REPORT ON A VISIT TO SWAINS ISLAND BY THE DEPARTMENT OF MARINE AND WILDLIFE RESOURCES MARCH 27-29, 1996.

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PART I. PRELIMINARY INVESTIGATIONS INTO POTENTIAL AQUACULTURE DEVELOPMENT IN SWAINS ATOLL. - MARCH 1996 -

Introduction: Swains Atoll is a low lying coral atoll approximately 100 miles north of Tutuila. It is oval in shape circular about 1.4 nautical on it's east/west axis and 0.9 Nautical miles across. The highest land is about 15' above sea level. The lagoon in the center is also roughly oval separated from the ocean by a strip of coconut forest vegetation approximately 0.3 to 0.4 Nautical miles wide.

The aquaculture challenges for Swains Atoll include its distance from markets and lack of air strips, and lack of protected anchorages for ships. Travel to Swains is via an 18 hour boat trip from Tutuila. Passengers and supplies must be loaded onto small skiffs and driven through a treacherous channel in the reef, and from there off loaded by hand onto the beach. Transporting cargo from Swains to a vessel is done similarly, and this procedure may put constraints on the size and types of shipments of potential aquaculture products produced on Swains.

Swains island use to have a large copra farm, producing shipments of 40-60 tons every 4 months. The copra industry ended in 1968 with the collapse of the markets. Copra was bailed on Swains and loaded onto ships as described above, so evidently transport of large, heavy, and voluminous objects is possible provided the manpower is available to accomplish the task.

Outer reefs: Swains atoll is surrounded by fringing reefs whose maximum width is about 0.1 Nautical miles. The reefs are shallow and high energy, offering very little potential for any sort of aquaculture activity.

Lagoon: The lagoon was connected to the ocean at one time, however a hurricane in the 1880's filled in the channel. today the lagoon appears to be completely isolated from the ocean, we saw no evidence that water levels were even under tidal influence. Drainage of the lagoon probably consists of seepage through the coral substrate, and possibly overflow through the coconut forests during periods of high rain falls. We saw no streams feeding into or out of the lagoon.

The lagoon bottom consists of eroded coral formations, sand, and large deposits of shells of marine bivalves and gastropods. These are legacies of the lagoons one-time oceanic conditions.

About 2/3 of the lagoon is shallow, depths ranging from .5 to 1.5 meters. The remainder is variable in depth, the deepest point we measured was 8.7 meters.

The entire bottom and any trees and organic debris (such as coconuts) which have come to rest on the bottom are blanketed with a layer of green filamentous algae slime of 1 to 5cm thick. This algae apparently grows into thick coatings and breaks off periodically. The broken chunks settle into the deeper areas of the lagoon filling them in. We found areas where the algae was at least 2 meters thick, all but the top few centimeters was anoxic. Hydrogen sulfide gas would bubble up when the layer was disturbed, and the buried algae was reddish or black indicating anoxic decomposition was occurring. The algae on the bottom was very loosely packed, and presented little resistance to a hand or leg extended into it.

There was little evidence of sand, sediment, or fine organic debris washing into the lagoon as would occur in a stream fed lake or pond.

The water appeared well mixed, at least during this time of year when trade winds blow across the surface. No thermocline or haliocline was evident. We did not have an oxygen probe, but is likely the entire body of water is well oxygenated. The thick benthic algae, and the green color of the water indicate an abundance of nutrients for algae growth. Salinity measurements revealed the lagoon to be slightly brackish, values ranging from 1.5% to 2.0% were recorded in the water column. It is unknown at this time how much these values change as a function of weather and rainfall.

Two species of fish were observed, and unidentified guppy and a mosquitos fish. Samples were preserved, and ID's will be made in a later report.,

Sampling: Owing to lack of resources, sampling equipment was limited to a zooplankton net, and YSI Temperature/Salinity/Conductivity meter, a seccie disk, and samples taken and preserved with formaldehyde.

The sensitivity fluctuations of the YSI meter is such that differences of readings of 1 C, or 1% between sites should not be considered significant.

10 minute plankton tows picked up very little (one mosquitos larvae). A phytoplankton net would undoubtably yielded large amounts of phytoplankton. Samples were preserved with formaldehyde, and an analysis of the contents will be included in the final report.

Four stations were sampled for depth/temperature/salinity and conductivity. The sites selected were chosen for their representation of the various habitats available:

Station#1 Close to the pier at "Etena" (Antenna). Over hanging trees shade the shoreline, the shore drops steeply to about 2.6 meters. The pier is a small pier built of large chunks of coral lime stone many years ago. "Etena" is now a ghost town, one large building remains, foundations of several other are in the area.

Bottom is eroded coral formations covered by woody debris, leaf liter, and a thick blanket of filamentous alge.

Station #1 Temperature/Salinity/depth profile				
Comments	Depth	Temp (°C)	Salinity ppT	Conductivity (µmHOS)
surface	10cm	29°	1.5‰	2500
top of algae layer	2.6	29°	1.8‰	2500
Seccie disk reading = still visible on the bottom				

Station #2 - A shallow bench at the mouth of the "Tupua" (Tombstone) end of the lagoon. This end of the lagoon was shallow and largely similar to the sample station. Bottom was coral rubble and sand covered by a thick layer of algae.

Station #2 Temperature/Salinity/depth profile				
Comments	Depth	Temp (°C)	Salinity ppT	Conductivity (µmHOS)
surface	10cm	29°	2.0‰	2500
Bottom	1.8m	29°	2.0‰	2500
Seccie disk reading = still visible on the bottom				

Station #3. In the deeper middle portion of the lagoon. Bottom was buried under at least 2m of algae. Salinity values were more or less constant through the water column and raised sharply as the probe entered the algae muck layer.

Station #3 Temperature/Salinity/depth profile				
Comments	Depth	Temp (°C)	Salinity ppT	Conductivity (µmHOS)
surface	10cm	29°	1.7‰	2550
	2m	29°	1.5‰	2550
	4m	29°	1.5‰	2550
	6m	29°	1.5‰	2550
In the muck	8m	29°	4.0‰	4000
Bottom	9.5m	29°	4.0‰	7500

Seccie disk reading = 3 meters

Station #4 Also in the deeper center of the lagoon. Very similar to station #3.

Station #4 Temperature/Salinity/depth profile				
Comments	Depth	Temp (°C)	Salinity ppT	Conductivity (μmHOS)
surface	10cm	30°	2‰	2600
	2m	30°	2‰	2550
	4m	30°	2‰	2550
	6m	30°	2‰	2550
	8m	29°	1.5‰	4000
Bottom	9.5m	28.5°	5.0‰	8500
Seccie disk reading = 3 meters				

Synopsis: The lagoon presents a rather unique habitat. It is basically a fresh water pond completely isolated from any other body of water, except possibly during periods of storms or hurricanes. The biodiversity is extremely low, undoubtably owing to its isolation and relatively recent creation. It appears that organisms occupying several basic trophic levels (algavoures, planktavoures, and picivoures) are largely if not entirely absent in the lagoon.

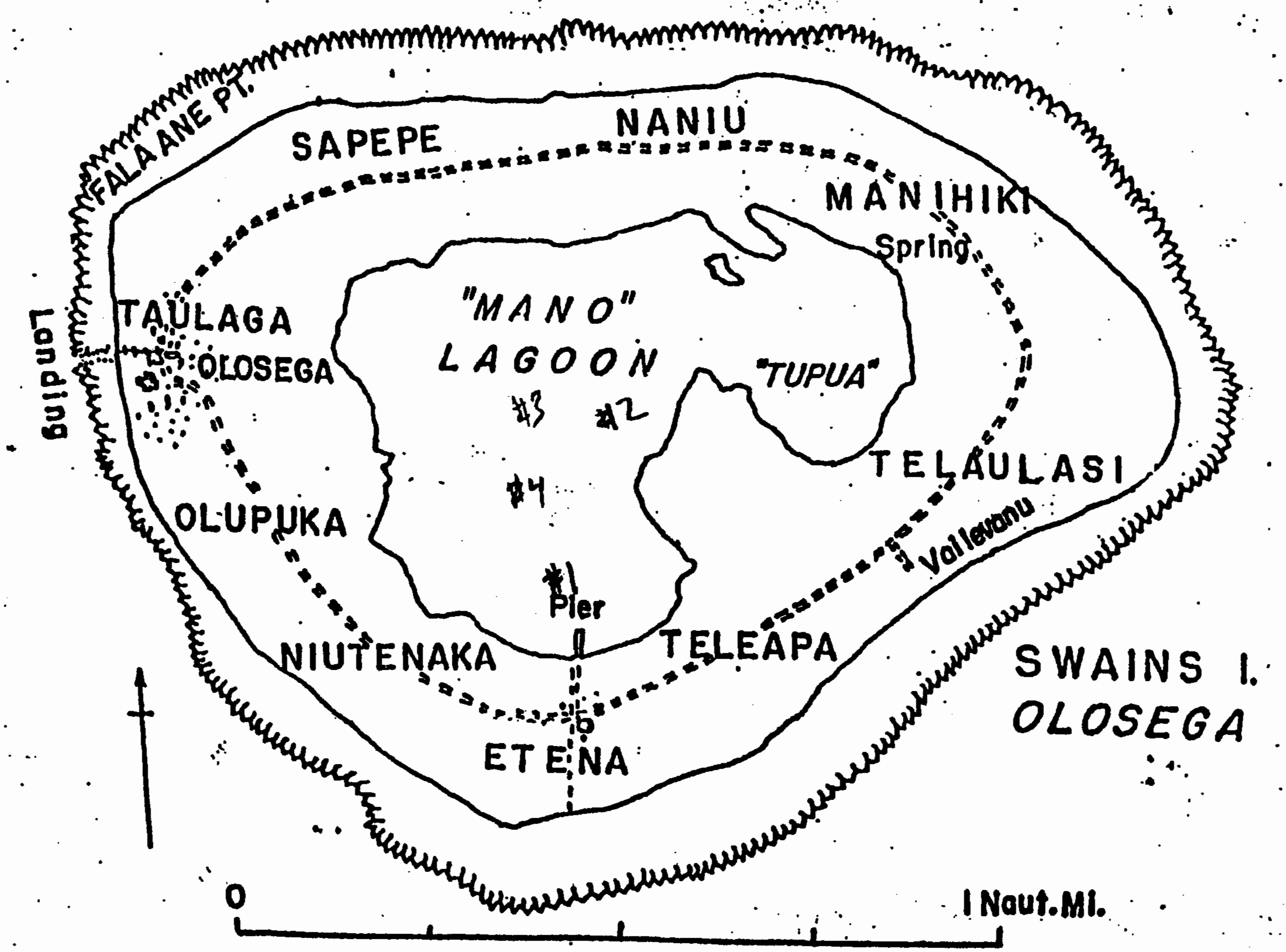
Recommendations. The great abundance of the green filamentous algae, and present lack of algavoures and planktavoures suggest that an aquaculture operation culturing a fresh water algavoures or planktavours may enjoy great success in the lagoon, particularly since such a species would enjoy a lack of competition and predation. Owing to the lagoons isolation, it is likely an introduced species would likely suffer little disease problems as well.

The transportation difficulties suggest that a successful aquaculture venture should target a high value species. A freshwater tropical fresh water aquarium species may be a candidate, as their high value may offset the transportation difficulties. Such a fish would have to be transported live to Tuituila, then held in a staging facility and air freighted to distant markets.

The introduction of telapia has been suggested. I recommend against this species, as it's market appeal in Samoa is as of yet unproven, and once introduced it would may be very difficult to eradicate. Telapia may also out compete other more potentially valuable species as well. The Fisheries Division in Western Samoa is currently experimenting with telapia introductions into several fresh water ponds and will be testing the local marketability of this species in short order. Because production costs and shipping arrangements of Western Samoa produced telapia would give them a large market advantage over Swains produced telapia, it is doubtful that Swains should even consider this species. Also, the opinions of the fisheries officers in Western Samoa is that telapia will not compete favorably in the Samoan food markets owing to it's undesirable texture and taste. But that is only one opinion based on limited experience.

People should exercise extreme caution in introducing any species however, as once introduced a species may be impossible to get rid of, and make it difficult to farm a more desired species.

Future reports. A final report will be written, giving speciation of algae, fish and shell samples collected, and water chemistry analysis from the samples collected. Also summaries of two previous investigations of the lagoon will be presented.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PART II: THE CORAL REEFS OF SWAINS ATOLL - 1996 STATUS REPORT -

Swains Island is one of only two remote atolls in American Samoa. The island is privately owned and was incorporated as part of American Samoa in 1925, but it is actually situated 370 km to the north near the Tokelau Group. Swains is a ring-shaped island that is surrounded by coral reefs and encloses a large brackish water lagoon. The reef flats are narrow (100 to 300 m wide) and dominated by pink coralline algae. The reef front slopes gently down to about 20 m and then plunges almost vertically down to a depth of >60 m.

Very little was known about the coral reefs on Swains Island until 1986 when the Department of Marine and Wildlife Resources (hereafter DMWR) visited the island. At this time, the reefs were flourishing, water clarity was very high, and there was lush coral growth and abundant fish life.

In February 1987, Swains Island was badly damaged by Hurricane Tusi. Shortly after the hurricane (April 1987), DMWR visited the island to assess the extent of the damage on the coral reefs on the island. Unfortunately, they reported that most of the reefs had been devastated by the storm.

Prior to the hurricane, coral over was extremely high (90-100%) at the majority of sites around the island. Most of the reef was dominated by branching corals (mostly **Pocillopora** and a few **Acropora** colonies) as well as encrusting and foliaceus species (**Montipora**) and a few massive colonies (**Porites** and **Favia**). After the hurricane, coral cover had been reduced to 0-12% in most places except on the eastern side where a small area had escaped damage.

There had also been a great change in the fish community at Swains as a result of the hurricane. Of particular note was the decrease in the abundance of small species, and a noticeable loss of larger predatory species. Almost one year later (January 1988), another survey by DMWR showed that there had been little recovery since the hurricane. The only noticeable change was an increase in the number of herbivorous fishes on the reef, possibly because of the increase in algae which had grown over the dead coral after the hurricane.

Nine years, after the hurricane (March 1996), DMWR visited the island again to assess the condition of the coral reefs. This survey showed that the reefs appeared to have recovered from the hurricane. Coral cover was high (45-65%) and comprised similar species and growth forms to those present prior to the hurricane. Reef fishes were also more abundant and species composition was similar to prehurricane observations. Large predatory pelagic fishes were also common in the near shore waters, including yellow fin tuna, dogtooth tuna, giant trevally, wahoo and barracuda. In fact, this study recorded a total of 131 fish species on the reefs at Swains. Previous surveys of the island also recorded an additional 32 species that were not seen on this survey, bringing the total number of fish species recorded at Swains to 169.

The coral reefs at Swains are characteristic of those found on remote oceanic atolls. As such they are more similar to the reefs at Rose Atoll than they are to those found on the other islands in the Samoan Archipelago. Coral species diversity is low compared to the other islands, but coral cover is high.

Fish species diversity is also low compared to the other islands, although fish biomass is high. The fish community on the reef front at Swains is dominated by planktivorousa species, especially damselfishes (**Chromis acares**) and fairy basslets (**Luzonichthys waitei, Pseudanthias bartlettorum** and **Pseudanthias pascalus**). In general. there are more large fish at Swains than on the other islands, especially snappers, reef sharks and trevally. In contrast there are fewer herbivores (surgeonfishes and parrotfishes), although unicornfishes are relatively abundant. The fish community at Swains is also characterized by a group of species that are either absent or rare on most of the other islands in American Samoa: one angelfish species (**Centropyge loriculus**), two species of surgeonfish (**Ctenochaetus hawaiiensis** and **Zebrasoma rostratum**), two species of fairy basslet (**Luzonichthys waitei** and **Pseudanthias bartlettorum**) and a wrasse (**Pseudocheilinus tetrataenia**). Eels, surgenfishes and damselfishes were also abundant on the reef flat, although the species that were abundant (**Sidera thyrsoidea, Acanthurus nigoris, Pomacentrus glauca** and **Stegastes fasciolatus**) were different to those that were common on the reef front (see above).

Only one giant clam (**Tridacna maxima**) was seen on the survey, which was the first time that giant clams have been recorded at Swains. This clam was a 13 cm individual that was seen on the reef slope south of the ava at Taulaga at a depth of 10m. No turtles, marine mammals or crown-of-thorns starfish were observed on this or previous trips.

In summary, the reefs of Swains Island have recovered well from the devastation of Hurricane Tusi and are among the most spectacular in American Samoa. They are in extremely good condition with lots of live coral and an abundant and diverse fish community. This, in combination with the steep drop-offs and exceptionally clear water conditions, make diving at Swains among the best in the Samoan Archipelago.

Acknowledgements

Special thanks to Captain Wally Thompson for the opportunity to visit this beautiful island and spectacular coral reef. I also thank Fale Tuilagi and Elia Henry for their usual expertise at organizing and implementing a diving project on a remote atoll. This report draws heavily on the results of three previous trips to Swains Island in 1986, 1987 and 1988 by David Itano.