*). The small boats were tied up to the Manuatele III for the night. Naughton, Kindig, and I discussed the day's field work and began planning specific marine surveys we wanted to conduct during our allotted time at the atoll.

11-03-93

Woke up to a windy, grey, rainy morning. After breakfast, met with Naughton, Kindig,

and McConnaughey to plan survey work for the day. We decided to examine lagoon pinnacles downcurrent from the wreck site due to the observation by McConnaughey of longline gear on reef adjacent to Sand Island on the opposite side of the lagoon near the ava. At approximately 10:30 pm, Tuilagi joined us and we headed out in the boat to snorkel the double pinnacle ESE of wreck. Water was very rough due to an ESE wind fetch across lagoon. The double pinnacle appeared normal; no recently dead *Tridacna* or debris from wreck were seen within its vicinity. The absence of large-sized reef fishes at the pinnacle was striking.

We then moved to the single pinnacle NE of wreck and again found no visual signs of oil impacts to marine biota. However, we did observe debris (cardboard, clothing) strewn across the lagoon floor not very far from the pinnacle. A large pile of old *Tridacna* shells, apparently from past harvesting sessions, was seen at the base of the pinnacle. Fish biomass surrounding this pinnacle also was lower than expected.

From the single pinnacle we swam toward the barrier reef in the direction of the wreck and passed over an increasing amount of debris (cardboard pieces, wood shards, clothing, mattresses, fishing gear, bags, plastic). As we moved over the sand/rubble lagoon terrace, numerous dead tests of burrowing sea urchins (Family: Loveniidae) were seen amidst the debris, which was all oil soaked. Several recently dead giant clams with decomposing meat were found near rock outcrops on the terrace. Scars from the formerly attached clams were often very obvoius on nearby rocks.

We decided to space ourselves across the width of the terrace and sweep NW until all *Tridacna* mortality appeared to stop. We saw only dead clams on some of the outcrops, but on others we saw both live and dead clams, suggesting that clam mortality was patchy. Naughton and Kindig estimated that the clam mortality on the lagoon terrace outcrops appeared to cease approximately 500 m NW of the wreck. During most of the swim, the smell of diesel was very strong and I could feel the fumes when I breathed and could taste the fuel in the water.

At noon we took boat to Rose Island to check on Balazs turtle-tagging team and get a tour of the island by Flint. We returned to the Manuatele III for lunch at around 1:00 pm. After lunch, we decided to take more people back to the wreck site to survey the reef flat at low tide. Naughton, Kindig, Tuilagi, McConnaughey, Flint, and myself took off for the site at approximately 2:15 pm. Our first task was to use a 19-inch quadrat to measure the percent occupancy of burrowing sea urchin (*Echinometra*) holes along a transect on the outer reef flat that extended 200 m SE and 200 m NW of the wreck.

Next, we spaced ourselves across the width of the reef flat (approximately 200 m total distance) and surveyed for the visual presence of oil, benthic green algal turf, freshly-dead molluscs, live and dead *Tridacna*, and bleached corals along five parallel transects. The transects were oriented roughly parallel with and between the seaward and lagoonward reef margins. Data were recorded for each 10-m section of the transects. The surveys

continued until it became apparent that oil, green algae, and dead Tridacna were no longer encountered on any of the transects. We completed the SE transect, which extended 200 m from the wreck. We returned to the Manuatele III at approximately 4:30 pm.

Crew night fishing for jacks (*Caranx lugubris*), snappers (*Lutjanus bohar, L. kasmira, L. gibbus, Aphareus furca*), groupers (*Cephalopholis urodeta*), and squirrelfishes (*Sargocentron spiniferum, Myripristis berndti*). Based on the relatively small size of individual fishes, it appears that the reef-fish stocks at Rose Atoll are being exploited. However, because (a) the atoll is so isolated, (b) the small, shallow ava allows only small boats into lagoon, and (c) the atoll is under protected status, this situation does not seem likely. During the night the Manuatele III almost hit the reef after the current shifted. To avoid the reef, the captain goosed the vessel forward quickly and some of the crew's fishing line got caught around the propeller shaft.

11-04-94

Before we got going with the day's survey work, some crew members dove to remove the fishing line from the prop shaft. They also tied our temporary anchor line to some floats so we could temporarily move the Manuatele III to the wreck site and be able to tie back up near the ava later.

At approximately 9:00 am, Naughton, Tuilagi, McConnaughey, and I made a survey dive on the longliner, with Kindig and Russo in the dive boat. We entered the water behind the longliner's stern to measure the reef scars created by the grounding. The water was choppy and our drop point for the dive relative to the position of the first scar (the one farthest behind the grounded vessel) was an educated guess. On the way down, I observed a large, male green sea turtle cruising in midwater over the reef dropoff.

Our observations indicated that the vessel hit the reef while traveling parallel to it and skipped across two spurs (depth 3-4 m) before coming to rest on a third. Molina and Tuilagi measured the two scars farthest behind the vessel to each be approximately 40 m long and 15-20 m wide. There was a groove between these two scarred spurs that was approximately 12 m wide. The scar ending at the vessel stern appeared deeper and more rounded than the first two, and it also contained a groove that was created by the vessel's keel. The reef substrates on the scarred spurs were relatively flat and smooth, apparently from the vessel shearing off and pulverizing the upper layer of reef, including its veneer of living biota. The scarred substrate was beginning to be colonized by algal turf. Numerous juvenile surgeonfishes (esp. *Acanthurus olivaceus*) were seen grazing on the turf. In general, the fish community exhibited small individual sizes and low species abundances of particularly among carnivores.

We made a visual inspection of the reef surrounding the hull of the longliner, which was rocking with the swells and making eerie creaking sounds. We noted a tremendous amount of debris on the reef bottom and hanging into the water off the vessel's stern and aft

section of the port gunnel. The hanging debris was mostly longline gear (no hooks). Debris on the reef included many coils of longline (cotton and mono), stainless steel tubs and sieves, fishing tools, misc. galley items, clothing, boots, aprons, video tapes, anodes, a whole lot of metal, fiberglass and wood wreckage, and other items. The absence of fishing hooks (not one was seen) was striking and very surprising. Two main areas of coral rubble (pulverized reef) extended down the reef slope below the vessel hull to a depth of approximately 35 ft. Apparently a large amount of vessel debris was buried in these sediments as evidenced by the numerous pieces of fishing line and other items we observed sticking out of the rubble.

Coral and algal cover on the reef near the vessel appeared lower and higher than expected, respectively. Fish abundance appeared low, and individual fishes were smaller than expected. Did not have time to do a species list, but dominant fishes included fairy basslets (*Pseudanthias pascalus*), surgeonfishes (*Acanthurus olivaceus, Naso lituratus*), and damselfishes (*Chromis acares*). No sharks were seen , which also was surprising and unexpected. Max. Depth = 50 ft.; Bottom Time = 41 min. Reboarded Manuatele III and returned to our tie-up site near the ava for lunch.

At approximately 1:00 pm, Naughton, Kindig, Flint, Tuilagi, McConnaughey, and I took the inflatable back into the lagoon to the double pinnacle ESE of the wreck to get another quick look an apparentrly "undisturbed" site. The *Tridacna maxima* abundance on the double pinnacle was impressive (counted over 750 clams), but fish abundance was surprisingly low, and no sharks were seen. One young green sea turtle was observed near the base of the pinnacles.

We moved the boat over to the barrier reef near the wreck site to make a count of the dead *Tridacna* we found on the lagoon terrace yesterday morning. All but Tuilagi, who was with the boat, participated in the count. We started the count at a point immediately lagoonward from the bow of the wreck. First we snorkeled to the SE and found only live clams. We agreed to try the other direction to the NW, which was downwind. The following data were collected:

Person	Live Tridacna	Dead Tridacna
Molina	6	20
Flint	1	15
Kindig	13	32
McConnaughey	29	34
Naughton	19*	61

* = calculated based on a subset of 23 dead and 7 live clams

Based on these data, we calculated that the *Tridacna* mortality on this part of the lagoon terrace was approximately 75%. We estimated that the last dead clam found in this direction (NW) was approximately 400 m away from the wreck. Also noted were many

bleached coral colonies (predominantly *Favia*).

By the time we had finished the *Tridacna* survey on the lagoon terrace, the tide had ebbed low enough for us to survey for the presence of oil, benthic green algal turf, freshly-dead molluscs, live and dead *Tridacna*, and bleached corals on the reef flat NW of the wreck. We began this set of five parallel transects but had to postpone its completion because of the flooding tide and dimming daylight (approximately 5:30 pm). We marked our stopping point with flagging tape and returned to the Manuatele III for the night.

11-05-93

After a quick breakfast, Naughton, Kindig, and I headed out to try to catch the low tide on the barrier reef near the SW corner of the atoll. At approximately 8:30 am, we started recording observations on the extent of *Lithothamnion* bleaching on the seaward reef margin SE of the wreck site. We made observations along a transect that began 650 m SE of the wreck and extended to the wreck. Kindig took photos of the reef within a 19-inch quadrat at each 100-m interval. Schools of reef fishes (parrotfishes and jacks) were seen traversing the reef flat between 650 m and 200 m away from the wreck within a zone where the *Lithothamnion* exhibited relatively normal brick-red coloration. At approximately 200 m SE of the wreck, the *Lithothamnion* coloration started to appear yellowish-brown, and it continued to fade to a dirty cream color closer to the wreck. By the time we got to the wreck, the tide was flooding too fast to continue this transect NW of the wreck. We decided to complete the transect during low tide on the following day.

Before returning to Rose Island to pick up Craig and some gear to transport back to the Manuatele III, we decided to measure the longest dimension of the sand berm that was accreting on the reef flat adjacent to the wreck. This distance was approximately 50 m between the seaward and lagoonward edges of the berm. The berm, which appeared to be migrating toward the lagoon with some lateral spreading, had scoured reef flat between itself and the wreck. Also, the berm sediments had filled in numerous cracks and fissures in the reef flat substrate. We departed the wreck site for Rose Island at approximately 9:30 am and eventually returned to the Manuatele III for lunch.

After lunch, Naughton, Tuiagi, Craig, and I made a scuba dive on the upper reef slope near the NW corner of the atoll. Russo dropped the four of us into the water east of the NW corner for a drift dive that took us around the corner toward the wreck site. Our main objective for this dive was to investigate the biomass of reef fish inhabiting the upper reef slope in order to help gain some perspective on our earlier observations of surprisingly low numbers and individual sizes of many reef fishes seen in the lagoon and on the reef slope below and immediately surrounding the wreck.

Almost immediately after going in, I noticed a fisherman's plastic apron caught on a coral head on the reef slope in about 25 ft of water. Overall, fish biomass on this part of the reef slope appeared greater, although many fishes were relatively small and not abundant.

especially among common species of food fish. Surgeonfishes (*Acanthurus achilles, Naso literatus*) were among the most abundant and ubiquitous fishes seen, and many small groupers (*Cephalopholis argus, C. urodeta, Gracila albomarginata, Anyperodon leucogrammicus*) were present. A few relatively large midwater snappers (*Aprion virescens, Lutjanus bohar*), a large wrasse (*Coris aygula*), and two large milkfish (*Chanos chanos*) were seen. A small group of jacks (*Carangoides orthogrammus*) and three large male green sea turtles (*Chelonia mydas*) were noted. No sharks seen during this dive. When we ended the dive we were nearly half way to the wreck from the NW corner. We returned to the Manuatele III and decided to make a brief scuba dive while waiting for the afternoon low tide. We planned to return to the wreck site at that time to complete the Porolithon survey on the reef flat NW of the wreck. Max Depth = 95 ft; Bot. Time = 45 min.

Naughton, Craig, Tuilagi and I made a second scuba dive on the reef slope immediately west of the ava and the ripping current exiting the lagoon. Immediately west of the ava, the reef face appeared to be favorably oriented away from the damaging effects of frequent storm wave assault. Coral growth on the upper reef slope there appeared relatively healthy, especially within the protection afforded by a series of vertical grooves. A large colony of plate coral (*Turbinaria reniformis*) was found in a large groove extending down to approximately 90 ft. Overall, the reef slope in this area appeared to have been spared the widespread hurricane damage that is still visible at other areas of the atoll. Hurricane damage became evident, however, after the reef curved west of this relatively protected section and assumed a more exposed orientation. Reef fish abundance was noticeably greater near the ava and within the relatively protected section of reef. We observed a large school of barracuda (*Sphyraena forsteri*) spiraling up to the surface from a depth of about 40 ft and a large school of jacks (*Caranx sexfasciatus*) circling by in midwater. One male green sea turtle was found resting on the bottom at a depth of around 55 ft. Tuilagi found the anchor lost from the Manuatele III in approximately 85 ft of water almost directly below the vessel. Russo picked us up and we returned to the Manuatele III. Max. Depth = 90 ft; Bot. Time = 30 min.

At approximately 3:15 pm, we headed in to Rose Island to drop off Craig and pick up Harbison and a crewman, Flint, and McConnaughey on our way back to the reef flat at the wreck site. Along the way, we dropped off Harbison and the crewman on the barrier reef near the SW tip of the atoll so they could set up a coordinates bench mark station there. When they finished, they walked down the reef flat to the wreck site to set up another station on the bow of the wreck and rejoin the rest of us to return to the Manuatele III. Naughton, Kindig, and I began the *Lithothamnion* survey NW of the wreck at approximately 4:00 pm. Normal coloration appeared to return to the *Lithothamnion* at a distance of 450 m from the wreck. The transect was terminated 550 m NW of the wreck. After this survey was completed, we joined Flint, McConnaughey, and Tuilagi to continue the five parallel reef flat transects that extended NW of the wreck. These transects were terminated 500 m NW of the wreck at about 5:15 pm after it became apparent that oil, green algae, and dead Tridacna were no longer being encountered on any of the transects.

We all regrouped at the wreck site and headed back to the Manuatele III for the night. During the night a squall hit and the Manuatele III's anchor line separated from the old buried anchor. The Captain sounded the alarm and had the crew hoist the two small dive boats back onto the afterdeck. Wild. Since we had no other anchor, we laid off all night.

11-06-93

The hot topics of discussion this morning were the night's squall and aftermath and the fact that we did not have enough gas (1.5 gal left) to use both small boats as planned (i.e., one for us to accomplish the last day's fieldwork and one for the land team to use to break camp on Rose Island). We decided to only use the inflatable with the smaller engine for breaking camp and not use a small boat for fieldwork. Naughton, Kindig, and I wanted to survey the northern lagoon terrace and reef flat since it appeared to be down current from the wreck and could have been impacted by the fuel spill. We asked Captain Alama to move the Manuatele III in as close to the ava as possible, keeping clear of the strong current exiting the lagoon, so we could jump in and swim for the reef.

Naughton, Kindig, and I jumped in at approximately 8:00 am and snorkeled into the lagoon. We surveyed the lagoon terrace from the ava to the large pinnacles in the NW corner of the atoll. The reef showed clear signs of having been severely impacted by past hurricane waves (toppled coral blocks - some immense), but for the most part the reef appeared to be relatively healthy. I counted approximately 550 live *Tridacna* on the swim between the ava and the corner. However, we did find seven dead clams within a small area approximately half way between the ava and the corner. Also, the amount of debris (cardboard pieces, clothing) on the lagoon substrate increased noticeably as we approached the corner. In the corner, we found five recently dead *Tridacna* with scars on nearby rock outcrops and seven recently dead *Tridacna* near one of the large pinnacles. This mortality appeared to be oil-related. A remnant of a sea turtle skeleton was also found near one of the other large pinnacles. Two live green sea turtles (one male; one female) were seen between the ava and the corner.

The biomass of reef fishes surrounding the large pinnacles in the NW corner of the lagoon was larger than the biomass seen near other lagoon pinnacles closer to the wreck site. Nevertheless, overall reef-fish biomass still appeared to be unexpectedly low in view of the protected status of resources at the atoll. A solitary large barracuda (*Sphyraena barracuda*), several moderately-sized jacks (*Caranx melampygus*) and snappers (*Lutjanus gibbus, L. monostigmus, L. bohar, Monotaxis grandoculis*), and schools of small snappers (*Gnathodentex aureolineatus*) and goatfishes (*Mulloidex vanicolensis*) were seen. Surgeonfishes and butterflyfishes were among the most common fishes seen.

We circled around the large pinnacles and continued our survey back to the ava over the shallow reef flat. No recently dead Tridacna were seen and the reef flat appeared relatively healthy. We reached the ava and exited the lagoon with the strong current. We noted numerous fishes in the pass, especially a large school of the twinspot snapper (*Lutjanus*

bohar). We finished the survey at approximately 11:00 am.

The land team broke camp on Rose Island and transported two loads of gear and supplies back to the Manuatele III with the inflatable. This operation was completed and the Manuatele III departed Rose Atoll at 1:00 pm. The ride back was windy and rainy with 10+ ft swells but fairly comfortable with following seas.

11-07-93

We arrived at Pago Pago Harbor around 3:00 am and were tied up dockside by 3:30 am. Slept until 6:00 am and then off-loaded gear. Checked into Rainmaker Hotel for shower and food. Went over to DMWR office and met Craig and Tuilagi so we could copy summary data tables and figures for all parties (DMWR, FWS, NMFS, and Beak). Rested during the afternoon and departed Pago Pago for Honolulu at approximately 11:35 pm.

11-08-93

We arrived in Honolulu at approximately 5:45 am.

Faxed for Peace Boat

NO : .....
DATE : .....

Agriculture Department.
Vemali
S.E. Ambrym, VANUATU
S.W. PACIFIC.

VEMALI

11 July, 1994.

Dear Mr Balazs,

Re: Turtle № K-625.

Here is the information that you requested on the above subject.
I didn't witness the attack so as the boy who first found the turtle you tagged. Just because it came ashore with no head and one hand missing, we thought this might have been caused by a Shark or Some other fishes. There were no other turtles around this location when K-625 were found dead on the Shore - but there are alot of turtles around Ambrym island so as the other islands of Vanuatu.

Since the turtle (K-625) came ashore on a "Good Friday" (1st April, 1994) it was eaten by the people of Ulei village as a meat Supplement during the last Easter holidays. There is unconfirmed report that another turtle with tags came ashore at Sesivi village on the western side of Ambrym Sometimes earlier. I was unable to find out more about this turtle since its not close to where I am staying.

NO : .....

DATE : .....

I would prefer if you could send me a red or yellow, size 44 T-Shirt. If you are selling those T-shirts, please send me one extra - the same size but a different colour. I promise to send you the cost of this extra one as soon as possible.

Thank you in advance.

Best wishes,

Richard.

RICHARD NAMELSON.

PS: If you need more information, you may contact me by the above address.

NO : .....
DATE : 30/5/94.....

HIMB
JUN 15 1994

AGRIC. DEPARTMENT.
VEMALI
S.E. AMBRYM
VANUATU.
S.W. PACIFIC.

APPLIED
TAGS K622 - K625
11/5/93 ROSE ISLAND
CCL 105cm
WEST Shore near Beast Rock
NESTING - EGGS LAID

HIMB
UNIVERSITY OF HAWAII 96744
HONOLULU
HAWAII.

Dear Sir,

This is just to inform you that one of your turtles registered No. K-625 came ashore on the island of Ambrym, Vanuatu on the 1st of April, 1994. It was attacked and killed by a fish therefore it was washed ashore with no head and one hand missing. I decided to inform you as thought this might be of great importance to you on your research or whatever the purpose of marking this turtle.

Wishing you all the best.

Rlahm.

RICHARD NAMELSON.

Republic of Vanuatu

George Balazs
NOAA National Marine Fisheries Service
SWFC Honolulu Laboratory F/SWC2
2570 Dole Street
Honolulu, HI 96822-2396

11 December 1993

Dear George,

Thank you for the encouraging letter and article about turtles in Alaska. Here is the results from the Rose Atoll sample you wanted.

11-05-93 American Samoa, Rose Atoll outer reef

Microdictyon japonicum Setchell

Caulerpa urvilliana Montagne

Polysiphonia sp. (trace) epiphytic on Microdictyon

The majority of the sample was M. japonicum with C. urvilliana making up about 30%.

I have taken a look at the (8-93 Select Indian River) Florida samples, but need to look a few things up before sending the IDs. One of the samples had a seagrass that looks something like Halophila in it.

Most of my belongings are packed right now and soon I will be settling into a condominium near the Auke Bay laboratories and University of Alaska SE campus. I will send you my new P.O. box at Auke Bay and electronic mail numbers as soon as possible.

Aloha,

Dennis J. Russell
Biology Department
University of Alaska Southeast
11120 Glacier Highway
Juneau, Alaska 99801-8671

(this address is good after 28 December 1993)

11-5-93 American Samoa Rose Atoll outer reef

Microdictyon japonicum	60%
Caulerpa urvilleana	40
Polysiphonia sp.	Trace

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

O.C.-190
ROSE ISLAND
AMERICAN SAMOA
WH6BLQ/KH8

DEPARTMENT OF MARINE & WILDLIFE RESOURCES

AMERICAN SAMOA GOVERNMENT
P.O. BOX 3730
PAGO PAGO, AMERICAN SAMOA 96799

TEL:(684)633-4456
FAX:(684)633-5944

A.P. LUTALI
Governor

TAUESE P.F. SUNIA
Lt. Governor

RAY TULAFONO
Director

PHILIP LANGFOR
Deputy Director

January 21, 1994

TO:

FROM: Peter Craig

SUBJECT: THE GREAT SAMOAN TURTLE MYSTERY

Here's another update on the turtle contest.

TURTLE FANS

Things are hopping now. The 3 green turtles tagged at Rose Atoll (American Samoa) are really trucking.

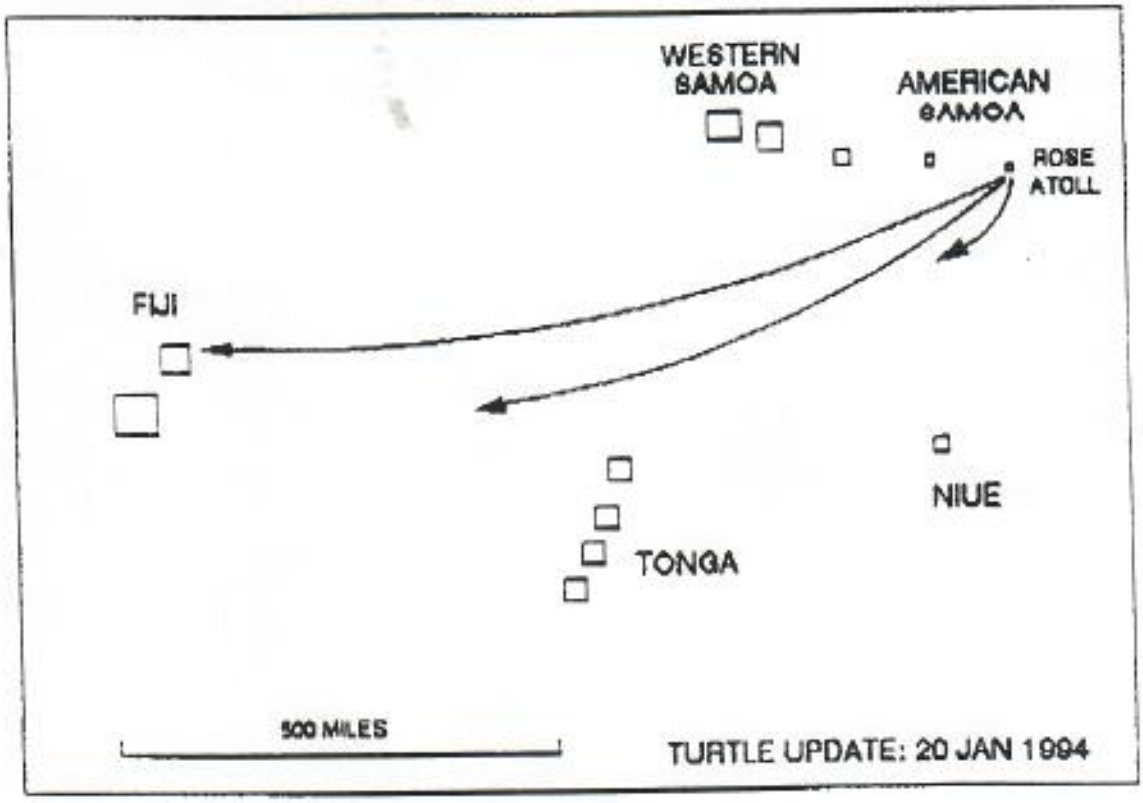
Michelangella left Rose Atoll 3 weeks ago and swam directly to Fiji, a migration distance of about 900 miles. She appears to be taking up residence in Nateva Bay on Vanua Levu. Let's hope that Michelangella doesn't get eaten there, because it is still legal to hunt sea turtles in Fiji.

Donatella just passed by Tonga and also seems to be headed for Fiji. The third turtle, Raphaela, left Rose Atoll only a few days ago and appears to be going in the same general direction.

Remember, the contest will end when all 3 turtles reach their feeding grounds, wherever that may be. We received almost 300 contest entries from school children and the public.

(See map on next page)

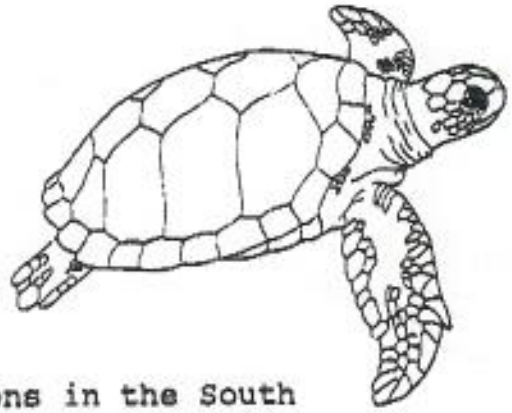
JAN 13 '94 08:52 OMNR (684)633-4456



THE GREAT SAMOAN TURTLE MYSTERY

THE GREAT SAMOAN TURTLE MYSTERY !!!

CONTEST PRIZE: $250.



DEADLINE: Submit an entry form to the Department of Marine and Wildlife Resources (DMWR) by December 17, 1993. See contest rules on entry form.

HERE'S THE DEAL. Sea turtle populations in the South Pacific are in serious trouble. Their numbers have declined drastically due to over-harvest and habitat loss. Something must be done soon or future generations of Pacific islanders may lose this valuable resource.

To promote public interest in sea turtles, DMWR is sponsoring a contest. You can win $250 if you correctly guess where 3 tagged turtles will migrate to in the coming months.

We do not know beforehand where they will go. That's why we tagged them! As the turtles travel, we will publish updated maps of their progress in this newspaper column every week or two.

We can do that because we fitted the 3 turtles with special tags that transmit electronic beeps to satellites overhead. The satellites, in turn, send us the exact location of each turtle. This is the first time this has ever been done in the central South Pacific. The contest will end when all 3 turtles reach their destination.

DO NOT TRY TO FIND OR CAPTURE THESE TURTLES! The satellite tags will provide daily information about their locations, so there is no need for you to find them.

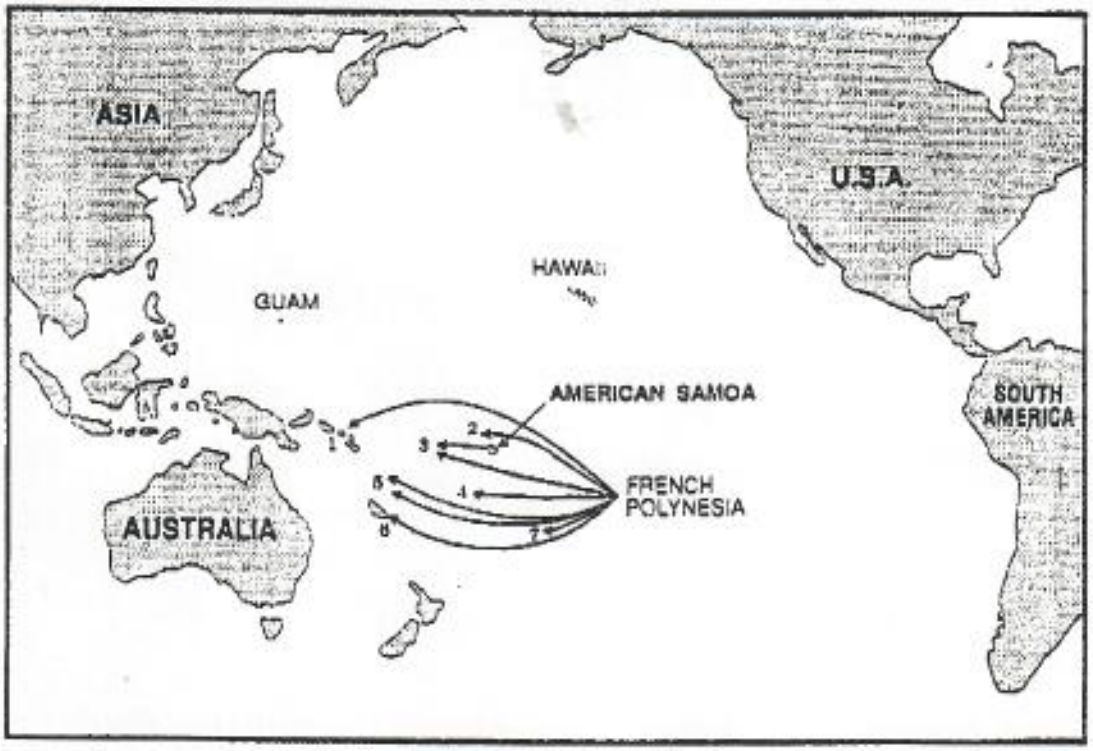
GENERAL INFORMATION. The 3 turtles with satellite transmitters are females named Michelangela, Donatella, and Raphaela. They are large green sea turtles that weigh about 250 pounds and are 4 feet long. They recently nested at Rose Atoll (located 150 miles east of Tutuila Island), and they are now about beginning to migrate to their feeding grounds.

At this point, your guess about where they will go is as good as DMWR's guess. To improve your odds at winning, here is some information that might provide useful clues.

1. The life cycle of the green sea turtle involves a series of long-distance migrations back and forth between their feeding and nesting areas. In American Samoa, their only nesting area is at Rose Atoll. When they finish laying their eggs there, they will leave Rose Atoll and migrate to their feeding grounds somewhere else in the South Pacific. After a couple of years, the turtles will swim back to Rose Atoll to nest again. Every turtle always returns to the same nesting and feeding areas throughout its life, but that does not necessarily mean that all turtles nesting at Rose Atoll will migrate to exactly the same feeding area. It is very possible that the 3 turtles will go to different areas.

2. In past years, biologists marked 45 turtles with fin clips at Rose Atoll, but only 2 were recovered. They both went to Fiji.

3. In another study, turtles marked with fin clips in French Polynesia swam in a westward direction to many locations (see map). Note, however, that turtles cannot go from east to west forever. At some stage in their life, they also have to travel eastward to get back to their nesting beaches. And other turtles might have feeding areas to the east of Rose Atoll.



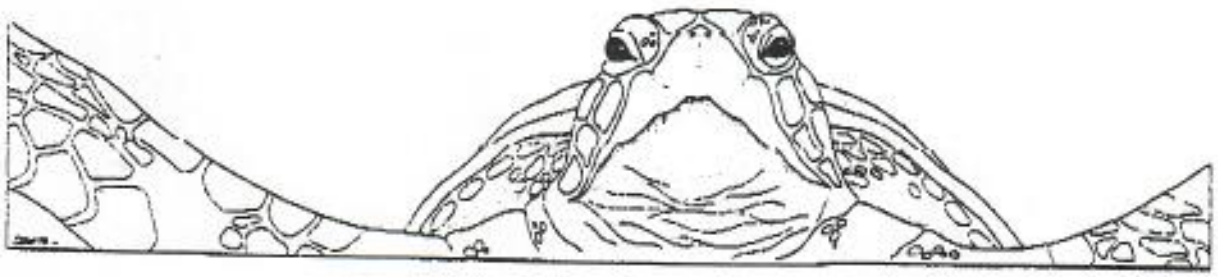
Map 1. Movement of green sea turtles in the central South Pacific Ocean. The turtles travelled from French Polynesia to many other islands, which are indicated by number: 1) Solomon Islands, 2) Wallis Island, 3) Fiji, 4) Tonga, 5) Vanuatu, 6) New Caledonia, and 7) Cook Islands.

4. Green turtles are herbivores. Their feeding grounds will be areas with lots of algae and seagrasses.

5. The average swimming rate of migrating green turtles in Hawaii is about 30 miles per day. Currents in the South Pacific could, however, make our turtles travel faster or slower. Also, remember that Michelangela, Donatella, and Raphaela will probably not return to nest again at Rose Atoll for at least 2-3 years, so they have plenty of time now to visit distant places.

A FINAL THOUGHT. The information above shows that turtles throughout the South Pacific are a shared resource. As nature would have it, sea turtles do not nest and feed in the same area. This complicates conservation efforts for these animals. For example, it does little good to protect turtles at their nesting sites in one country, only to have them killed for food or tortoise-shell jewelry when they migrate to their feeding areas in another country. All Pacific islanders must work together to save this unique and valuable Pacific resource.

ACKNOWLEDGMENTS. This project was headed by George Balazs (National Marine Fisheries Service) and assisted by DMWR. Funds for the purchase of satellite tags were contributed by the American Samoa Environmental Protection Agency and the US National Park Service. The contest prize was donated by Le Vaomatua and DMWR, and the Samoa News provided space in their newspaper for this contest.



SEA TURTLE ENTRY FORM --- $250 PRIZE !!

Your name (print)_____

Address

Phone number_____

INFORMATION: Three large turtles were recently tagged at their nesting beach at Rose Atoll, American Samoa. Their names are Michelangela, Donatella and Raphaela. Information from their tags will tell us when they leave their nesting beaches and arrive at their feeding grounds, which are probably located hundreds or thousands of miles apart (no one knows where they will actually go).

Question #1. Name the 3 countries where Michelangela, Donatella and Raphaela will migrate to (a single country can be listed more than once):

Country A_____

Country B_____

Country C_____

Question #2. In case there is more than one winner to the first question, a single winner will be chosen based on next question: How many days will it take all 3 turtles <u>combined</u> to reach their destinations? For example, if Michelangela takes 20 days, Donatella takes 40 days, and Raphaela takes 80 days, the combined number of days would be 140 days.

Total days to migrate_____

RULES: 1. $250 Prize. 2. There is no cost to enter. 3. Only one entry per person. 4. Anyone can enter except DMWR employees and their families. 5. Return this form by <u>December 17, 1993</u> to the Dept. of Marine and Wildlife Resources (behind the market in Fagatogo), P.O. Box 3730, Pago Pago, American Samoa 96799. Phone 684-633-4456, Fax 684-633-5944.

NO :.....

DATE : 30/5/94.....

AGRIC. DEPARTMENT.
VEMALI
S.E. AMBRYM
VANUATU.
S.W. PACIFIC.

APPLIED
TAGS K622 - K625
11/5/93 ROSE ISLAND
CCL 105cm
WEST Shore near Beach Rock
NESTING - EGGS LAID

HIMB
UNIVERSITY OF HAWAII 96744
HONOLULU
HAWAII.

Dear Sir,

This is just to inform you that one of your turtles registered No. K-625 came ashore on the island of Ambrym, Vanuatu on the 1st of April, 1994. It was attacked and killed by a fish, therefore it was washed ashore with no head and one hand missing. I decided to inform you as I thought this might be of great importance to you on your research or whatever the purpose of marking this turtle.

Wishing you all the best.

Rlahn.

RICHARD NAMELSON.

Republic of Vanuatu.

To: HIMB
UNIVERSITY OF HAWAII 96744
HONOLULU
HAWAII.

GEORGE BALAZ

BY AIR MAIL
PAR AVION

AGRIC. DEPT. VEMALI,
S.E. AMBRYM
VANUATU.