
Summary. Reports

Habitat Surveys - Brainard (NMFS), Holowar, Kenyon, Chojeack-Keesan (NMFS-UH-JIMAR) Towed Diver Surveys -

Conducted towed diver habitat/fish surveys around SE, E and NE portions of Tutuila and 10 and 14 towed diver habitat/fish surveys completely around Ta'u and Ofu/Olosega Islands, respectively. A total of about 17 km of benthic habitat was mapped at Tutuila and 70 km of habitat was mapped in the Manu'a Islands. Preliminary findings from the towded surveys suggest that while these island ecosystems remain relatively healthy, the shallow water coral communities often show signs of having sustained extensive damage due to large storms or other natural events of the past (literature suggests possibly the strong hurricanes in 1990 and 1991). Although complex reef structures indicate extensive past coral development at many of these sites, many of the corals have not recovered from this event as evidenced by low live coral cover (5-10%) and high coraline algae cover (>50%) in many sites. The SE side of Ta'u and portions of the SE sides of Ofu and Olosega had particularly intact and healthy coral cover. Very large, healthy coral boulders were abundant along the E shore of Ta'u. These large Porites heads are presumably very old indicating high stability on the side of the lagoon over long periods of time. The towded fish surveys revealed generally low abundance of commercially or ecologically important apex predators, including sharks. The towded team did observe two lemon sharks along the SE corner of Tutuila.

TOAD/DOTC - Ho'oko (NMFS-UH-JIMAR) & White (TC)

The TOAD was used to investigate the fauna of the deeper habitats (to 60 m) along the SE banks around Tutuila and at various sites around the Manu'a Islands. Surprisingly, the TOAD images revealed healthy, diverse coral communities at depths of 50 m. In addition to examining species composition, the TOAD is used to ground-truth the acoustic habitat classifications provided by the GTCC.

Fish - B. Zilinsky (NMFS) and R. Schroeder (NMFS-UH-JIMAR)

The fish-crest teams surveyed 5 stations at Tutuila, 6 stations at Ta'u, 2 stations at Olosega, and 4 stations at Ofu. Stations on all sites of the islands were included on these transects, except at Tutuila where work was conducted around the E half of the island. The benthic team followed the fish team at all survey sites. In addition, the fish team took CTD casts around each island at stations approximately 0.5 km apart, to 30 m depths. A total of 21 CTD casts were completed at Ta'eva Island, 51 at Ta'u Island, and 39 combined casts at Olosega and Ofu Islands (see below).

Fish transect-nalines consisted of 3 consecutive 25 m lines set along a single depth at 13-15 m. After each line was set the observers swam along either side of it at 5 m apart, counting and recording site classes for all fish >20 cm total length (TL) within an area 4 m wide and 4 m high. At the end of each 25 m line, the divers turned and while remaining either side of the line, began counting and recording site classes of all fishes >20 cm TL within 2 m along their side of the line and 4 m off the bottom. Numbers of highly abundant species such as juvenile damselfish (Pomacentridae) and schooling damselfish (Carangidae) were estimated. A list of fish species observed was recorded for each transect site.

Although this was the first time an extensive fish survey has been done by the NMFS in American Samoan waters, the general consensus was that the fish populations at each station wereologic of generally low diversity (of the total pool of species known to occur at these islands), with a relative absence of many large fish. In general, the most common species during the surveys were small-bodied fish such as gobies, blennies, and cardinalfishes, with some exceptions. Notably, the predatory fish and some large predators were not observed during the surveys, possibly due to the presence of other large predators nearby. A few large predators were observed during the surveys, such as a few sharks. In general, the reef systems in American Samoa are believed to be very healthy.

American Samoa. NOAA. 90 pp.
A species of Pomacentridae was observed at Ta'u, Ofu, and Olosega that displayed unique characteristics from any other described species. Using an annotated species checklist of Samoan fishes (Wass, 1984) as a reference, the fish would be described as Centropyge heraldi, but after reviewing more recent works (Allen G, Steene R, Allen M, 1998) we believe the Centroprunya sp. to be a new species that is being described by Ruhe Kauter. This particular Centroprunya sp. is thought to be a close relative of C. heraldi and until present was only thought to inhabit rubble bottoms in the Coral Sea off of Australia's Great Barrier Reef.

Therefore with further analysis and verification of the photographs taken, a possible range extension could be made for this pomacentrid species.

Fish species records were noted during the limited time following each census dive but no fish species observer was dedicated to making a species checklist during each dive. At the end of each day, species records were recorded and photographs were reviewed to aid in compiling a species checklist form each site. Andy Comish also contributed to the fish species checklist. A total of 127 species were observed at Ta'u, and 168 at Olosega/Ofu I.

On 15 Feb., a deep dive (to 90 ft.) was conducted on the S. side of Olosega followed by snorkeling in the National Park at Ofu to complete the species record. During the 35 m dive a single pink unmeasured fish (Amphiprion purpurascens) was observed for the first time during the survey and a large dog-nose tuna (Gymnosarda unicolor) 1.6 m TL was observed. No other unique or unusual observations were made during the dive.

Coral. - Jean Kecky (NMFS-UH-JIMAR)

Stony Corals
Jean Kenyon participated in shallow water coral surveys as part of larger benthic and fish surveys in the area. These are the first coral surveys conducted in American Samoa by the Coral Reef Ecosystem Investigation. Five sites were surveyed at Tutuila, 4 sites at Ta'u, 4 sites at Ofu, and 5 sites at Olosega. The survey sites were chosen in consultation with A. Comish, Coral Reef Initiative Coordinator with the Territorial Govt. of American Samoa Dept. of Marine and Wildlife Resources. Sites were chosen based upon the lack of surveys in the general area by previous investigators and/or by their location within the boundaries of the National Park of American Samoa.

All of the survey sites at each island were species inventories and rapid ecological assessments (REAs) of coral populations. In addition, a total of 72 samples from 7 species of Acropora were collected from Tutuila, Ta'u, and Ofu and fixed in formalin in order to assess their sexual reproductive status.

Rapid Ecological Assessments (REAs) of coral populations.

With the exception of the final, deep dive to 90 feet off Olosega Village, at each survey site the fish team laid out three, 25m-long transect lines along a 45-foot depth contour; the beginning of the record and third transect line were separated from the end of the previous transect line by 3-4 meters. Kenyon videotaped all 3 transect lines while slowly swimming ~1 meter above the length of the line. These video sequences will be edited later, computer-assisted quantitative analysis of percent coverage of coral, algae, and substrate types. Additionally, at the beginning of each of the 3 transect lines, a 360° pan of the surrounding reef area was videotaped to document the topography and general nature of the surrounding area. Kenyon then swam back along the size of the transect line as bottom line permitted and listed coral species (or genus), when species identification in the field was ambiguous: occurring within ~0.5m of each side of the transect line, the size class to which the maximum diameter of the colony belonged (0,5 cm; 5-10 cm; 10-20 cm; 20-40 cm; 40-80 cm; 80-166 cm; or ≥ 160 cm) and the relative abundance of the species-genus using the DACCOR protocol (dominant, subdominant, common, occasional, and rare). These size classes were chosen based on a 1996 report by Craig Mundy1, so as to make results of the present study comparable with Mundy's surveys of other reef sites around Tutuila and the Manu'a Group. Mundy's surveys of other reef sites around Tutuila and the Manu'a Group.

Analysis of coral frequency, cover, and size distribution from nominal and numerical data collected during the surveys will be accomplished as time permits during the remainder of the TC-02-01 cruise. Analysis of digital video taken along the transect line will be conducted using duplicates of the videotapes either then the original, which will be archived as a permanent record of the state of the reefs in early 2002. Analysis of the transect video will be conducted at a future date after returning to the Honolulu Lab. However,
preliminary analysis suggests that the two most numerically abundant coral genera in Mundy’s study, Montipora and Porites, continue to comprise the largest percentage of all coral colonies recorded. Similarly, as each genera appears to represent the highest equilibrated proportion of coral cover, variations in the growth rates existed at the individual sites; for example, at a site along the eastern coast of Tu’u-i (38 mile NNE of Tufu Point) the lime species Forhisops magnostoma was dominant while species of both Montipora and Porites were either rare or only occurred occasionally. A site close to Asaga Strait on the south coast of Ofu also exhibited divergence from the general overall pattern, as members of the genus Goniastrea formed a large number of small colonies, while members of the genera Montipora and Porites were only occasionally noted.

Mundy’s report of his surveys conducted in October and November 1995 concluded that the reefs of American Samoa were in a recovery phase following a combination of natural and anthropogenic impacts. Chief among these impacts were an outbreak of the corallivorous Crown-of-thorns starfish (Acanthaster planci) in the mid-1980s and two severe tropical cyclones (“Vil” in 1990 and “Ofu” in 1991). As evidence of this recovery he points to the size-class distribution of more than 18,000 colonies measured during his surveys. Although the number of coral colonies measured during this survey (n = 228) is substantially less than in Mundy’s surveys, a comparison of their overall size-class distribution suggests that this process of recovery is continuing, as existing colonies continue to increase in size and new coral recruits enter the reef community.

Octocoral (soft coral) surveys - Andy Cornish (DMWR)
The goals of the octocoral surveys are to catalogue and quantify the diversity and abundance of octocoral fauna in the shallow water reef ecosystems of American Samoa and examine patterns in their distribution.

Methodology
1) Determining the octocorals of American Samoa is a continuation of a study initiated on Tutuila and Ofu in late 2001. The 2001 Census, which allowed collections to be made, involves the use of Tafu, Osuga, and four atolls that make up the territory, greatly increasing the coverage and value of this baseline study. Collections are made opportunistically during the quantitative surveys, and are therefore limited to 15 m depth, although deeper dives will be made where possible. Specimens are photographed in the field and collected when they are not recognized as being previously encountered. These specimens will be examined at a later date (as a high-powered microscope is required to examine the spicules for species-level identifications) and a checklist compiled. Specimens will later be deposited in the Museum and Art Gallery of the Northern Territory, Australia, where Dr. P. Aldersdale, a prominent octocoral taxonomist, is a curator.

2) The methodology used to examine the distribution of octocorals is a combination of a semi-quantitative, rapid assessment methodology employed by Fabrizio and De’ath (2006) to survey octocorals on the Great Barrier Reef. Swim surveys of no less than 100 m in length are made at 3 depths at each site. NOAA dive tables, and the need to supply with another member of the team, are limited to the deepest depth to 15 m with another at 8 m. The reef crest (0-5 m) is surveyed (where one is present) by snorkeling. Octocorals are surveyed at different depths, as their distribution varies more with depth than along the reef, at least on small scales (Fabricius & Aldersdale 2001). Octocorals are identified to genera and the abundance of each along each survey (and within + - 1 m of the depth contour) estimated into one of five abundance categories. Hard and soft coral cover is estimated in the categories 0-5%, 5-10%, 10-35%, 20-50%, etc.

Progress to date
The semi-quantitative surveys were performed at 17 sites (6 at Tu’u-i, 6 at Ofu/Osuga, and 5 at Tutuila). Around 10 specimens have been collected during these surveys and during an additional, less-dense dive to 28 m in the southern shore of Osuga. The results so far show that the shallow water octocoral fauna at these locations is dominated by four genera (Stukenbergia, Cadiellia, Saracophyton, and Lobophytophytum), all from the family Abysiniidae. Specimens believed to be of another genera in this family of feathery soft corals, Klyxum, have been collected and were quite abundant while one colony of Rumphelia, a gorgonian in the family Gorgoniidae, was also recorded.
While the data has yet to be analyzed, there appears to be a pattern of higher octocoral abundance and diversity in sites with higher coral cover. Many of the reef sites in Manus’ appear to be recovering from one or several mass mortality events and the soft corals unsurprisingly are richest at sites where the hard corals appear to have been less affected, or where recovery has been quicker. Octocorals were not the dominant benthic fauna at any site, with cover always being estimated at less than 10%. With regards to depth, soft-coral communities were richest at either the 8 or 15 m depths. Octocorals were scarce along the reef crest at most sites, especially in Manus’ where all of the surveyed reefs had high exposure.

The deeper dive at Mt. Olua was disappointing in revealing no sea lans or tree corals (Nephtheidae) despite apparent suitable habitat. These octocorals are often encountered on reefs in the depth range 15–45 m with good water flow on Tutula (pen, obs) and their absence was intriguing, although little conclusion can be drawn from a single site. Two colonies of Rhumphelia were also recorded from a deep waver diver survey at about 30 m depths.

Marine Algae - Peter Vrana (US-Botany).

American Samoa has a rich algal flora that is in much need of detailed scientific research. Although a few studies have documented species composition from select areas, published species records probably vastly under represent actual species numbers. From our recent investigations, sites around Tutula Island and the Manus Island group revealed a diverse turf community that undoubtedly consists of several dozen filamentous red, green, and brown algal species. Macroalgae varied in abundance between sites, and although laboratory confirmation is still required, represent over 43 species in 35 genera. Additionally, crustose encrusting red algal were of major importance at all sites, forming pavements that cement the reef together.

One of the most interesting aspects of algal collections from Samoa is the paucity of brown algae. Although brown algae are usually present in smaller numbers than green and red algae in tropical locations, only one species of Dictyota was collected during our 7 days of field surveys. Future laboratory analysis of preserved specimens may reveal additional genera, however, the percentage of browns will remain unusually low compared to the percentage of greens and reds collected.

Tutula Island: Samples still being collected.

Tau Island
Sites TAU1 (E side), TAU2 (S side), TAU4 (N side), and TAU5 (N side) all ranged from 30 to 50 ft deep, and exhibited diverse coral communities with a surprisingly high number of algal species compared to other islands in the Manus’ group. The green algal genus Dictyosphaerium, Chlorodesmis, and Halimeda were found at essentially all of these sites. Other genera included: Dictyota sp. (brown algae); Acetabularia sp., Brooklyn sp., Bryopsis sp., Caulerpa taxifolia, Chalcopytha sp., Thamnophis expediente, and Valonia sp. (green algae); Actinosphaerium sp., Amphiroa sp., Chondria sp., Filidium sp., Fucus sp., Rhipidoglaea sp., Laurencia sp., Laurencia sp., Laminaria sp., Peyssonnelia sp., Phoreia hemipneu, and Wrangelia sp. (red algae).

Site TAU1 was located on the SW corner of the island, and obviously was a site subjected to extreme water motion. The site was covered clean of essentially all but small corals and turf algae. The only macroalgae found consisted of small clumps of Dictyosphaerium versiculosus located with depressions in the carbonate pavement, and a few small clumps of Laurencia. Site TAU2, located on the NW side of the island, exhibited an environment in between that of TAU1 and the four previously described sites. Although it looked as if it had been recently scourred (perhaps by a hurricane?), it exhibited a richer algal flora than site TAU1. Genera found included: Acetabularia sp., Chlorodesmis sp., Dictyosphaerium sp., Halimeda sp., Nemerium sp. (green algae); Chondria sp., Laminaria sp., and Laurencia sp. (red algae).

Olu/Oloeaga Islands
All sites consisted of typical spur and groove reef formations (30–50 ft deep) with fairly diverse coral communities, but relatively little macroalgal cover. The one exception was site OLI14 where dense and extensive beds of Halimeda species occurred. The most common algal genera encountered included:
Marine Invertebrates - Scott Godwin (Bishop Museum)

A total of 5 sites for Tutuila and 10 for the Manu'a Islands were surveyed during the period between Feb. 9-15. The focus was to cover as many areas at each site as possible. No permanent transects were set up during this survey period. The accomplishments for each survey site are as follows:

Tutuila: Surveys were begun E of Pago Pago and continued to the central N shoreline.
Sites surveyed included: Alega, Fagalua Bay, Aiala, Aiteau, Mainau Bay.

Manu'a Islands:
Ta'u - Surveys were begun at the SE shore and proceeded to the SE, then a second set was begun at the NE shore and completed at the central W shore. Sites surveyed included: lcs north of Tutu Pl, Luava'u waterfall, Mi',u'eale Pl, NE shore, Lofo Pl, and Ta'u Village.

Oloa - One site was surveyed on the E shore and one on the W shore. Sites surveyed include: central E shore and Sili Village.

Oloa - Beginning on the central N shore and moving to the central S shore, the following 5 sites were surveyed around Oloa; N shore, the proposed airport extension, S shore due E of Pasoloa Pl, S shore near To'a'a, S shore near To'a'a (deep dive 180 ft) in conjunction with snorkel survey of intertidal area.

General Impressions

From interviews with local residents and with the American Samoa Bureau of Marine and Wildlife Resources, there does not appear to be heavy near-shore fishing pressure from local residents at any of the sites. Stress to the near-shore communities appear to be from natural events. Damage attributed to storms and heavy wave action appear to be the most influential and predator activity, such as Crown-of-Thorns starfish, seems to have minimal impact. The populations of macro-invertebrates do not appear to be impacted by human activities.

The distribution of marine macro-invertebrates does not appear to be evenly distributed between the shallow blow-reef area and the shallow reef slope (20-45 feet). Many more species regularly occur in the reef flats and not on the reef slope. This is especially true of echinoderms, which are rare to absent on the shallow reef slope. The one macro-invertebrate species that is an exception is the giant clam. These appear rarely in the reef flats and exist more commonly on the shallow reef from 15 to 30 feet. On Tutuila, giant clam populations were rare or not found shore and common on the north shore, and they were common in abundant throughout sites in the Manu'a Islands. Overall, the macro-invertebrates on the shallow reef slopes tend to be hermit crabs, gastropod mollusks, and giant clams. The back-reef flat areas had large numbers of sea cucumbers and sea urchins, and considerable numbers of other species found throughout the habitat from the reef flat to the reef slope.

Oceanographic Monitoring Stations - Brainard (NMFS), Holtzworth, Kenyon, Chepmanki and Hoke (JIMAR)

Surface Argos SST Buoys

A surface Argos SST buoy (#2) was moored in 76 m of water on a sand and coral rubble patch near the entrance to the small boat harbor at Aunu'u Island at position 14°17'.023S, 170°33'.737W. Another surface Argos SST buoy #3 was moored in 17 m of water on the reef slope on the E side of Ta'u Island at 14°14'.140S, 170°33'.134W. These buoys record sea surface temperature (SST) every 10 minutes and transmit hourly averages daily using the Argos satellite system. These near-real-time measurements will provide scientists and resource managers with the ability to remotely monitor the actual water temperatures over the reef. Since water temperature is one of the key variables affecting reef health, this monitoring will allow us to remotely evaluate potential threats to the ecosystem caused by extreme warming due to strong El Ninos or global warming. These in-situ measurements will be linked to the Coral Reef Early Warning System.
System (CREWS) to provide early warnings and to groundtruth satellite measurements of SST in this region.

Oceanographic Observations - Zgliczynski, Cornish, White, Hooke and Brainard
Closely-spaced (~35 nmi) CTDs were conducted around Tutuila (2), Ta’u (31) and Ofu/Olosega (39) islands to investigate the small scale ocean dynamics of these reef ecosystems. Three CTDs, which were conducted to a depth of 50 m, included measurements of temperature, salinity and chlorophyll a versus depth.

A grid of 4 shipboard CTD stations were conducted to a depth of 500 m around the Manu’a Island and acoustic Doppler current profiler transects were repeated each night for four nights to examine the vertical structure of water properties (temperature, salinity and chlorophyll a versus depth) and ocean currents surrounding these islands.

Surface Velocity Drifters - Hooke, White and Brainard
Three satellite-tracked surface velocity drifters were deployed to track upper ocean currents in the waters of American Samoa. Information on ocean surface currents will assist scientists in evaluating larval transport and recruitment dynamics in the waters of American Samoa and will assist resource managers in evaluating locations and the effectiveness of marine protected areas. Drifter buoy #35645 was deployed 3.5 nmi NE of Tutuila. Drifter buoy #35646 was deployed midway between Tutuila and the Manu’a Islands. Drifter buoy #35644 was deployed E of Ta’u. Positions for these positions are determined using the Argos satellite system. Drifter tracks will be made available on the Honolulu Laboratory website.

Acoustic Signatures - Zgliczynski, Hooke, Chojnacki and Brainard
In collaboration with colleagues at Eastern Carolina Univ (Lucasovich and Sprague), we deployed a prototype Remote Underwater Digital Acoustic Recorder (RUDAR) at Ta’a and Olosega Islands to continue gathering baseline information about the acoustic signatures of coral reef ecosystems. These systems continuously record acoustic signals of the reef habitats for 25 hour deployments. Each deployment records 2 Gbytes of information which will be used to help develop a method to remotely monitor to biological health of these remote ecosystems acoustically. The RUDAR deployed at Ta’u had water inside the housing upon recovery. While the data was saved, the instrument suffered electronic damage which cannot be repaired in the field.
Summary Reports

Habitat Surveys - Brionard, Zgliczynski (NMFS), Holsworth, Kenyon (NMFS-UH-JMAR)

Towed Diver Survey:
Conducted 18 towed diver habitat/fish surveys around the reef/slopes surrounding all of Swains' Island at 2 depths (typically 8-12 m and 12-20 m). A total of about 20 km of bottom habitat was mapped around Swain's Island. The tows were relatively high live coral cover around the entire area at most depths. While generally relatively homogenous, the coral and algae communities did show pronounced vertical and subtle horizontal heterogeneity. As would be expected, coral cover was low near the reef crests in water depths less than about 4 m. Coral cover quickly increased away from the surf zone with 55-90% live coral cover being common in depths of 8-15 m. Below about 20 m depths, coral cover was typically reduced to 20-40%. As mentioned in the coral section below, tows on the southern flank of the reef slope had more coral cover. The northern tows had greater total cover and increased coraline and macroalgae cover (up to 45% in some areas). Although most of the reef slopes had relatively high live coral cover, most of the coral colonies were small and apparently relatively young. This would support the hypothesis that a recent and devastating natural event (hurricane, tsunami, or bleaching) occurred in the early to mid-1970's as discussed below. Some areas of the reef slope had notable abundance of the fleshy macroalgae Acanthaster and associated coral damage. Some areas reportedly dead coral, apparently due to Acanthaster and possibly bleaching, as high as 80% estimated. Only two giant clams were observed during the two surveys. Interestingly, no echinids, sea cucumbers or lobsters were observed during the towed surveys. Only a few small pieces of bleached fish were seen during the surveys.

The fish surveys from the tows on the southern flank of the reef slope had greater total cover and increased coraline and macroalgae cover (up to 45% in some areas). Although most of the reef slopes had relatively high live coral cover, most of the coral colonies were small and apparently relatively young. This would support the hypothesis that a recent and devastating natural event (hurricane, tsunami, or bleaching) occurred in the early to mid-1970's as discussed below. Some areas of the reef slope had notable abundance of the fleshy macroalgae Acanthaster and associated coral damage. Some areas reportedly dead coral, apparently due to Acanthaster and possibly bleaching, as high as 80% estimated. Only two giant clams were observed during the two surveys. Interestingly, no echinids, sea cucumbers or lobsters were observed during the towed surveys. Only a few small pieces of bleached fish were seen during the surveys.

TOAD/UC - Hooke (NMFS-UH-JMAR) & White (TC)
Very steep topography surrounding Swains' Island prevented the ship from approaching close enough to the shallow water sites to allow QTC acoustic and TOAD optical habitat mapping. Since the TOAD and QTC could not be used for habitat mapping at Swain's, the opportunity was afforded to make work on and test modifications to the TOAD. The ship's engineering department provided assistance in fabricating replacement components to try to improve the TOAD's performance while towing.

Fish - Ed DeMartini (NMFS) and Robert Schroeder (NMFS-UH-JMAR)
The fish census team surveyed 10 stations at Swains Island. Quantitative transects were conducted at 6 stations and qualitative REA surveys at another 4 stations. Stations were located on all sides of the island. The N side was exposed to a large (> 2 m) swell and strong surge at < 10 m depths during this time but underwater visibility was consistently < 20 m. At some stations moderate surge occurred at the transect depth (15 m). The benthic team followed the fish team at all visual census sites and most REA sites.

Fish transect-stations were conducted using the same, previously described surveying protocols used on the Phoenix Islands cruise leg and around the main islands of American Samoa. All quantitative transects were set along a single depth at 15-15 m. Additional, qualitative surveys spanned 1-30 m depths.

This was the first time coral reef fish surveys were conducted by the NMFS as Swains Island. Fish species diversity (richness) was generally low at the spatial scale (2000-5000 m²) of individual stations, averaging only about 30-35 species out of the total pool of species observed at Swains. Pelagic predators like yellowfin tuna were encountered. Sharks and some other reef-associated species, predators such as giant trevally were rare. Other large reef-associated fish (snappers, groupers, rainbow runners, barracudas, dogtooth tuna) were nevertheless more abundant at Swains than observed previously at Tutuila or the
Manus Island. Groupers also were more abundant at Swains but small (< 30 cm total length) Gray reef
sharks (Carcharhinus amblyrhynchos), reef whitetip sharks (Triaenodon obesus) and reef blacktip sharks
(Carcharhinus melanopterus) were the only three species of shark seen at Swains, with only one sighting
on the transects. Local fishing pressure at Swains is presently very light as only one family of four currently
resides on the island, but up to 100 families have lived on Swains during recent decades.
In addition to the 6 quantitative transects, 4 qualitative stations (2 deep: maximum 21-28 m and 2 shallow:
3-8 m) were conducted as supplemental the list of total fish species present at Swains. Additional fish
species were also noted during the limited time following each visual transect but no fish-look observer
was dedicated to making a species checklist during the entire dive. Andy Corish and Lida Prekaski
(benthic team) and Brian Zgliczyński (tow team) also contributed to the fish species checklist at the end of
the dive. A grand total of 568 fish species were observed at Swains during the four day visit. The only
other existing fish survey data at Swains consists of a single pair of stations visually surveyed by A. Green
on the SW side in 1995 and described in her 1996 unpublished report to the Department of Marine and
Aquatic Resources of American Samoa. Green reported 67 fish species at 10-m depth.
New species (currently being described by others) Dacollaria aurumnata (yellow belly) and Centropyge
of honali (which lacks dorsal) were also observed at Swains.
DeMartini and Schneider also collected 15 specimens of the weeny hawkfish, Paragobiodon atactatus.
These are contributing to an ongoing study of the genetics of this polymorphic species throughout the
Pacific being conducted by DeMartini and G Bernardi of the University of California at Santa Cruz.
Stony Corals – Jim Maragos (USFWS)
Geologically, Swain’s Island is the southernmost of the 4 atolls comprising the Tokelau Islands, but it is
under the jurisdiction of the U.S. and Territory of American Samoa. Few published marine biological
or coral surveys are available for Swains, and our trip provided the first opportunity for detailed observations
of the reef. The local Samoan name is Tuvalu Lata-Mali, meaning “the Tokelau island closest to Samoa”,
according to Foi (Suffol Fa’amu), a knowledgeable terrestrial biologist with previous survey experience
at Swains and who accompanied our expedition. Foi said that the local residents experienced a devastating
hurricane in 1991, possibly a coral bleaching event in 1994, and a tsunami consisting of 3 large waves that
passed over the S of the atoll near Etuna in 1995. After the tidal waves, all residents except a small family
evacuated Swains, leaving only four residents, the parents and their 2 children living on the island.
According to Foi, Swain’s once had a shallow passage into the lagoon on the west side that was blocked by
changes wrought by hurricanes. Residents remember the marine life dying and more turbidity in the
“lagoon” after the hurricane. The marine lagoon is now a brackish water lagoon, devoid of any marine life.
Stony coral biologist Jim Maragos spent 4 days at Swain’s and accomplished 5 SCUBA or snorkel surveys
at 17 sites, including 6 REA and transect surveys at depths of 5-13 m, deeper (15-25m) REAs without
transects at 2 sites, and establishing 9-10 permanent transects at 2 sites (SW-A-9P, SWA-10P) at a
depth of 5-10m. In addition, snorkel surveys were accomplished at the freshwater lake or lagoon, which is
now entirely landlocked. The survey technique followed the earlier described protocols for Howland and
Baker islands, except that photographs, rather than video footage, was acquired along the transect lines at
the shallow REA sites. Both video and photographs will be later analyzed to quantify coral communities
along both permanent and REA transect sites in terms of size class distribution, frequency, species richness,
morphology, and percent coral cover. One 15 cm coral core of Pocillopora obtusa was collected at site SWA-9P
off the NW reef of Swain’s at a depth of 6.5 m. The core will later be analyzed to estimate annual and seasonal
growth rates, age, and calcification temperatures as part of a larger central and NW Pacific investigation.
Observations revealed that shallow reef depths to depths of 15m are dominated by stony corals covering 50-
95% of the flat reef around the island and averaging 75% live coral for the entire perimeter of the island.
What is surprising is the total coral species composition for Swain’s is only 78 stony corals and 2 non-
stony corals. The coral communities are poorly zoned at depths less than 15m, although larger heads of
Pocillopora, Favia and Favia protostellate below depths of 15m. Only a sparse table corals (Acropora)
and brain corals (Echinopora, Favia, Leptastrea) were present, in unusual circumstance for low-latitude
central Pacific coral reefs. Above a depth of 15 m the largest corals measured 2 m in diameter (mostly the 3rd growing plate coral Montipora aequituberculata) but most other colonies are less than one-half to one meter in diameter, suggesting a young and healthy "pioneering" coral community reestablishing on the previously submerged reef slopes of Swains. Several species besides M. aequituberculata dominate the coral communities including Stylophora pistillata (max. diameter of 30cm), Pocillopora euryoides and P. meandrina (max. diameter 1m and 0.5m respectively), and P. verrucosa (30-50cm max. diameter).

Collectively these 5 species accounted for 90% of the coral communities at depths less than 15m.

Further evidence of a shift to a younger population are residual large (2-4m diameter) colonies of Porites, Favia, Favia, and others in deeper water that likely survived the forces that devasted corals at lesser depths. This leads to the conclusion that large waves from the hurricane may have destroyed the corals on the shallow reef slopes, leading to rapid growth and colonization of new coral colonies now dominating these reef slopes. The crown-of-thorns starfish Acanthaster planci are actively feeding on live corals, especially below depths of 10m, and the predation may be selectively reducing the proportion of preferred prey species Pocillopora acuta; Pocillopora meandrina, Favia mollispora, Montipora aequituberculata, and Porites damicornis and even Porites which is not normally predated upon. Table corals (Acropora) are normally a preferred prey food for the crown-of-thorns starfish, and perhaps earlier predation contributed to the present paucity of these species at Swains.

Conditions are very favorable for coral growth and diversification in future years in the absence of catastrophic events. Underwater visibility exceeded 80m at most sites, and there are no known sources of pollution, contaminant, sedimentation, construction impacts. Anchor damage was noted near the two small boat passages and perhaps heavy fishing pressure occurs at Swains, but the impacts on some coral species are negligible to date. In the absence of data collected before the large hurricane of 1941, it seems safe to conclude that Swains' corals and reefs are in healthy condition and well on the road to complete recovery.

The lower diversity of coral may be in part the result of geographic location, the small size of the island, the lack of sufficient time for many other species to successfully establish at Swains in the wake of the catastrophic events of the early 1990s. Certainly the maximum diameters of shallow water corals observed at Swains falls within the range of known coral growth rates for similar species (1-10 cm per year, depending on species and growth form). Certainly all of the dominant species could have established within the past decade under the favorable conditions observed at Swains. Recovery of permanent transects and additional transect studies elsewhere in future years will help explain the present situation and better predict future conditions for corals at Swains.

Octocoral (soft coral) surveys - Andy Corsham (DMWR)

The swim-survey methodology conducted at Tutuila and the Manu'a group was continued at Swains Island.

Six transects spaced widely around the island, 3 along the N-shores and 3 on the S, were surveyed with the fish and benthic teams. In addition, 2 deeper collecting dives were made off the SW coast (depths between 20 and 28 m) and observations made whilst associating with other surveys at 3 additional sites.

Swain's Island proved to be remarkably depauperate with regard to octocorals; none were recorded on the reef slope to 15 m depth, either along the 12 x 100 m swim-surveys at 8 and 15 m during any of the dives to this depth. Furthermore, no octocorals were observed by B. Godwin and L. Prisant in their survey of the intertidal zone, nor by the towboat teams that comparatively circumnavigated the island at 2 depths.

Indeed, the only octocorals encountered were small communities of Sinularia colonies, some long established, on a vertical wall at 25 m on the NW tip of the island. Several specimens were taken for more detailed identification.

The total absence of octocorals on the Swains shallow reef slope is in stark contrast to similar habitats in Tutuila and Manu'a, where octocorals were present at 16 of the 17 sites. The only site where octocorals were absent was a highly exposed reef at To'a's where live coral cover was estimated to be less than 5%. It was noted from the previous sites that there was a general trend of increasing soft coral diversity and abundance with increased hard coral cover. This trend clearly did not hold for Swains where soft corals were absent but where hard coral cover was consistent. High, being estimated at between 40-50%, and 80-90% on all 8 and 15 m depth transects.
The most likely explanation for the scarcity of octocorals at Swains Island is that communities were largely wiped out by the widespread mortality event that seems to have devastated the hard corals (see this report). This theory is supported by the presence of an established octocoral community on deeper reef where old scleractinian coral colonies were also present. Several pioneering hard coral species are now flourishing at Swains, the octocorals in closest show no signs at present of re-establishing the shallow reef slope. This is likely due to a paucity of larvae reaching the shallow reef slope propagated by surviving colonies in deeper waters, or other nearby efts (which are notably few). Another explanation may be that octocorals have always been scarce at Swains due to poor larval flow (the habitat would seem to be suitable), a theory which is hard to disprove without historical data showing the presence of soft corals in the shallows at Swains. The available literature will be examined for this in the future. In the meantime, these surveys will be invaluable in setting as baseline data in documenting any colonization of the reef slope by octocorals in the future.

Marine Algae – Linda Preskitt (UH-Botany)

This investigation provides the first inventory of algae at Swain’s Island. With no previous algal records, algal surveys focused on sample collection for herbarium archives and laboratory identification, and field photography of algal communities to initiate a formal record of species composition at Swain’s Island.

Nine surveys conducted with the benthic coral team were located around the perimeter of the island to sample’s variety of locations with varying exposure. The sites were surveyed by SCUBA at 8 to 12 m, with one site at 22 m. All the sites were on reef slopes subjected to constant surge from wave action and little current. Snorkel surveys on two reef flats and in the lagoon lake were also done.

All 9 reef slope sites were heavily covered by corals and the algae community has a surprisingly low diversity. The algal community was dominated by a number of crustose and upright species of coralline algae, and the non-coralline were represented primarily by a few species of green macroalgae and red filamentous algae. The sites were quite homogenous, with a handful of macroalgae species found at all sites. The macroalgae community consisted of Microdictyon setchellianum, Holmeda sp., Udotea sp., Dictyosphaeridia coronaformis, and Cardia sp. (green algae). The most common red alga was Microdictyon setchellianum, which was located in open exposed areas where it forms dense, tightly packed tufts tucked in among the spreading Montipora corals, and was sometimes covered with microscopic algal epiphytes and red filamentous algae. Species of Udotea, Caulerpa and Halimeda grew in small communities and individual stands in the more shaded, protected areas under overhangs and coral heads.

Much of the coral rubble and open hard substrate was covered with many species of crustose and upright coralline red algae. Peyssonnelia sp. (red) and small, dense turfs were attached to the base of the uprights. The underside of most of the Montipora plates was covered with thick red turfs. The few red macroalgae that were found included small ephytic calcareous species of Jania, Laurencia sp. in turf, and one sample of a Dasya sp. attached to the underside of a Montipora coral plate. At all sites red filamentous algae were attached to the edges of coral and coralline algae or ‘neath thick, spreading mats attached to coral rubble. The filamentous and turf algal require additional laboratory analysis for identification.

The reef flat was a shallow (approximately 1 meter deep) carbonate pavement with occasional grooves with coarse sand and some algae attached to the sides. The algal community on the reef flat comprised of Dictyosphaeridia coronaformis and versalitii, Cardia sp., Udotea sp., Roodia sp., Microdictyon setchellianum, and diverse turfs. The reef flat also produced two additional species of red macroalgae: a calcareous goosone (possibly a Dichelogalaxia sp.), and another Jania sp.

The lagoon lake was a lens of fresh water over a deeper layer of salt water. From the coral rubble and mollusk shells scattered on the substrate, it appears to have at one time been an open saltwater lagoon. The freshwater lake’s substrate was completely covered with cyanobacteria colonies, either as a solid sheet in which small fish lived in burrows, or in the form of irregular small masses that congregated on the bottom and formed a thick, loose moving layer, estimated to over 2 feet deep in some areas. Cyanobacteria colonies in marine turf conditions are known to be high in photosynthesis activity and important nitrogen fixers. These successful strategies may be partly responsible for this unusual phenomenon on the lake bottom. Samples of the different colonies were made, but additional laboratory analysis is necessary for identification.
Marine invertebrates – Scott Godwin (Bishop Museum)

Surveys focusing on marine invertebrates other than corals were performed in conjunction with surveys of coral and macroalgae, collectively termed the benthic survey. A freshwater lake exists in the central portion of Swain’s Island, and this was roughly surveyed by snorkeling.

Methods
Surveys for marine invertebrates were done qualitatively along 2 separate 50 m transect lines. A zigzag pattern that extended roughly 2 m on either side of the transect line was done for each of the 2 lines. Once this was accomplished, a brief swim of the general area was done to record species away from the transect area. A single invertebrate survey was accomplished by swimming two transects from the shoreline to the reef crest. Swain’s Lake was surveyed by swimming two transects from the shoreline to the center of the lake. Species were recorded and the qualitative abundance was given using the DASCOR method (Dominant, A-Abundant, C-Common, Uncommon, and Rare).

Accomplishments
A total of 10 surveys for marine invertebrates were done while at Swain’s Island, which are summarized as follows: 6 outer reef surveys on N, S, E, and W sides of the island with 7 surveys ranging from 5-15 m and 1 survey ranging from 12-22 m. 1 intertidal survey from shoreline to reef crest on the southernmost portion of the island; and 1 survey of Swain’s Lake from shoreline to the center, which included a bumper survey and plankton tow.

General Impressions
Overall Reef
The outer reef slope areas of Swain’s Island had impressive coral cover but low diversity. This coral reef community appears to be a pioneer stage following a large-scale disturbance that has affected the entire reef around the island. Marine invertebrates were not very abundant and not very diverse across all sites. The sites will be summarized by a breakdown of taxonomic groups.

Molluscs – Gastropods ranged from common to occasional with there being an even makeup between the families recorded. The gastropod species recorded were midsizes distributed in the 15-30 foot depth zone. Giant clams were extremely rare areas the 8 sites surveyed and only appeared in the 30-50 foot depth zone.

Crustaceans – As with most coral reef habitats, most decapod crustaceans, with the exception of hermit crabs, are cryptic during daylight hours. With size in mind, hermit crabs are the most likely crustaceans noted during the surveys. It is possible to observe lobsters as well, but holes, overhangs, and other retreats are examined during surveys. Hermit crabs were common through the 5-10 m depth zone but were rare in the deeper areas. Judging by conch morphology examination, there are only 2 common species observed during surveys. No lobsters were seen during surveys but a segment of a molt was found during the 15-22 m survey dive.

Echinoderms – There was a surprising lack of sea urchins, sea cucumbers, and sea stars throughout all habitats surveyed. The only species commonly occurring through all sites surveyed was a single species of rock-harbor urchins. These urchins occurred in small numbers on the walls of surge channels. A single species of sea cucumber was noted below 70 feet on a sandy area of the slope but at other sites surveyed. The Crown-of-Thorns sea star was the only commonly seen sea star, and it tended to be at depths below 40 feet. Brittle stars were found irregularly at the bottom of surge channels.

Other species – There were other species commonly seen at all sites surveyed, which tend to be grouped under the sessile feeding organism category. There was a single species of yellow sponge seen regularly and two species of hydroids. Other common sessile species normally found in this habitat were commonly absent.

Intertidal
The intertidal area surveyed was hard carbonate pavement with sparse coral rock and abundant holes scoured into the surface. The same taxonomic groups common on the outer reef were present in the intertidal.

**Molluscs** - Gastropods were more abundant and diverse in the intertidal but still not as much as would be expected. Giant clams were completely absent in this habitat at Swain's Island.

**Crustaceans** - A single species of hermit was abundant in the habitat. Lobster carapace was noted occasionally, away carapace of a large xanthid crab.

**Echinodermata** - Expectations were for the echinoderm groups absent from the reef slope in the intertidal. Although a single species of sea cucumber was found commonly, the echinoderms swam was truly lacking in the intertidal zone. The rock-boring urchin seen on the reef habitat was rare to absent in the intertidal area surveyed. Lastly, there was a single species of brittlestar associated with the coral boulders located in this habitat.

**Swain's Lake**

This was an unusual habitat dominated by live-green algae mass located on the lake bottom. There was an abundance of 3 different bivalve shells and a single small shell on the bottom but no live specimens were found. Two fish specimens (Gobiidae) were obtained during the survey.

**Oceanographic Monitoring Station** - Brainard, Zgliczynski (NMFS), Holzwarth, Kenyon, and Hooke (MMPF-UHI-JMAR)

**Subsurfice ADPCT/CTD Mooring**

A subsurface mooring (M01) was deployed on the deep SW reef slope of Swain's Island to remotely monitor an site of oceanographic conditions affecting the health of the reef ecosystem. The mooring is situated in a relatively small flat sandy hole completely surrounded by healthy coral reefs with about 80% live coral cover including high abundances of Acropora sp and Porites sp. Breaking waves are observable on the sandy reef slope above this steep reef slope. This mooring consists of a 1200 ft concrete mooring with an easily removable instrument package which includes a SonTek acoustic Doppler current profiler and a SBEsidero/MicroCat conductivity-temperature-depth (CTD). These systems will record in-situ measurements of temperature, salinity, and pressure, profiles of 3-dimensional ocean currents (speed and direction) from near the bottom to near the surface at 0.2 m intervals, and wave energy and duration every 2 hours (or less) for the next 2 years. The coral reef ecosystem of Swain's Island is constantly changing in response to changes in ocean temperature (affecting coral growth rates and survival), the destructive forces of large wave events associated with hurricanes and typhoons, and the transport and recruitment of larvae by the ocean currents. This subsurface monitoring system will assist scientists and resource managers in better understanding biological changes to this remote ecosystem.

**Surface Argos SST Buoy**

Although we intended to deploy a surface Argos SST buoy at Swain's Island to allow near real-time transmissions of sea surface temperature, extensive surveys of reef slopes and reef flats were unable to locate any sites acceptable for long-term survival of the buoy. The reef slopes on all sides were much too steep. Given the required scope in the mooring line (251), any mooring sites on the reef slope would have placed the buoy in the breaking surf during on-shore wind conditions. The reef flats were either unshaded or too shallow during low tide to allow safe mooring there.

The SST buoys deployed off Atum Island and Tsu Island are properly transmitting temperatures to the Honolulu Laboratory.

**Oceanographic Observations** - Brainard, Zgliczynski, White, and Hooke

Fourteen closely-spaced (~15 mm) CTDs were conducted around Swain's Island to investigate the small scale ocean dynamics of these reef ecosystems. These CTDs, which were conducted to a depth of 30 m, included measurements of temperature, salinity, and chlrophyll a versus depth. An additional 5 CTDs were conducted within Swain's Lakes to determine possible exchange rates with the surrounding ocean. For the lake survey, the fluorometer was replaced with a dissolved oxygen sensor. The lake was found to be only slightly brackish (~2.5 PSU) down to the depth of a soft estuarine layer of blue-green algae covering the lake's bottom. When the CTDs was allowed to penetrate into this thick algae layer, temperature increased by about...
A grid of 4 shipboard CTD stations were conducted to a depth of 500 m around the Swan’s Island and acoustic Doppler current profiler transects were repeated each night for three nights (2 CTDs on the 3rd night). It was the vertical structure of water properties (temperature, salinity, chlorophyll a and dissolved oxygen versus depth) and ocean currents surrounding this remote island.

Surface Velocity Drifters – White, Hook, and Brainard
Satellite-tracked surface velocity drifter buoy #3 was deployed to track upper ocean currents in the waters of American Samoa. Information on ocean surface currents will assist scientists in evaluating larval transport and recruitment dynamics in the waters of American Samoa and will assist resource managers in evaluating locations and the effectiveness of marine protected areas. Drifter buoy #35645 was deployed 3.5 nm NE of Tutuila. Drifter buoy #35646 was deployed midway between Tutuila and Manu’as Island. Drifter buoy #35648 was deployed E of Tutuila. Positions for these positions are determined using the Argus satellite system. Drifter tracks will be made available on the Honolulu Laboratory website.

Acoustic Signatures – Hoeko (NMFS-US-JIMAR), White, Mowitt, Callahan (TC) and Brainard
In collaboration with colleagues at Eastern Caroline Univ (Luzhkovich and Sprague), we deployed a prototype Remote Underwater Digital Acoustic Recorder (RUDAR) at two sites along the S and SW reef slopes of Swan’s Island to collect baseline information about the acoustic signature of coral reef ecosystems. These systems continuously record acoustic signals of the reef habitats for 25 hour deployments. Each deployment records 2 Gbytes of information which will be used to help develop a method to remotely monitor the health of these remote ecosystems acoustically. The 2nd RUDAR deployment at Swan’s had water inside the housing upon recovery. While the data was saved, the instrument suffered electronic damage which cannot be repaired in the field. This is the 2nd flooded unit of the cruise suggesting a faulty design in the commercially provided unit.

Terrestrial Activity Summary – Joshua Swammon, Ph.D. and Sandon Fa’amu (ASG, DMWR)
Methodology
Set Arthropod Transect (ATR)1 SE from Taualuga to Namu (lagoon); 10 sets of wet/dry pitfall and yellow traps. Established, flagged (single red flag), and surveyed Vegetation Transect (VTR) #1 extending roughly from SE of SI (old Eli Leming residence) to Taualuga clearing - 23 stations at 100 m intervals. At each station a categorical assessment of woody plants (not herbaceous, ferns, or vines) abundance was conducted by scoring presence or absence in each of four quadrants oriented along the primary cardinal quarters for each species, as well as notes on phenology, size and other species representing significant components of the vegetative community. Checked and collected specimens from ATR #1, Creepad, marked, and surveyed VTR #2 - N from Taualuga to coast, then SE to Namu (lagoon) - 18 sta, std methods. Conducted manual survey and collection of litteral (macro) insect fauna S from Taualuga shore access point. Checked and collected specimens from ATR #1. Created ATR #2 (littoral, 10 sta, yellow traps only) and ATR #3 (grassy clearing and agroforest edge in Taualuga, 5 sta, yellow traps only). Created, marked and surveyed VTR #3 along coast S from Taualuga (20 stations, std methods); Checked and collected samples from all ATR, then all traps pulled.

Notes:
1. Geographical positions were recorded for salient points using a Trimble Geodimeter 3. Generally, only two points were taken per VTR/ATR due to difficulties in getting satisfactory signals in the forested areas.
2. Bird and mammal observations were recorded incidentally during other surveys.
3. This text was prepared sans taxonomic guides, so generic or specific misspellings may occur.

Summary:
Leptocentrum - Cocoa nucifera is the most dominant component of the vegetative community in forested areas of Swan’s Island (SI), but most of the standard low-island flora are also represented. Species distributed widely and commonly across SI include Guadara spicata, two species of Pandanus, and Hordonia nymphaphylla. Species that are locally common but more clumped in distribution include Calyptrium
Imophila, Cordia subcordata and Pisonia grandis. The shoreline community is composed of species commonly found on remote Pacific islands, with Scavola aequata and Towrerania argensia the most common. Of note is the occurrence of very large individuals of Arocarpus utilis, C. imophila, C. subcordata, and T. argensia, and the generally small and stunted physiognomy of Morinda cordifolia (which may be a more recent arrival).

Orthoptera - Preliminary impressions (since systematic analysis of trapping data will be conducted later) suggest a skewed insectivorous fauna. Well represented (allowing for the isolation of Rj) are Lepidoptera, Diptera and Hymenoptera (primarily ants). Mosquito abundance was high, but more specific collection methods should be used to assess their species diversity. Most other groups seem poorly represented, including Coleoptera and Araneida, although at least one representative of most higher-level taxa was observed.

Mammals - Rumur: very little evidence of rats was found - only a single individual was seen, and that well inside the forest. Kelis - common in Tsuacii (10 individuals seen), only occasional in more remote areas, typically along beaches (2 individuals seen, plus occasional tracks). Home - most recent invasive activity (i.e., nesting vegetation instead of simple gleaning) seems to be confined to pre-existing settlement areas such as Tsuacii and the old Anigisa's property, or major paths connecting such areas.

Birds: Only 2 land (not shore) bird species were found: Ducula pacifica (presumably resident, since ample resources appear available) and Eudynamis helvola (a potentially migrant from the southwest Pacific, although occasionally seen throughout the year on Tsuacii). Abundant shorebirds include Limosa lapponica (coastal beaches are exposed reefs, grassy areas, and lagoon edge) and Heteroscelus longirostris (coastal and lagoon margins). Arocarpus superbus was an abundant but regular ex coast and grassy areas. Buff white and dark morphs of Ergata oncorhynchos were seen, but abundance was not high. Seabird nesting was only (indirectly) confirmed for two species: Gygis alba and Anous stolidus. The latter was very abundant, both at sea and on land. Other seabirds common to the region were observed only over the ocean near Rj, not on the island proper.
Crust Summary Statistics (in data)
Towed diver habitat surveys - 79 tows, -240 km
Towed fish surveys - 79 tows, -240 km
QTC acoustic-habitat mapping - 997 km
Teledreded Optical Assessment Device (TOAD) - 21 dives, 112 digital plots, -9 hours of video
Fish survey stations - 65 stations
Benthic REA surveys - 65 stations
Permanente Transects Established - 5 stations
CREWS tow deployments - 1: Rose Atoll Settlement phase deployments - 2: Baker Inland, Swains Island Rose Atoll
AST buoy deployments - 2: Howland Island, Tutuila Island (2), Aunuu Island, Tru’u Island
Subsurface ADCP/CTD deployments - 2: Baker Island, Swains Island
American RCMF current meter deployments - 2: Rose Atoll pedestal, Step's Point (Tutuila Island)
Surface Velocity Dithers - 8: Tutuila Island (4), Tu’u’u Island, between Tutuila and Manu’a Group; Rose Atoll, Swains Island
AUDAR acoustic recordings - 6 stations (10 GB)
Shallow water (30 m) CTDs - 201 stations
Deep water (300 m) CTDs - 47 stations
AIDCP current profiles - -7000 km
Thermosalinity transects - -6000 km
Terrestrial Surveys - Swains Island, Rose Atoll

Summary Reports
Towed Div Heri habitat Surveys - Rusty Brown (NMFS) and Joan Kay's (NMFS-UIHJIMAR)
Rose Atoll
Fourteen towed divers/habitat surveys were conducted around the reef slope surrounding all of Rose Atoll at 2 or 3 depths (typically 2-10 m, 10-18 m, and 18 - 28 m) and 4 towed diver habitat/fish surveys inside the lagoon. A total of -54 km of benthic habitats representing all major habitat types, except the very shallows, were surveyed at Rose Atoll. Habitat “complexity”, a subjective assessment of the 3-dimensional roughness of the reef structure varied from medium-high to very-high throughout all surveys. Assessments of habitat complexity attempt to integrate both the fundamental architecture of the reef structure and the fine-scale microhabitats that are available to fish organisms (for space and shelter). The outer reef slope at Rose Atoll therefore provides a rich spatial heterogeneity in which a wide variety of reef organisms can potentially exist. The outer reef slopes are generally very steep, except for gently sloping terraces on the NE end and on the NE end of the diamond shaped atoll. Coral and algae cover are generally depth stratified on all of the reef slopes. Typically, live coral cover is low over the shallow (2-5 m) and moderately high (17-60%) over the intermediate depths (5-18 m). In these intermediate depths, members of the genus Porites dominate the coral fauna, followed by Acropora, Porites, Porites, and soft corals. Live coral had a healthy appearance, with few indications of bleaching or crown-of-thorns starfish (Acanthaster) predation. No crown-of-thorns starfish were noted during any of the tows.
Along some of the deeper (18-30 m) areas, such as the reef slope on the SE and NW sides, live coral cover, particularly pocilloporids and the presence of massive colonies of Porites, was high (40-60%).
The carbonate platform that forms the basis of the atoll is heavily encrusted with coralline algae and, to a substantially lesser extent, fleshly and turf algal. Assessments of 40-60% cover by coralline algae are common throughout the surveys. Interestingly, at the intermediate depths (5-18 m), the coralline algae commonly forms 3-dimensional castas (like "rosettes", tending to increase the overall roughness of the habitat at these depths. Among the fleshly algae observed, encrusting Lobophora and calcareous Halimeda are dominant. Virtually no benthic carbonate platform exists, it is invariably covered with encrusting corall or algae.
At each of the 3 depths surveyed along the NW reef slope, large increases in cyanobacteria (blue-green algae) were observed as the surveys approached the site of the 1997 shipwreck of the longliner "Sea Lion". The effects of the wreck can be clearly seen over a distance of 1 km. Well before the physical scars and deadened reef directly caused by the wreckages are seen, a dark layer of cyanobacteria (blue-green algae)
algae) appears. Live coral cover drops precipitously, from 20-30% to 5%. As one continues to move towards the center of the wreck site, the gridded hard-bottom pavement is increasingly covered and dominated by the dark cyanobacteria; aside from a few small coral heads and the cyanobacteria-covered carbonate, little other benthos life exists.

Portions of 2 towns included the high current channel into the lagoon. The benthos had a scattered, barren appearance, a few small colonies of Pavona clavus, and several Anara穿搭 managing to survive this narrow pass that is daily subject to currents that are reported to reach as high as 5 m/s (10 knots). Note: a current meter (described below) was installed to document the currents in this channel.

The towed diver surveys of the lagoon revealed primarily rubble and sand habitat (85-95%) around the perimeter of the lagoon with occasional pinnacle/patch reefs, particularly along the W half of the lagoon. The sand and white-back reef slopes are generally steep (30-40°). Although the towed diver surveys are not the best survey tool for the pinnacle patch reefs, it was evident from the surveys that the pinnacles were havens for much of the fauna of the lagoon. Relatively high densities of giant clams (Tridacna sp.) were observed on most of the pinnacles surveyed. The central portion of the lagoon consists of homogenous sand (60%) interspersed by occasional live or dead coral outcroppings (<10%). The live corals primarily included Eueropina myopoma, Manigoria verrucosa, Pachyseris, and Acropora arbuscans. Typical depths of lagoon wetter is 20-25 m.

Towed diver surveys at Rose Atoll revealed very few conspicuous macro-invertebrates. The few plant clams which were observed, aside from the lagoon pinnacles above, were found on the intermediate depth reef slopes on the N side. No sea urchins, crown-of-thorns starfishes (Acanthaster), or lobsters were observed at Rose Atoll. In some areas of the shallow reef slopes, boring sponges were observed in abundance.

Very few sea cucumbers (Holothuroidea) were observed during the towed diver surveys.

A small seine net was observed on the SE reef slope. This net was later recovered by ship's divers Mossvitt and White. A single coraline algae encrusted longline (could not distinguish whether bottom or pelagic longline) was observed extending about 40 m along the N reef slope. Based on the complete coraline algae cover, it is assumed that this reef has been at Rose for many years. Two anchors and a stainless steel box of some sort were found on the bottom just outside the channel into the pass in about 30 m of water. Several components of the 1993 shipwreck were observed along the SW reef slope.

Tutula

In addition to the 8 towed diver surveys conducted around the SE, E and NE sides of Tutula on Feb. 9-10 (reported previously), 9 towed diver habitat/fish surveys were conducted along the reef slopes of the SW, W and N sides of Tutula on Feb. 27 and Mar. 2-3. Each of these surveys were conducted within the 5–18 m intermediate depth range. These surveys revealed surprisingly high coral diversity and live coral cover in many areas. The SW and W end of Tutula were noted to have much higher coral diversity and cover than observed along the SE, E and NE reef slopes earlier in the month. High spatial heterogeneity of habitat was observed at all locations, most likely dependent on the level of protection from ocean wave conditions.

The topography can be generally characterized as a series of spurs and grooves, with occasional headlands, along with their associated fauna, from topographical characters provide regions of high to very high habitat complexity. Punctuating these high-complexity areas, however, were flat, relatively featureless stretches of carbonate pavement or basalt with only sparse cover of live coral. The more protected bays, such as Ammanave Bay, were observed to have the highest live coral cover and diversity while the more exposed headlands and other areas were often predominantly benthic habitat with only limited live coral of lower species diversity.

Topographic complexity was typically mirrored by the degree of live benthic coverage. On the high-complexity spurs of the spur-and-groove structure, coral cover ranged as high as 60%, with the chief components comprised of Acropora, Pavoniana, Eteropora, faviids, encrusting Montipora, Porites, and soft corals. Impressive stretches of large table corals stood in stark contrast to their absence along the tracks of the towed surveys conducted in early Feb. along the E portions of Tutula. A low level (<2%) of unencrusted dead coral was generally noted, assessed to be the result of bleaching rather than crown-of-thorns starfish predation. No crown-of-thorns starfish were noted on any of the surveys.
in contrast to Rose Atoll, where carbonate pavement was invariably covered with live coral or algae, and barren pavement was extremely rare. Substantial amounts of bare carbonate or basalt pavement were noted at some points along the W portions of Tutuila, particularly in areas of low relief. Not uncommonly, this bare pavement was covered with a thin veneer of sediment. This difference is likely attributable to both the different geologic nature of the two reef areas (i.e., atolls vs. volcanic high island) and the effects of human populations utilizing Tutuila.

Towed Diver Fish Surveys – Brian Zgliczynski (NMFS) and Stephen Holzworth and Joe Chopacki (NMFS-UH-JMAR)

Rose Atoll

The towed diver fish surveys at Rose Atoll found some interesting results which complement the fish surveys of the fish rapid ecological assessment. Although the humphead wrasse (Chelmon undulatus) was observed during the towed diver fish surveys, they were not as common as expected and observed individuals were generally small (<150 cm TL) compared to the wrasse’s maximum size of 220 cm total length. This was surprising due to the remoteness of Rose Atoll along with the belief that there is low human interaction and fishing pressure at the atoll. The humphead wrasse is one of the largest reef fish in the Pacific and is one of the few predators of the toxic crown-of-thorns starfish (Acanthaster planci). Another large fish, vulnerable to fishing pressure previously reported to be common at Rose, the giant bumphead parrotfish (Bolbometopon muricatum), was not observed during any of the 18 towed diver surveys (not during the fish REAs discussed below). Three other species of large growing parrotfish (>50 cm total length) were observed during the surveys. Both terminal and initial phase pacific steephead parrotfish (Chlorurus microrhinos) was commonly observed inhabiting the reef front while large reef parrotfish (Scarus rubrocinctus) and large terminal phase red parrotfish (S. astrepturus) were commonly seen inhabiting waters deeper than 10 m. Large aggregations of the smaller tan-fused parrotfish (C. frontalis) were also seen during the surveys. Sharks and rays were not as common as expected but if the 3 species observed, blacktip reef (Carcharhinus melanopterus), gray reef (C. amblyrhynchos), and whitetip reef (Triaenodon obesus), the blacktip reef shark was observed to be the most abundant but only found inhabiting the shallow reef crest. The spotted eagle ray (Aetobatus narinari) and the large (3 m TL) black-blotched stingray (Urolophus halleri) were the 2 species of ray observed involving the Komodo Islands. Common inhabitants of the reef with the biogeographic (C. variegatus) and the bluefin trevally (C. maculatus) being the most abundant jack and the black and white snapper (Macolor niger) and black snapper (M. maculatus) being the most abundant large snappers (>50 cm TL) at Rose Atoll. The green jobfish (Apteronotus leptorhynchus) and smallmouth cichlid (A. varroa) were also seen commonly during the surveys but not recorded due to their size being less than 50 cm TL.

Tutuila

The towed diver fish surveys along the reef slope of the W portions of Tutuila revealed numerous interesting features. Juveniles fish appeared to be abundant during most of the towed survey. Fish diversity was moderately high and appeared to relate to habitat complexity, lowest at areas with low relief (e.g., 5 and highly sourced exposed N station), and highest where substrate ruggedness was high (e.g., spur/grove zones, high coral diversity). Thralls and other large reef-associated predators were very rare; very few were observed during the towed diver surveys. Although most wrasse were (C. undulatus) observed were small-medium size, a few very large (>10 cm) terminal phase raori wrasses were observed along the W shores of Tutuila. No humphead parrotfish (B. muricatum) were observed during our surveys.

Habitat Mapping (TOAD/2TC) – Ron Hoekse and Ranai Minshak (NMFS-UH-JMAR) & Phil White, Jay Fryeher and Nathan Elrod (TC)

Very steep topography surrounding Rose Atoll prevented the ship from approaching close enough to the to allow QTC acoustic and TOAD optical habitat mapping. Since the TOAD and QTC could not be used for habitat mapping at Rose, the opportunity was afforded to conduct development and testing the TOAD with the assistance of the ship’s chief engineer Jay Fryeher and Nathan Elrod. After continued refinements, the TOAD team conducted successful performance tests off Tutuila on Feb. 27. During TOAD/QTC operations on the night of Feb. 27, the TOAD ran hard aground and fouled into the bottom in about 22 m of water.
Upon fouling the TOAD, efforts were made to get out cable and slow the ship as quickly as possible. Even with these efforts, the 4th reel 1-beam supporting the cable block was severely bent and twisted as cable tension increased to very high loads. Miraculously, the TOAD came free of the bottom and all components were recovered. While the TOAD frame and other structural components were partially damaged, several cameras, strobes, floodlights, altimeter and lasers survived relatively unharmed. The TOAD team utilized the remaining components to build a modified version of TOAD called the Veedle Optical Gadget (VOG) to allow digital still and video camera drop over selected habitats.

QTC acoustic seabed classification surveys were conducted around most of the remaining unsurveyed areas of the shallow submerged-reef habitats surrounding Tutela on Feb. 27 and Mar. 2-4. A total of 185 km of QTC habitat survey lines were conducted around Tutela. A total of 341 digital still photos and about 9 hours of video were recorded by the TOAD and VOG, revealing complex heterogeneity of habitats on these deeper banks. Some areas have high live and consolidated coral cover, others have high fleshy and coralline algal cover, and others have high sand cover. Many areas have complex bathymetry and high ruggedness. The photographs and videos will be used to validate the acoustic classifications of theQTC.

Fish — E. DeMartini and Brian Zgliczyński (NMFS), Rob Schnoor (NMFS UH-JIMAR), Rose Atoll

The fish census team surveyed 15 stations at Rose Atoll. Quantitative transects were conducted at 12 stations, most of which were followed by qualitative REA transects conducted while snorkeling shelter/cove at the same station. Qualitative REA surveys were conducted at another 3 deep (average 23- to 28-m) stations. Transect stations were located inside the lagoon and 11 were located on the fore reef (on the seaward side of the barrier reef). Habitat diversity at Rose was greater than Swains. Suitable fish habitat within the lagoon at Rose was limited to a few pilings/patch reefs (mostly along the W), which served as focal points for large fish in the lagoon, and isolated small coral leads on the back reef flat, which harbored small species or recent recruits/juveniles. Structural complexity on the slope outside was low, partly due to the general lack of large old coral colonies, which may have accounted for lower fish densities. Sea conditions were generally calm and underwater visibility excellent (> 35 m) outside, but visibility was only about 5-20 m inside the lagoon. Severe large ocean swells were present at the more wave-exposed stations. The hermit crab followed the fish team at most visual census stations. Habitat types surveyed were the fore reef slope, outer reef terraces, inner reef flat, and lagoonal patch/pinnacle reefs.

Fish transect-stations were conducted using the same, previously described, surveying protocols used on the earliest legs of this cruise. All quantitative transects were set along a single depth at 13-15 m. Additional qualitative surveys spanned 1- to 30-m depths.

These were the first reef fish surveys conducted by the NMFS at Rose Atoll. Fish species diversity (richness) was generally low (and only slightly greater than at Swains islands at the spatial scale 2000-5000 m) of individual stations, averaging only about 35-40 species out of the total pool of 222 species observed at Swains during the 5-day visit. This contrasts with 103 species recorded at Rose (at 14, 10-16 m deep 3.5 reef stations, 2 of which were supplemented by observations on the adjacent reef flat and back reef) by Allison Green during 2 brief visits in 1994 and 1995. Sharks and other large reef-associated predators were uncommon. Only 3 species were noted (Chiloscyllium undulatus) and no batrachoidichthys (batothomus macrolepidotus) were sighted. Both species were noted by the UH-JIMAR as common at Rose Atoll in the early 1980s. Large individuals of other species (peristedidines) were concentrated in the surge zone (<10 m). Grey reef sharks (Carcharhinus amblyrhynchos), red whitetip sharks (Triaenodon obesus) and reef blacktip sharks (Carcharhinus melanopterus) were the only 3 species of shark seen at Rose, most of which were small and none of which were common. Only a few sightings were made of large pelagic fish (e.g. jacks, rainbow runner, dolphinfish). Rose Atoll's inhabitants and levels of past or present fishery exploitation are unknown.

The qualitative REA dive was conducted to supplement the list of total fish species present. Additional fish species were also noted during the limited time (5-10 min) following each visual transect but no fish-team observer was dedicated to mixing a species checklist during the entire dive. Cornish and Preiskel (bentic team) and Zgliczyński (low team) also contributed to the fish species checklist at the end of each day.
Perhaps the most interesting biological observation made at Rose Atoll was the apparently greater diversity and density of herbivorous fishes at and near the site of the 1993 grounding of the Shiang Fa (a 250-net Taiwanese longliner). The numbers of pygmy angelfishes (*Centropyge australis* and *C. flavirostris*) and emperor angelfish (*Pomacanthus imperator*), as well as the number and biomass of many species of herbivorous surgeonfishes (*Acanthurus nigropunctatus* and *A. nigricaudus*, *C. chrysogaster*, *Naso lituratus*) appeared notably greater at the wreck site, compared to reference sites located one-half to several km on either side of it, at depths extending from the reef crest to at least 15 m. A greater herbivorous abundance at the wreck site most likely reflects a persistent redistribution of grazers in response to a conspicuous bloom of primarily blue green algae at the coral-impacted and iron-enriched site.

**Tutulia**

The fish census team surveyed 9 additional stations (SW, W and N sides) around Tutulia 27 February and 2-3 March (5 stations were surveyed 9-10 Feb and discussed in an earlier report). Quantitative transects were conducted at these sites, most of which were followed by qualitative REAs while snorkeling shallow at the same time. No additional deep qualitative REA surveys were conducted. The benthic survey followed the fish team at all stations. Habitat diversity ranged from low relief exposed outer reef slopes to highly rugose coral structure in protected bays. Sea conditions were generally calm and underwater visibility average to good (20-30 m). Slight surge from larger ocean swells was present at some stations, except in protected embayments.

Fish transect-stations were conducted using the same previously described surveying protocols used on the earlier legs of this cruise. All quantitative transects were set along a single depth at 13-15 m. Additional qualitative shallow REA surveys spanned 1- to 12-m depths.

Fish species were noted (qualitative REA) during the limited time (5-10 min) following each visual transect, but no fish-team observer was dedicated to making a species checklist during the entire dive. Comish and Preskitt (benthic team) and Holzwarth (low team) also contributed to the fish species checklist at the end of each day.

Fish species diversity (richness) was generally low at the spatial scale (2000-5000 m²) of individual stations, averaging only about 25-35 species out of the total pool of about 228 species observed at Tutulia during both visits. This contrast with 173 species recorded at Tutulia by Allison Green during 1994 and 1995.

Juvenile fish dominated at all stations indicating recent heavy recruitment. Fish diversity appeared to relate to habitat complexity, lowest at low relief stations (e.g. S and highly scoured exposed N stations) and highest where substrate rugosity was high (e.g., spur-groove zones, diversity of coral structural types in W, N bay). The low diversity might also be attributed to the impact of recent hurricanes on substrate complexity. The S station near the road construction site (land fill) appeared to have more algae and herbivorous damselfish and surgeonfishes seemed more abundant here as compared to other REA stations around the island.

Sharks and other large reef-associated predators were very rare; none were seen by the fish or benthic dive teams. Although most maori wrasse (*Cheilinus undulatus*) observed were small-medium size, a few very large (>130 cm) terminal phase maori wrasses were observed along the W shores of Tutulia. These wrasses were the largest observed among all of the islands surveyed. None of the large growing bumphead parrotfish (*Bolbometopon muricatum*) were observed during our surveys and most groupers and snappers seen were small.

**Stony Corals - Jim Maragos (USFWS)**

**Rose Atoll**

Stony corals were surveyed at 11 sites off lagoon and ocean reefs at Rose Atoll NWR. Open reef work consisted of 7 REAs and 2 permanent 50 m transects. Lagoon work consisted of 2 REAs sites, resurveying 1 existing 50 m permanent transects, and establishing 1 new 50 m permanent transect on lagoon patch reefs.
Additionally, Maragos assisted in the collection and removal of marine debris from near Rose Island, and assisted Thunberg (see terrestrial surveys) during collection of 35 water samples and completion of algal quadrate surveys along the reef flat and surf zone along the SW side of the atoll. Survey of fish, corals, giant clams, benthic algae, and dissolved iron have been monitored several times since 1994 to assess damage and coral reef response to the grounding. In conjunction with this project, Maragos accomplished a general coral survey of 7 ocean and lagoon sites in March 1994, and established 7 permanent transects on lagoon patch reefs in 1999-2000.

The grounding on the longliner resulted in a major fuel and chemical spill that killed off reef organisms on the shallow SW perimeter reef flat, fore reef, and lagoon back reef in late 1993. A salvage tug was successful in removing only the bow section of the ship from the reef. The remaining 2/3s of the vessel quickly broke up and dispersed into pieces, with lighter, non-metallic debris washing into the lagoon. In turn, invasive blue green algae (Lyngbya, Schizothrix, etc.) quickly established on the dead reef areas and have spread along the entire length of the SW reef, threatening resident crustose coralline algae. Dissolved iron concentrations from the metallic debris was thought to be stimulating the blue greens, and 1997 chemical analyses of iron concentrations have corroborated this relationship (Green et al. 1998). The grounding-related threats to the reef compelled the USFWS to sponsor the partial removal of the metallic debris from the SW reef flats and fore reef. Maragos served as COTR and salvage diving supervisor during 3 separate cleanup efforts in 1999-2000 that is removed 122m of metallic debris from the reefs. An additional 40m of larger metallic debris remain to be removed from mostly the fore reef and another 10m of non-metallic debris remain to be removed from the lagoon. The 2002 visit of the Crosswell allowed USFWS scientists to continue monitoring efforts and assess the effect of earlier debris cleanup operations.

The March 1994 coral survey revealed that coral populations were only locally stressed by the ship grounding, but an unrelated coral bleaching event was underway along the ocean reefs to depths of 20-30m. Many large tule, rose, lobe, and brain corals were in the process of bleaching. The 1994 survey duration was too short to determine the fate of the bleached corals. The 2002 Crosswell visit allowed fore reefs off all 4 sides off the atoll to be resurveyed for the first time since the 1994-4 grounding and bleaching events.

The 2002 coral surveys revealed that coral populations are in the early stages of recovery from a massive kill, presumably the 1994 bleaching event that affected all reef areas and the more localized effects of the 1993 grounding and spill. Coral diversity is high on all reefs ranging from 29 to 51 species per site (20 to 13 species on lagoon reefs). A total of 72 species of corals were reported at the atoll in 2002, compared to only 49 in 1994. Altogether, 103 species of corals belonging to 39 genera have been reported from the atoll. The most common corals are the soft corals Pocillopora, Montipora encrusting corals, the brain corals Montastrea, Lepisastrea, Favia, and Faviidae; the lobe corals Porites; and several small table coral species of Acropora. Some larger 2 m diameter corals of Porites and Favia were reportedly on deeper ocean fore reefs, but larger 3m diameter Porites boulders were reported at the base of lagoon patch reefs in the S corner of the lagoon. These heads apparently survived the bleaching event of 1994.

Coral cover on fore reefs is lower on windward fore reefs, averaging 15-20% cover compared to 30-67% on more sheltered reefs. The 1994 estimates for coral cover averaged 60-70% on fore reefs, indicating that coral recovery has not yet reached pre-bleaching levels. Coral cover on lagoon patch reefs varied from 25-35% lagoon back reefs near the grounding site now support many small colonies of the brain corals Favia and Faviidae and several species of small table corals of Acropora. Reef flat in the surf zone of the SW reef near the grounding site now support high densities of the rose coral Fungiophora. Despite these gains, many thallial of the blue green algae Lyngbya are breaking off and drifting downstream into the lagoon and snapping on and injuring young corals. Large drifts of other blue green algae accumulate in the sluggish NW lagoon, suggesting that algal growth rates are still high.

Pink crustose coralline algae have recovered somewhat since the completion of the 1999-2000 metallic debris cleanup. The zone of heavy growths of Schizothrix and associated blue-greens has shrunk from a 700m to a 400m wide "black" swath along the shallow SW reef, with a less severe "brown" extending an
additional 200m at each end. The collective 2002 observations reveal that most of the remaining 4mT of iron still needs to be removed before crustose coralline algae can fully recolonize reef flats, shallow back reef, spurs-and-grooves, and shallow fore reef habitats of the SW perimeter of the atoll.

Since the earlier cleaning operations, metallic debris remains stabilized in the shallow to mid-depth fore reef slopes with only a few small pieces having washed up on the reef flat from the ocean side. Most of the pieces are estimated at less than 5mT, but the 15mT drive train of the ship remains imbedded in the upper reef margin in the surf zone. Further debris removal will require a salvage-class tug, large lift bags, heavy-duty cable and winch and underwater cutting operations to position and remove the remaining metallic debris from the fore reef. Removal of the debris would eventually allow pink crustose coralline algae to compete successfully against the blue-green algae and reestablish their role as primary reef builders at the atoll.

Tutuila

Stony coral biologist Jim Maragos conducted surveys of corals as part of a larger benthic team. Nine sites (6 through 14) were surveyed to depths of 15m, all off the W half of the island. Jean Kenyon reported on the coral surveys off E Tutuila in an earlier report.

The 9 survey sites consisted of REAs, generally following established protocols developed in 2000. As part of the benthic team, the coral biologist took wide-angle photographs, using a Nikon F5 camera with a 13cm lens, along the first two 25m transect lines previously laid out by the fish team at each site. These photos will be processed and later analyzed to calculate quantitative data on coral cover, population size distribution, frequency, and generic-level richness and diversity indices. Unfortunately, no camera was not available for surveys at the first 3 sites, and instead corals were counted in situ along each of the 2 transects at each site. All corals with their centers within 1 m of each side of the line were assigned to one of 7 size classes and each identified to the genus level. Data were collected on 150 to 200 corals in this manner along each line. These data have been collated and will be used to calculate the same coral parameters as those using the photographs.

In addition, all stony coral species within the general dive area (roughly 5,000m²) were listed and assigned an abundance level visually approximated at the end of each dive. These levels are dominant (D), abundant (A), common (C), occasional (O), and rare (X). At each site, estimates were made of the overall percent live coral cover, diameter data on the largest corals at each site, and recorded moter on bleaching, predation, competition with algae, tumors, and diseases, if any.

The corals of Tutuila have been surveyed several times over the past 25 years, including Lambers in 1979, Birkeland et al. over several times since the early 1980s, Maragos et al in 1991-2, Mundy in 1995, and Maragos 2000 as a part of the present Census of Marine Life expedition. The locations and methodologies of these studies vary, rendering comparisons difficult. However, 6 of the 9 sites surveyed in 2002 were also surveyed in 1992 by the benthic investigator, following very similar protocols and allowed comparisons over a decade of coral cover and species richness at these sites.

A total of 173 species of corals were reported at the nine 2002 sites including 162 stony coral species. This compares to 175 species reported in 1991-2 at 40 sites using very similar techniques. Adding 1991-2 and 1995 species not seen in 2002, a total of 255 species of corals have now been recorded from Tutuila over the past decade. Additional species were reported by earlier investigators, but major uncertainties remain for consistent and accurate identification of many corals, especially for the phyla of Acropora and Montipora species. Many of the native (nominal) are sure to be combined with other species. Nevertheless, there are likely between 250 and 300 stony coral species in American Samoa, including species only reported elsewhere in American Samoa. These totals are high compared to those of other U.S. coral reefs in the eastern and central Pacific, but are comparable to other archipelagoes bordering the western Pacific where reef biodiversity is higher.

Species of Acropora and Montipora accounted for nearly half the species and a majority of the coral cover at most sites. Other stony corals include Paviliphora, Aspidopora, Favia, Parfom, Pavona, and Montastrea. Large colonies of most of these species were present, and exceptionally large (and old)
colonies of Lobophyllia, Echinopora, and Merulinus were also noted at some sites. Coral cover was high at all sites, between 50-80%, except at one exposed basaltic headland (TUC-13) on the N coast where corals covered only 10% of the bottom. Coral cover was also high at the one site close to heavily urbanized Pago Pago Harbor (TUC-10). The highest abundance and diversity of corals were reported off southwest corner of Tutuila, with the highest off Amanave Bay (87 species, 80% coral cover). At least 50 species of corals were reported at every site, an exceptional level of diversity compared to other U.S. reefs to the NE of Samoa.

Maragos conducted surveys at 40 Tutuila sites in 1991-2 shortly after 2 devastating hurricanes and a decade after a severe crown-of-thorns starfish (Acanthaster) infestation. In fact, the hurricanes struck just before coral populations could recover from the earlier infestation. Moreover, overproduction from heavily urbanized Pago Pago Harbor also stressed adjacent reefs to 1992. However, the 2002 surveys revealed that coral populations have almost completely recovered from the earlier stresses and natural catastrophes. At the 6 same sites surveyed in 1992 and 2002, coral cover and species richness nearly doubled during the decade at all but one site (see table below). The fact that as many coral species were reported at 9 sites in 2002 vis-a-vis 40 sites in 1992 is additional evidence of corals on the road to recovery off W Tutuila.


<table>
<thead>
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<th>Site</th>
<th>1991-2</th>
<th>2002</th>
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<tr>
<td></td>
<td>% cover</td>
<td>No. spp.</td>
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<td>Larsen Bay</td>
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<td>Poloa</td>
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Coral Settlement Plates - Jean Kenyon (NMFS-UH-JIMAR) and Brian Zgliczynski (NMFS) An array of ceramic settlement plates has been attached to the anchor at the base of the CRW'S buoy (below) deployed in the lagoon at Rose Atoll to investigate long-term recruitment and settlement of corals, invertebrates and algae. These plates will be removed in 2 years to determine what species have settled onto the plates over these longer time periods. Some of the plates are positioned vertically and others are positioned horizontally.

Coral Reproductive Studies - Jean Kenyon (NMFS-UH-JIMAR) and Rusty Brainard (NMFS) As part of a study to begin to determine coral spawning cycles in this part of the Pacific, samples were collected from 4 species of the important reef-building coral genus Acropora at Rose Atoll between 23 and 26 Feb. and at Fagasa Bay, Tutuila on Mar. 3. For most coral species in which spawning has been either directly observed, or inferred from the size and color of mating gonads, spawning occurs only once per year. The degree of spawning synchrony among different coral species varies geographically, from mass coral spawning of more than 150 species on the Great Barrier Reef of Australia, to little interspecific synchrony in Hawaii. What little work has been done on this subject in American Samoa (C. Mundy, personal communication from L. Basch) suggests that coral spawning occurs in October and November. Species of the coral genus Acropora were prioritized in this study because their reproductive cycles have been well studied in other areas. Eggs take about 9 months to develop, and fertilize less than 2 months. In the month before spawning, eggs of many species become brightly colored and can be easily seen in fresh samples by a trained observer. Fresh, mature testes typically have a yellow coloration in fresh samples. The presence of colored eggs and yellow testes is therefore an indicator that spawning will occur within several weeks.
At Rose Atoll, samples (n = 5-10) were collected from *Acropora cervicornis* and *A. millepora* in the shallow (<10 feet) lagoon, while *Acropora digitifera* and a fourth acropod species still to be identified were collected from the shallow (15-20 feet) reef slope. All samples were fixed in 10% formalin-seawater for later analysis of the presence and size of any developing gonads. It is noteworthy, however, that most samples of *A. digitifera* had dark orange eggs and deep yellow testes that were easily visible to the naked eye, supporting the prediction that spawning will occur within 2 weeks. This result indicates that much remains to be determined concerning coral spawning cycles at Rose Atoll, and within the larger region of American Samoa.

Octocoral (Soft coral) surveys - Andy Cornish (DMWR)

Rose Atoll

The swim-survey methodology conducted at Tutuila, Manu’u’s and Swains was repeated at Rose Atoll. Eight sites were surveyed on the reef slope and atoll while 4 pinacles were surveyed within the lagoon. Additionally, coral bommies within the lagoon were snorkelled around in several locations while 2 deeper REA dives, both to 30 m, were made on the reef slope, one on the NW shore and the other near the N of the lagoon channel.

Sinularia and Lobophyton were the most abundant octocorals, being present on nearly all of the reef slope transects at 8 and 17 m depths. Both genera were particularly abundant in the E shores although not extensively to exceed 3% cover at any site. Sarcophyton was present in small quantities on some transects. All three genera were recorded on both deep dives in addition to 2 patches of *Rumphella* colonies also encountered on the dive close to the lagoon mass. Only Lobophyton was recorded on reef crest transects, and only then in small quantities. Sediment levels were negligible on the reef slope, unlike within the lagoon where there were considerable amounts. Octocorals were absent at depths of 15 m (the lagoon was only deep enough to allow a transect to be surveyed at 15 m on one of the four pinacles) and at 8 m within the lagoon, apart from one pinnacle where a small amount of Sarcophyton was recorded. Soft coral diversity and abundance were greater, although still generally low, on the pinnacle crests. Sarcophyton was the most common genera on the crests. Some colonies were bleaching, probably due to the high water temperature (33°C). Casual observations around large bommies in the shallow of the back reef suggested that Sarcophyton was also the most abundant genera in that habitat and were concentrated just under the low water mark.

Overall, octocoral communities appear healthy on the reef slopes at Rose Atoll. These communities are regenerating, as indicated by the small size of most colonies, in contrast to larger colonies (>1 m diameter) encountered on the deeper dives in the 25-30 m depth range. The most likely source of the disturbance to the shallow reef slopes would be the hurricanes in the early 90s which appear to have caused considerable damage to Manu’u’s and Swains. The lack of sea-fans, poritoplasms apart from Rumphella, and tree corals in the family Nephtheidae, which were observed to be abundant on the two deep dives to depths of 40 m is probably due to a paucity of larval supply or unsuitable environment (the habitat itself was similar to deeper reef on Tutuila where such octocorals thrive). The complete lack of Cladiella, which is abundant in Tutuila, and a lesser extent, Manu’u was site of interest and is probably related to the nutrient-poor environment of atolls (Maggs, pers. comm.).

Within the lagoon, the environment appears to be less than optimal habitat for most octocorals with its high sediment levels and elevated temperatures. It is not surprising that Sarcophyton was the dominant genera there as these corals are known to be able to thrive in waters with high sediment loadings (Fabricius & Anderstolfe, 2001). The scuba board team noted a few small colonies of Rumphella within the central region of the lagoon in 20-25 m of water (Brainard, pers. comm.).

Tutuila

Fourteen sites were surveyed around the main island of Tutuila, 7 on the N shores and 7 on the S. As with the other sites, 100 m tranverse swim-surveys were conducted at 3, 6 and 15 m depth. Sites were conducted primarily on coral reef slopes in bays but also along exposed rocky shorelines.

From this and ongoing surveys by the same researcher, Tutuila has the highest soft coral and sea-fan diversity of any of the islands and atolls of American Samoa. Five genera were recorded during this survey,
Lobophyllum, Cladiella, Sarcophyton, Sinularia, Rumphella and another type believed to be Klysum (samples will need to be identified with a high-power microscope). Collections made previously in dives to 40 m were also found: Dendrogyra cylindrus, Poriferopleuroscyphus, Kerathophyllum and Ameilla, genera not recorded at Hanu’s, Rose Atoll or Swains Island. Lobophyllum, Cladiella, and Sinularia were the most abundant genera with Klysum (7) and Sarcophyton encountered in small amounts occasionally and Rumphella being rare. Tutula had the only site where octocorals, primarily Cladiella, which was dominant, were estimated at 30-40% cover. As with all other locations apart from the pinacles in the Rose Atoll lagoon, soft corals were more abundant at 8 m and 15 m depths than on the reef crest.

Further observations will have to wait until more detailed analysis of the data can be made. Tutula’s area is the most diverse array of habitats of any of the reefs in America Samoa and while many of the sites appear to have healthy octocoral communities, there were also areas, particularly those more exposed sites, where diversity and abundance were low. Such a variety of octocoral communities obscures any differences with the other islands and atolls other than those noted in previous progress reports for those localities.

**Marine Algae – Linda Presskitt (UH-Botany):**

**Rose Atoll**

**Algal Community Summary**

The perimeter of Rose Atoll is comprised of steep reef slopes with waves breaking over the reef crest and falling quickly to 150 + feet with good visibility. The visibility at Rose Atoll is very high providing light to the algal community at deeper depths. It may be for this reason that there is little vertical zonation in the algal community on these reef slopes. Any zonation appears to be horizontal, with the macroalgae abundance changing as one moves around the perimeter of the atoll. The outer reef slopes of Rose Atoll are dominated by algae. Crustose and upright columnar forms of coralline algae dominate the reef community at all of the outer reef locations, averaging around 40% of the substrate, with the seaweed macroalgae changing around the reef perimeter.

On the NE reef slope near the lagoon channel, the most abundant algae in the macroalgal community are species of Halimeda. On the E outer reef, where the trade winds blow across the atoll and the surge and wave actions is the heaviest, the most abundant macroalgae is Microdictyon echiellum, with a Caulerpa sp. the second most abundant. Right around the E corner, the Caulerpa sp. becomes the most abundant macroalgae, growing over much of the reposed substrate and between knot heads and coralline algae mounds with Microdictyon echiellum as the second most abundant. On the S side of the atoll, Microdictyon echidellum again is dominant, with very little of the Caulerpa sp. present and more crustose forms, such as Peyssonnelia sp. and Dictyosphaeria verrilli, more evident. Moving W around the S tip, the Microdictyon echiellum and Caulerpa sp. disappear and a number of Halimeda sp. are more abundant. The SW reef slope of the atoll changes dramatically, however, with macroalgae giving way to heavy coverage of small turfs and Lobophyllum sp., both epithelioated by bluegreens. This side of the atoll was the site of a shipwreck in October, 1993. The debris, much of it iron, remained on the reef until salvaged in most of it in 1999. It is likely that the debris has affected the water quality, thus the predominance of bluegreen. Once the debris has completely disintegrated and the water quality normalizes, the bluegreens will mostly likely disappear.

The lagoon was covered with a layer of very warm water (~34°C) that is heated as it moves over the wide, carbonate pavement reef flat. The calm, lagoon water is heavily stratified in thermoclines, with the upper 1-3 m very warm. The pinnacles also show a zonation in the algal community. The deeper depths from 3-12 m have large masses of bluegreens in form of ropes, balls and mass covering much of the sides of the pinacles. Mass of bluegreens stretch across the lagoon bottom as well. Other algal at these depths are Halimeda sp. and Peyssonnelia sp., with red turfs on the underturfs. The upper 2-3 m of the pinacle and the flat pinacle top is riddled with holes and recesses. These areas were home to species of Bryopsis, Halimeda, Dictyosphaeria verrilli, crustose corallines, and turfs. The reef flat was mainly bare carbonates pavement subjected to the hot sun at low tide. A few species of algae were found in pools and holes in the pavement. These were mainly species found on the reef slopes: Halimeda, Caulerpa, and Bryopsis, with turf.
Though the atoll is small, the changing character of the algal community on the reef slope around the perimeter was surprising. *Microdictyon* and *Caulerpa* sp. were more prevalent in high energy regimes, while the calmer areas had more turfs and crustose macroalgal forms. All of the perimeter was dominated by coralline algae, which often grew in fantastic and coral-like shapes. The lagoon, on the other hand, had little variety, with the only zonation occurring with the thermocline. Further observations of the area around the shipwreck for a possible recovery of the coral and algal community is recommended.

**Marine Invertebrates – Scott Godwin (Bishop Museum)**

Surveys for marine macroinvertebrates were done qualitatively along 2 separate 50 m transect lines. A zig-zag pattern that extended roughly 2 m on either side of the transect line was done for each of the 2 lines. Once this was accomplished, a brief swim of the general area was done to account for species away from the transect area. Species were recorded and the qualitative abundance was given using the DACOR method (D=dominant, A=abundant, C=common, O=occasional, and R=rare).

Intertidal surveys for invertebrates and algae were conducted in the lagoon at Rose Atoll. These were done at low tide and began at the shallow lagoon in 1.5 m of water and proceeded to the butresses at the reef edge.

**Accomplishments**

During period between February 22 and March 3 the Rose Atoll National Wildlife Refuge was surveyed and the continuation and completion of the survey around Tutuila was accomplished. A total of 15 benthic surveys were done at Rose Atoll and Tutuila. Favorable weather gave unlimited access to windward and leeward sides of Rose Atoll. At Rose, 8 sites evenly spaced around the outside of the reef Rose were surveyed, as well as the site of a shipwreck that has caused environmental changes at the site of the grounding. At Tutuila, an additional 4 sites were surveyed to bring the cruise total for Tutuila to 14. The breakdown of the sites for Rose Atoll and Tutuila are as follows:

**Rose Atoll**

- 6 sites at a maximum of 50 feet, evenly spaced on the outside reef
- 1 site at 95 feet
- 1 new permanent transect set up in the vicinity of the wreck site at 35 feet.
- 4 surveys of previously established transects on lagoon patch reefs at a maximum of 35 feet
- 1 new permanent transect set up on a deep lagoon patch reef at 35 feet
- 2 surveys of invertebrates and algae from the shallow lagoon (5 feet) to the reef butresses.

**Tutuila**

Standard REA sites:

1. Amanave Village
2. Pulea Village
3. Aolana Bay
4. Airport runway
5. Road construction site
6. Larsen Bay
7. Massacre Bay
8. Malaulau Point
9. Afono Bay

**General Impressions**

**Rose Atoll**

Rose Atoll is a classic atoll with a clear division between outer reef zone and lagoon. The surveys began by focusing on the outer reef, proceeded to lagoon patch reef habitats, and finished with an intertidal survey.
Outer Reef

There was a great deal of reef structure on the windward side of the atoll composed of coralline algae, which created an extremely rugose terrain, and the leeward sides had typical carbonate structure. The macroinvertebrate fauna on the outer reef was dominated by plumariid and stylasterid hydroids. As far as mobile invertebrate fauna, hermit crabs and molluscs were occasional to common. The molluscs were primarily in the 5-7.5 m range and were typically composed of Conus, Cypraeidae and Thaisidae gastropods. Proclus was seen occasionally in the 5-7.5 m range and surprisingly was common at a depth of 29 m at a single site. Giant clams were rare on the outer reef slope.

Lagoon patch reefs

The lagoon was a vast expanse of sand with periodic patch reefs that ranged from 3-14 m deep at the base. These islands of habitat had abundant populations of scyphophid sponges, giant clams, and chaetopterid tube worms. One exception was a single patch reef located close to the channel entrance, which was almost devoid of giant clams. At the base of the patch reef in the sandy areas there were signs of abundant Towna, with shellfish being everywhere. Also in the vicinity of the patch reefs there were common occurrences of sea cucumbers and sea urchins.

Intertidal

The shallow lagoon areas on the E and W sides of Rose Island were high in giant clam abundance. Reef flat on the E and W sides differ by their species composition. The E flat had an even distribution of gastropods, urchins and hermit crabs, while the W side was dominated by holothurians. Giant clams were rare on the reef flat on both sides of Rose Island.

Totals

As with the previous surveys, most sites were embayments near villages but a site near the airport runway, a road repair project, and an exposed point were also surveyed. The surveys began with the W and SW, proceeded to the N, and then finished in the N and NW. There was no conformity of species between sites of the similar embayment habitat. The only species common to each embayment site were hydroids, whereas the gastropods, hermit crabs, and echinoderms differed greatly. The airport site was a gently sloping low reef that had an abundant and diverse community of gastropods and hermit crabs. The site of the road project had a large number of sessile organisms such as zoanthids and turritas, while didemnid turritas and gastropods dominated the exposed area at Mululu Point. Giant clams were occasional to common at all sites surveyed.

Geographic Monitoring Stations - Brainard, Zgliczynski (NMFS), Holzwarth, Kenyon Hoke and Chojnacki (NMFS-UH-JIMAR)

Rose Atoll

A permanent Coral Reef Early Warning System (CREWS) buoy was established near twin pinnacle patch reefs inside the lagoon at Rose Atoll to monitor long-term variability of sea surface temperature and meteorological conditions. CREWS buoy (SOSI #262-005) was moored in 9.1 m of water at position 14°53.084'S, 168°09.611'W. This buoy is instrumented with a precision water temperature recorder at a depth of 1 m, an air temperature sensor, a barometric pressure sensor, an acoustic meter to measure wind direction and speed and an ARGOS transmitter to transmit subsets of the data multiple times each day. This information will be posted on the Honolulu Laboratory Coral Reef O System Investigation website to allow research scientists and resource managers up-to-date information about conditions at Rose Atoll. This information will also be forwarded to Dr. Jim Hendler at NOAA's AOML in Miami as part of the Coral Reef Early Warning System to alert resource managers of potential branching of other natural events which may be detrimental to coral reef ecosystem health.

In addition to the CREWS buoy at Rose Atoll, an Aanderaa RCM9 current meter (SN417) was deployed in the central portion of the high velocity entrance channel to Rose Lagoon at position 14°52.111'S, 168°09.289'W at the sill depth in 6.1 m of water. Numerous investigators (Manige, Burgert and others) have reported routinely high velocities, estimated as high as 5 m/s (30 kts), thru this channel and have speculated that the water is always exiting the lagoon due to wave setup around the remainder of the atoll. The current meter will provide a two year record of current speed and direction thru the pass and
water temperature which will allow oceanographers to test these hypotheses and better understand the dynamics of this ecosystem.

**Tutuila**

Two additional Sea Surface Temperature (SST) buoys were moored on the W and E shore of Tutuila to complement the observations from the SST buoy deployed off Aaua Island on the E side of Tutuila on Feb. 10. SST buoy #4 was deployed in 27 m of water in Amanava Bay on a sand bottom at position 14°19.694'S, 170°50.000'W. SST buoy #1 was deployed on a shallow reef pinnacle in 2 m of water in Fagasa Bay at position 14°17.677'S, 170°41.320'W. The locations of these SST buoys was determined in collaboration with the American Samoa Coral Reef Advisory Group (CRAG) and the Department of Marine and Wildlife Resources. The Director of DMWR worked closely with the leaders of the nearby villages to make sure the local communities would take ownership of these buoys and help protect them from the elements or potential vandalism. DMWR plans a series of meetings and television announcements to raise awareness in the local communities of the value these measurements have in protecting their resources. These buoys record temperature at a depth of about 25 cm every 10 minutes. Subsets of the hourly averages of these data are transmitted daily to Honolulu Laboratory for posting on the CREIS website using the ARGOS satellite system. This near real-time temperature data will be used to ground-truth the satellite-based Coral Reef Watch managed by Dr. Al Strong at NOAA NEDSS. DMWR plans to post this information in local newspapers to allow the communities to make effective use of the information in a timely manner.

In response to a request from the NOAA/NOS Fagateto Bay National Marine Sanctuary, an Aanderaa RCMC current meter was deployed off Sag's Point, Tutuila to monitor ocean currents and bottom temperatures at this southernmost point of Tutuila situated next to the Fagateto Bay NMS. This information on the temporal variability of ocean currents will assist Fagateto Bay managers in evaluating potential threats of upstream sources of pollution and other concerns.

**Oceanographic Observations – Brainard and Zgliczynski (NMFS), White (TC), and Hoeke (NMFS-\UH-JIMAR)**

A grid of 28 closely-spaced (\textasciitilde 0.5 mi) CTDs were conducted around the perimeter of Rose Atoll, in the channel, and inside the lagoon to investigate the small scale ocean dynamics of this reef ecosystem. These CTDs, which were conducted to a depth of 10 m, included measurements of temperature, salinity and chlorophyll \(a\) versus depth. To the surprise of oceanographers and divers alike, a very strong and shallow thermocline was observed in most regions of the lagoon. The thermocline was generally found at a depth of about 0.5 m with surface temperatures greater than 33°C and bottom temperature at 10 m of 29°C. The very warm surface waters in the lagoon were likely due to minimal wind-driven or convective mixing during the period of our visit. Sustained high water temperatures could result in coral bleaching and other stresses to the shallow reef organisms.

A grid of 4 shipboard CTD stations were conducted to a depth of 500 m around Rose Atoll and acoustic Doppler current profiler transects were repeated each night for three nights to examine the vertical structure of water properties (temperature, salinity, chlorophyll \(a\) and dissolved oxygen versus depth) and ocean currents surrounding this remote atoll.

**Surface Velocity, Drifters – White, Hoeke, and Brainard**

Eight satellite-tracked surface velocity drifter buoys were deployed to track upper ocean currents in the waters of American Samoa. During the period Feb. 22 – Mar. 4, surface velocity drifter buoys were deployed off Rose Atoll and off the SW, NW and S sides of Tutuila. The Rose Atoll drifter # 35651 was deployed at positions 14°56.333'S, 170°54.227'W, 14°23.846'S, 170°50.761'W, and 14°25.139'S, 170°36.112'W, respectively. Information on ocean surface currents will assist scientists in evaluating larval transport and recruitment dynamics in the waters of American Samoa and will assist resource managers in evaluating locations and the effectiveness of marine protected areas. Positions for these drifters are determined using the Argos satellite system. Drifter tracks will be made available on the Honolulu Laboratory CREIS website.
The tracks of the first drifters deployed in American Samoa off Tutuila, between Tutuila and Manu'a, off Ta'u and off Swains indicated a general trend in the flow to the E or SE. The one exception is the drifter deployed 6 km NE of Tutuila which drifted directly toward the E end of Tutuila and grounded. This drifter was recovered by a local fisherman and returned to the DMWR for redeployment.

Terrestrial Activity Summary

Vegetation and Arthropods - Joshua Seamon, Ph.D. and Siaosi Fa'aumu (ASG, DMWR)

Summary

Arthropods: Collected significant numbers of insect samples using yellow traps, pitfalls, light traps, and manual collection from all macrohabitats at Rose Atoll, many of which will require microscopic examination to verify taxonomic affinity. The arthropod fauna appears as diverse as would be expected from an island with such limited area, limited habitat types, and a frequent disturbance regime. The fauna included significantly fewer Lepidoptera and Dipteran species than Swains Island, an island of similar isolation. A significant and apparently debilitating scale insect infestation occurred on all P. grandis observed, including small recruits some distance from the adults. The scale insects were also observed on a few T. argunuea/rxpmal to heavily infested adult P. grandis. We recommend a rapid response to this problem, and will contact entomological colleagues (e.g., Dr. M. Schmedding) at the American Samoa Community College - Land Grant for methods shown to be successful on Tutuila, on which the same species is widespread.

Vegetation: We established four 10 m radius circular plots along a continuum of exposure, from internal forest habitat on Rose Island to the ephemeral and frequently disturbed Sand Island. Tracking recruitment and survival over time in these plots should generate useful predictions about population dynamics in such an isolated and exposed environment. We also collected size and location data on all newly colonizing tree species (C. macabra, C. subcordata and C. siliaceus). In total, we now have location and size data on 241 individual adults and recruits of the 5 dominant tree species on Rose Atoll. The health of the vegetation on Rose Island may be in jeopardy from heavy scale insect infestation (see preceding section on Arthropods).

Notes

1. J. Seamon tried to lessen USFWS concerns about potential minor negative impacts to seabirds by the terrestrial activities conducted by himself and Fa'aumu by pointing out that: the bird species present on Rose Island are neither rare nor restricted to the area; and the bird species present are long-lived, lived more or less continuously throughout the year, and are naturally subject to significant inter-animal variation in chick mortality (and thus recruitment).

2. The assistance and cooperation of USFWS personnel in providing invasive-species control equipment for DMWR use while on Rose Atoll, as well as generous sharing of consumables such as food, is greatly appreciated. Invaluable assistance and accommodation from the crew and staff of the Townsend Cromwell were acknowledged.

3. Very regrettably, the DMWR plant voucher specimens were accidentally discarded by one of the members of the scientific staff. All staff will be reminded that a conservative response and inquiry should follow any uncertainty regarding specimen collections. Specimens should never be discarded unless absolutely confirmed by the owner.

Seabird and wildlife assessments - Beth Flint and Jeff Burgett (USFWS)

National Wildlife Refuge wildlife biologists, Beth Flint and Jeff Burgett, traveled to Rose Atoll National Wildlife Refuge for a standard short monitoring visit courtesy of the NOAA Vessel Townsend Cromwell. The primary objective of this visit was to assess wildlife and wildlife habitat at the refuge and document any problems that might be affecting ecosystem health. Priorities for the visit included maintenance and repair of the 30-meter sampling grid in place on Rose Island, census of active nests of all breeding birds using the two islands at the atoll, continuation of the study monitoring the response and recovery of the plant community following the eradication of the Polynesian rat (Rattus exulans) that was initiated in 1993, and continuation of a study evaluating the effects of tin enrichment from the 1993 wreck of the FV Six Shiang Fa, a Taiwanese longline vessel, on the coraline algae reef at Rose Atoll. Two scientists from the American Samoa Department of Marine and Wildlife Resources also accompanied refuge staff with the objectives of documenting the current status of the terrestrial arthropods and some aspects of the plant community (to be reported separately).
The bird community at Rose appeared to be thriving with 10 of 12 seabird species observed actively breeding at the colony. Most numerous breeders during this visit were Black Noddies with 362 active nests followed by Brown Boobies with 232 nests. Five migrant shorebird species were using the atoll along with resident Pacific Reef Herons and a migrant Long-tailed Cuckoo from New Zealand.

At least 2 Green Sea Turtle nests hatched on the island during our stay and numerous turtle nests were observed around the island perimeters. Land crab (Cynomolga sp.) numbers continued to be depressed from those observed in the early 1990's.

The plant community appeared generally healthy with the exception of the grove of Pisonia grandis, a tall coastal tree much favored by nesting seabirds, which is suffering from a severe infestation of a scale insect. This insect was collected for identification and refuge staff will formulate management actions to try and save the few remaining Pisonia trees on Rose Island.

Burgett quantitatively assessed the algal abundance and species composition on the intertidal reef flat of the atoll, most importantly on the SW arm which was diversely affected by the 1993 shipwreck and oil spill. Previous surveys of this type were conducted in 1995, 1996, and 1998. He also measured the concentration of dissolved iron on 1000 metres of the reef front in order to detect any changes subsequent to cleanup efforts in 2000. The cleanup removed tons of corroding steel that had produced a plume of iron-rich water flowing onto the reef. We suspect that this iron source has produced the persistent and anomalous growth of cyanobacteria on the reef flat and within the lagoon noted on previous trips. Quantitative results must await analysis of survey data and water samples, but his general impression is that there has been no substantial recovery of the reef flat since his last visit in 1998. We observed a large area of cyanobacteria on the reef flat, and fragments of the ship remain in the intertidal and subtidal zones. We suspect that the iron anomaly persists despite the cleanup effort and is suppressing the recovery of the normal algal community of the Refuge.

There were no obvious signs of recent trespass on the refuge. We removed a raft with netting and a transmitter, presumably used as a fish aggregating device (FAD), from the reef crest to prevent wildlife entanglement and further coral damage.
Fish team activity summary, TC-02-01, Leg II (AS 1st) (Tutuila, Tu‘u, Olosega and Ofu Islands).

From 9-14 February, the fish-census team (Brian Zgliczynski & Robert Schroeder) surveyed 5 stations at Tutuila Island, 6 stations at Tu‘u Island, 2 stations at Olosega Island, and 4 stations at Ofu Island. Stations on all sides of the islands were included except at Tutuila where work was conducted around the eastern half of the island. The benthic team followed the fish team at all census sites. In addition, the fish team took CTD casts around each island at stations approximately 0.25 nmi apart, to 30 m depths. A total of 21 CTD casts were completed at Tutuila Island, 21 at Tu‘u Island, and 29 combined casts at Olosega and Ofu Islands.

Fish transect-stations consisted of three consecutive 25 m lines set along a single depth at 13-15 m. After each line was set, the observers moved along either side of it at 5 m apart, counting and recording size classes for all fishes >20 cm total length (TL) within an area 4 m wide and 4 m high. At the end of each 25 m line, the divers turned and, while remaining either side of the line, began counting and recording size classes of all fishes <20 cm TL within 2 m along their side of the line and 4 m off the bottom. Numbers of highly abundant species such as juvenile damselfishes (Pomacentridae), and schooling fusiliers (Caesionidae) were estimated. A list of fish species observed was recorded for each island/area.

Although this was the first time an extensive fish survey was done by the National Marine Fisheries Service in American Samoa waters, the general consensus was that the fish populations at each station were found to be of generally low diversity (of the total pool of species known to occur at these islands), with a relative absence of many large fish or sharks. In general, the predatory species seen during the surveys were smaller-bodied than perhaps expected, with many of the Saipan (Lutjanidae) Groupers, (Serranidae), and Trevallys (Carangidae) observed along the transects being smaller than 30 cm total length. Grey reef sharks (Carcharhinus amblyrhynchos), reef whitetip sharks (Triaenodon obesus) and reef blacktip sharks (Carcharhinus melanopterus) were the only three species of shark seen during the surveys, with none of the sightings occurring along the 25 m transects. Possible explanations for the smaller predatory fish and sparse shark sightings could be due to pressure from fishing or (less likely) due to the tendency for larger predators to remain in deeper water during day-time hours when the surveys were conducted. Artisanal fishing in the Manu‘a group is believed to be very light, but shark finning activities might easily occur undetected.

A species of Pomacanthidae was observed at Tu‘u, Ofu, and Olosega that displayed unique characteristics from any other described species. Using an annotated species checklist of Samoan fishes (Wass, 1984) as a reference the fish would be described as Centropryge heraldi, but after reviewing more recent works (Allen G, Steene R, Allen M, 1998) we believe the Centropryge sp to be a new species that is being described by Rudie Kuiter. This particular Centropryge sp is thought to
be a close relative of *C. heraldi* and until present was only thought to inhabit rubble bottoms in the Coral Sea off of Australia's Great Barrier Reef. Therefore with further analysis and verification of the photographs taken, a possible range extension could be made for this pomacanthid species.

Fish species records were noted during the limited time following each census dive but no fish-team observer was dedicated to making a species checklist during the dive. At the end of each day, species records were recorded and photographs were reviewed to aid in compiling a species checklist for each site. Andy Coraish also contributed to the fish species checklist. A total of 127 species were observed at Ta'u L and 168 at Olosega/Ofu L.

On 15 February a deep dive (to 90 ft.) was conducted on the S. side of Olosega followed by snorkeling in the National Park at Ofu to complete the species records. During the 30 m dive a single pink anthias fish (*Amphiprion periderion*) was observed for the first time during the survey and a large dogtooth tuna (*Gymnosarda unicolor*) 1.6m TL was observed. No other unique or unusual observations were made during the dive.
Fish team activity summary, TC-02-01, Leg II (AS 2nd, Swains Isl.).

From 17-20 February, the fish-census team (Ed DeMartini & Robert Schroeder) surveyed 10 stations at Swains Island. Quantitative transects were conducted at 6 stations and qualitative REA surveys at another 4 stations. Stations were located on all sides of the island. The north side was exposed to a large (> 2-m) swell and strong surge at < 10-m depths during this time but underwater visibility was consistently > 30 m. At some stations moderate surge occurred at the transect depth (15 m). The benthic team followed the fish team at all visual census sites and most REA sites.

Fish transect-stations were conducted using the same, previously described survey protocols used on the Phoenix Islands cruise leg and around the main islands of American Samoa. All quantitative transects were set along a single depth at 13-15 m. Additional qualitative surveys spanned 1- to 30-m depths.

This was the first time coral reef fish surveys were conducted by the National Marine Fisheries Service at Swains Island. Fish species diversity (richness) was generally low at the spatial scale (2000-5000 m²) of individual stations, averaging only about 30-35 species out of the total pool of species observed at Swains. Pelagic predators like yellowfin tuna were encountered. Sharks and some other reef-associated apex predators such as giant trevally were rare. Other large reef-associated fish (snappers, emperors, rainbow runner, barracuda, dogtooth tuna) were nevertheless more abundant at Swains than observed previously at Tutuila or the Manu'a Islands. Groupers also were more abundant at Swains but small (< 30 cm total length). Grey reef sharks (Carcharhinus amblyrhynchos), reef whitetip sharks (Triaenodon obesus) and reef blacktip sharks (Carcharhinus melanopterus) were the only species of shark seen at Swains, with only one sighting on the transects. Local fishing pressure at Swains is presently very light as only one family of four currently resides on the island, but up to 100 families have lived on Swains during recent decades.

In addition to the 6 quantitative stations, 4 qualitative stations (2 deep: maximum 23-28 m and 2 shallow; 3-10 m) were conducted to supplement the list of total fish species present at Swains. Additional fish species were also noted during the limited time following each visual transect but no fish-team observer was dedicated to making a species checklist during the entire dive. Andy Cornish and Linda Preskitt (benthic team) and Brian Zgliniski (tow team) also contributed to the fish species checklist at the end of each day. A grand total of 168 fish species were observed at Swains during the four day visit. The only other existing fish survey data at Swains consists of a single pair of stations visually surveyed by A. Green on the SW side in 1995 and described in her 1996 unpublished report to the Department of Marine and Aquatic Resources of American Samoa. Green reported 67 fish species at 10-m depth.

New species (currently being described by others) Dascyllus “auripinnus” (yellow below) and Centropyge cf. heartli (white black soft dorsal) were also observed at Swains.

DeMartini and Schroeder also collected 15 specimens of the arroweye hawkfish.
*Paracirrhites arcatus*. These are contributing to an ongoing study of the genetics of this polymorphic species throughout the Pacific being conducted by DeMartini and G. Bernardi of the University of California at Santa Cruz.
Fish team activity summary, TC-02-01, Leg II (AS 3rd, Rose Isl.).

From 22-26 February, the fish-census team (Ed DeMartini & Robert Schroeder) surveyed 15 stations at Rose Atoll. Quantitative transects were conducted at 12 stations, most of which were followed by qualitative REAs conducted while snorkeling shallower at the same station. Qualitative REA surveys were conducted at another three deep (average 23- to 28-m) stations. Four stations were located inside the lagoon and 11 were located on the fore reef (on the seaward side of the barrier reef). Habitat diversity at Rose was greater than Swains. Suitable fish habitat within the lagoon at Rose was limited to a few pinnacles/patch reefs (mostly along the W), which served as focal points for large fish in the lagoon, and isolated small coral heads on the back reef flat, which harbored small species or recent recruits/juveniles. Structural complexity on the slope outside was low, partly due to the general lack of large old coral colonies, which may have accounted for low fish densities. Sea conditions were generally calm and underwater visibility excellent (>35 m) outside, but visibility was only about 5-20 m inside the lagoon. Surge from large ocean swells was present at the more wave-exposed stations. The benthic team followed the fish team at most visual census stations. Habitat types surveyed were the fore reef slope, outer reef terraces, inner reef flat, and lagoonal patch (pinnacle) reefs.

Fish transect-stations were conducted using the same, previously described surveying protocols used on the earlier legs of this cruise. All quantitative transects were set along a single depth at 13-15 m. Additional qualitative surveys spanned 1- to 30-m depths.

This is the first time coral reef fish surveys have been conducted by the National Marine Fisheries Service at Rose Atoll. Fish species diversity (richness) was generally low (and only slightly greater than at Swains Island) at the spatial scale (2000-5000 m^2) of individual stations, averaging only about 35-40 species out of the total pool of 22 species observed at Rose during the five day visit. This contrasts with 103 species recorded at Rose (at 6, 18-m deep fore reef stations, two of which were supplemented by observations on the adjacent reef flat and back reef) by Alison Green during two brief visits in 1994 and 1995. Sharks and other large reef-associated predators were uncommon. Only three maori wrasse (Cettinus undulatus) and no bumphead parrotfish (Bolbometopon muricatum) were sighted. Both species were noted by the USFWS as common at Rose Atoll in the early 1990s. Larger individuals of other scarids (parrotfishes) were concentrated in the surge zone (<10m). Grey reef sharks (Carcharhinus amblyrhynchos), reef whitetip sharks (Triaenodon obesus) and reef blacktip sharks (Carcharhinus melanopterus) were the only three species of shark seen at Rose, most of which were small and none of which were common. Only a few sightings were made of large pelagic fish (e.g., jacks, rainbow runner, dogtooth tuna). Rose Atoll is uninhabited and levels of past or present fishery exploitation are unknown.
The qualitative REA dives were conducted to supplement the list of total fish species present. Additional fish species were also noted during the limited time (5-10 min) following each visual transect but no fish-team observer was dedicated to making a species checklist during the entire dive. Andy Corahh and Linda Preskitt (benthic team) and Brian Zgliczynski (tow team) also contributed to the fish species checklist at the end of each day.

Perhaps the most interesting biological observation made at Rose Atoll was the apparently greater diversity and density of herbivorous fishes at and near the site of the 1993 grounding of the Shiang Fa (a 250-mi Taiwanese longliner). The numbers of pygmy angelfishes (*Centropyge loricula* and *C. flavissima*) and emperor angelfish (*Pomacentrus imperator*), as well as the numbers and biomass of many species of herbivorous surgeonfishes (*Acanthurus nigrofuscus* and *A. triostegus, Ctenochaetus striatus, Naso lituratus*) appeared notably greater at the wreck site, compared to reference sites located one-half to several km on either side of it, at depths extending from the reef crest to at least 15 m. A greater herbivore abundance at the wreck site most likely reflects a persistent redistribution of grazers in response to a conspicuous bloom of primarily blue green at the coral-impacted and iron-enriched site.
Fish team activity summary, TC-02-01, Leg II (AS 4th, Tutuila).

The fish-census team (Ed DeMartini, Robert Schroeder & Brain Zgliczynski) surveyed 9 additional stations (SW, W and N sides) around Tutuila 27 February and 2-3 March (5 stations were surveyed 9-10 Feb and discussed in an earlier report). Quantitative transects were conducted at these sites, most of which were followed by qualitative REAs while snorkeling shallower at the same station. No additional deep qualitative RFA surveys were conducted. The benthic team followed the fish team at all stations. Habitat diversity ranged from low relief exposed outer reef slopes to highly regose coral structure in protected bays. Sea conditions were generally calm and underwater visibility average to good (20-30 m). Slight surge from larger ocean swells was present at some stations, except in protected embayments.

Fish transect-stations were conducted using the same previously described surveying protocols used on the earlier legs of this cruise. All quantitative transects were set along a single depth at 13-15 m. Additional qualitative shallow RFA surveys spanned 1- to 12-m depths.

Fish species were noted (qualitative REA) during the limited time (5-10 min) following each visual transect, but no fish-team observer was dedicated to making a species checklist during the entire dive. Andy Cornish and Linda Preskitt (beach team) and Stephani Holzwarth (tow team) also contributed to the fish species checklist at the end of each day.

Fish species diversity (richness) was generally low at the spatial scale (2000-5000 m²) of individual stations, averaging only about 25-35 species out of the total pool of about 228 species observed at Tutuila during both visits. This contrasts with 173 species recorded at Tutuila by Alison Green during 1994 and 1996.

Juvenile fish dominated at all stations indicating recent heavy recruitment. Fish diversity appeared to relate to habitat complexity, lowest at low relief stations (e.g., S and highly scoured exposed N stations) and highest where substrate rugosity was high (e.g., spur/groove zones, diversity of coral structural types in W, N bay). The low diversity might also be attributed to the impact of recent hurricanes on substrate complexity. The S station near the road construction site (land fill) appeared to have more algae and herbivorous damselfishes and surgeonfishes seemed more abundant here as compared to other RFA stations around the island.

Sharks and other large reef-associated predators were very rare; none were seen by the fish or benthic dive teams. Although most maori wrasse (Cheilinus undulatus) observed were small-medium size, a few very large (>150cm) terminal phase wrasses were observed along the eastern shores of Tutuila. These wrasses were the largest observed among all of the islands surveyed. None of the large growing bumphead parrotfish (Bolbometopon muricatum) were observed during our surveys and most groupers and snappers seen were small.
This was the National Marine Fisheries Services first opportunity to survey Rose Atoll and the fish survey portion of the towboard surveys found some interesting results. The humbold wasse (Chelilinus undulatus) was observed during the surveys but not as common as expected and the individuals seen were small (<15cm TL) compared to the wasse’s maximum size of 229cm total length. This was surprising due to the remoteness of Rose atoll along with the belief that there is low human interaction and fishing pressure to the island atoll. The humbold wasse (Chelilinus undulatus) is one of the largest reef fish in the pacific and is one of the few predators of the toxic crown-of-thorns starfish (Acanthaster planci).

Another large fish vulnerable to fishing is the giant humbold parrotfish (Bolbometopon muricatum). Although none of this parrotfish were observed during the towboard surveys, three other species of large growing parrotfish (>50cm total length) were observed during the surveys. Both terminal and initial phase pacific steehead parrotfish (Chlorurus microrhinos) was commonly observed inhabiting the reef front while large redlip parrotfish (Scarus rubroviolaceus) and large terminal phase mol parrotfish (Sc. xanthopterus) were commonly seen inhabiting waters deeper than 10 (10m). Large aggregations of the smaller tan-faced parrotfish (C. fornasini) were also seen during the surveys.

Sharks and rays were not as common as expected but of the three species observed, blacktip reef (Carcharhinus melanopterus), gray reef (C. amblyrhynchos), and whitetip reef (Triaenodon obesus), the blacktip reef shark (Carcharhinus melanopterus) was observed to be the most abundant but only found inhabiting the shallow reef crest. The spotted eagle ray (Aetobatus narinari) and a large (>150cm TL) black-blotched stingray (Uormura menyni) were the two species of ray observed inhabiting the lagoon during the towboard surveys.

Jacks (Carangidae) and snappers (Lutjanidae) were common inhabitants of the reef with the fjeye trevally (Caranx sexfasciatus) and the bluefin trevally (C. melampygus) being the most abundant jack and the black and white snapper (Macolor niger) and black snapper (M. maculatus) being the most abundant large snapper (>50cm TL) at Rose atoll. The green jobfish (Siprostes vittatus) and smalltooth jobfish (Lopharistes furcas) were also seen commonly during the surveys but not recorded due to their size often being less than 50cm TL.
Surveys of Stony Corals at Rose Atoll National Wildlife Refuge, February 22-25, 2002
By
Jim Maragos, USFWS

Coral biologist Jim Maragos surveyed stony corals at 11 sites off lagoon and ocean reefs during the visit of the NOAA research vessel Townsend Cromwell at Rose Atoll NWR during February 22-25, 2002. Ocean reef work consisted of seven rapid ecological assessments (REAs) and two permanent 50m transects. Lagoon work consisted of two REAs sites, resurveying four existing 50m permanent transects, and establishing one new 50m permanent transect on lagoon patch reefs.

Additionally, Maragos assisted in the collection and removal of marine debris from near Rose Island, and assisted USFWS biologist Jeff Burgett during collection of 35 water samples and completion of algal quadrat surveys along the reef flat and surf zone along the southwest (SW) side of the atoll. The samples will be later analyzed for dissolved iron concentrations as part of USFWS-sponsored reef monitoring studies in the aftermath of the grounding and breakup of a 250mT Taiwanese long-line fishing vessel on the SW reef in October 1993. Surveys of fish, corals, giant clams, benthic algae, and dissolved iron have been monitored several times since 1994 to assess damages and coral reef response to the grounding. In conjunction with this initiative, Maragos accomplished a general coral survey of 7 ocean and lagoon sites in March 1994, and established 7 permanent transects on lagoon patch reefs in 1999-2000.

The grounding of the long-liner resulted in a major fuel and chemical spill that killed off reef organisms on the shallow SW perimeter reef flat, fore reef, and lagoon back reef in late 1993. A salvage tug dispatched by the insurance company was successful in removing only the bow section of the ship from the reef. The remaining two-thirds of the vessel quickly broke up and disintegrated into thousands of pieces, with lighter, non-metallic debris washing into the lagoon. In turn, invasive blue green algae (Lyngbya, Schizothrix, etc.) quickly established on the dead reef areas and have spread along the entire length of the SW reef, threatening resident crustose coralline algae. Dissolved iron concentrations from the metallic debris was thought to be stimulating the blue greens, and 1997 chemical analyses of iron concentrations have corroborated this relationship (Green et al. 1998). The grounding-related threats to the reef compelled the USFWS to sponsor the partial removal of the metallic debris from the SW reef flats and fore reef. Maragos served as contracting officer representative and salvage diving supervisor during three separate cleanup efforts in 1999-2000 that succeeded in removing 125mT of metallic debris from the reefs. An additional 40mT of larger metallic debris remain to be removed from mostly the fore reef and another 10mT of non-metallic debris remain to be removed from the lagoon. The 2002 visit of the Cromwell allowed USFWS scientists to continue monitoring efforts and assess the effect of earlier debris cleanup operations.

The March 1994 coral survey revealed that coral populations were only locally stressed by the ship grounding, but an unrelated coral bleaching event was underway along all ocean reefs to depths of 20-30m. Many large table, rose, lobe, and brain corals were in the process of bleaching. The 1994 survey duration was too short to determine the fate of
the bleached corals. The 2002 Cromwell visit allowed fore reefs off all four sides of the atoll to be resurveyed for the first time since the 1993-4 grounding and bleaching events.

The 2002 coral surveys revealed that coral populations are in the early stages of recovery from a massive kill, presumably the 1994 bleaching event that affected all reef areas and the more localized effects of the 1993 grounding and spill. Coral diversity is high on ocean reefs ranging from 29 to 51 species per site on ocean reefs and 13 to 15 species on lagoon reefs. A total of 72 species of corals were reported at the atoll in 2002, compared to only 49 in 1994. Altogether, 163 species of corals belonging to 37 genera have now been reported from the atoll. The most common corals are the rose corals *Porites*, *Montastraea*, *Leptastrea*, *Favia*, and *Favites*; the lobe corals *Porites*; and several small table coral species of *Acropora*. Some large 2m diameter corals of *Porites* and *Favia* were reported on deeper ocean fore reefs, but larger 3m diameter *Porites* heads were reported at the base of lagoon patch reefs in the south corner of the lagoon. These heads apparently survived the bleaching event of 1994.

Coral cover on fore reefs is lower on windward fore reefs, averaging 15-20% cover compared to 30-67% on more sheltered reefs. The 1994 estimates for coral cover averaged 60-70% on fore reefs, indicating that coral recovery has not yet reached pre-bleaching levels. Coral cover on lagoon patch reefs varied from 25-33%. Lagoon back reefs near the grounding site now support many small colonies of the brain corals *Favia* and *Favites* and several species of small table corals of *Acropora*. Reef flats in the surf zone of the SW reef near the grounding site now support high densities of the rose coral *Porites*. Despite these gains, many shallow of the blue green algae *Lyngbya* are breaking off and drifting downstream into the lagoon and snagging on and injuring young corals. Large drifts of other blue green algae accumulate in the sluggish NW lagoon, suggesting that algal growth rates are still high.

Pink crustose coralline algae have recovered somewhat since the completion of the 1999-2000 metallic debris cleanup. The zone of heavy growths of *Schizopatha* and associated blue-greens has shrunk from a 700m to a 400m wide "black" swath along the shallow SW reef, with a less severe "brown" extending an additional 200m at each end. The collective 2002 observations reveal that most of the remaining 40mT of iron still needs to be removed before crustose coralline algae can fully re-colonize reef flat, shallow back reef, spurs-and-groove, and shallow fore reef habitats of the SW perimeter of the atoll.

Since the earlier cleanup operations, metallic debris remains stabilized on the shallow to mid depth fore reef slopes with only a few small pieces having washed up on the reef flat from the ocean side. Most of the pieces are estimated at less than 5mT, but the 15mT drive train of the ship remains imbedded in the upper reef margin in the surf zone. Further debris removal will require a salvage-class tug, large lift-bags, heavy-duty cable and winch and underwater cutting operations to mobilize and remove remaining metallic debris from the fore reef. Removal of the debris should eventually allow pink crustose coralline algae to compete successfully against the blue-green algae and re-establish their role as primary reef builders at the atoll.
<table>
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<th>Area GPS</th>
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<td>Acropora nasuta</td>
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<tr>
<td>February 14, 2002</td>
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<td>9</td>
<td>Acropora sp. (cerealis?)</td>
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<td>Rose Atoll</td>
<td>Shallow (15-20”), outer barrier, 14°32.587S 168°10.324W</td>
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<td>March 3, 2002</td>
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<td>Near: 14°17.057S 170°43.320W</td>
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<td>Acropora aculeus</td>
</tr>
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</table>

Each sample consists of a short branch 7-10 cm in length or, in the case of species with a tabular growth form, a segment no greater than 10 cm in diameter. The samples were collected in order to investigate coral spawning cycles in the Pacific. All
samples have been fixed in 10% formalin-seawater. Upon returning to the Kewalo Basin laboratory of National Marine Fisheries Service in Honolulu, they will be decalcified, and 10 randomly-chosen polyps in each sample will be dissected and examined for the presence of developing eggs and testes. The size of developing gonads will be measured, and their dimensions compared to the dimensions of mature gonads documented in the scientific literature, so as to infer the probable stage of development of reproductive products.
Coral Reproductive Studies at Rose Atoll

As part of a study to begin to determine coral spawning cycles in this part of the Pacific, samples were collected from four species of the important reef-building coral genus *Acropora* between 23 and 26 February 2002. For most coral species in which spawning has been either directly observed, or inferred from the size and color of maturing gonads, spawning occurs only once per year. The degree of spawning synchrony among different coral species varies geographically, from mass coral spawning of more than 150 species on the Great Barrier Reef of Australia, to little interspecific synchrony in Hawaii. What little work has been done on this subject in American Samoan (C. Munday, personal communication from L. Rasch) suggests that coral spawning occurs in October and November.

Species of the coral genus *Acropora* were prioritized in this study because their reproductive cycles have been well studied in other areas. Eggs take about 9 months to develop, and testes less than 2 months. In the month before spawning, eggs of many species become brightly colored and can be easily seen in fresh samples by a trained observer. Fresh, mature testes typically have a yellow coloration in fresh samples. The presence of colored eggs and yellow testes is therefore an indicator that spawning will occur within several weeks.

At Rose Atoll, samples (n = 5-10) were collected from *Acropora cervicornis* and *A. nasuta* in the shallow (<10 feet) lagoon, while *A. digitifera* and a fourth acroporid species still to be identified were collected from the shallow (15-20 feet) atoll reef slope. All samples were fixed in 10% formalin-seawater for later analysis of the presence and size of any developing gonads. It is noteworthy, however, that most samples of *A. digithifera* had dark orange eggs and deep yellow testes that were easily visible to the naked eye, supporting the prediction that spawning will occur within several weeks. This result indicates that much remains to be determined concerning coral spawning cycles at Rose Atoll, and within the larger region of American Samoa.
SUMMARY: CORAL SURVEYS, 2002
TUTUILA AND MANU’A GROUP, AMERICAN SAMOA
By Jean Kenyon, Ph.D.

From 09 February through 15 February, 2002, the NOAA research vessel Townsend Cromwell visited Tutuila and the three islands of the Manu’a Group (Ta’u, Ofa, and Oloega) in American Samoa. Jean Kenyon (JIMAR, RCUH) participated in shallow water coral reef surveys as part of larger benthic and fish survey teams. These are the first coral surveys conducted in American Samoa by the Coral Reef Ecosystem Investigation Program, which is based at the Honolulu Lab of National Marine Fisheries Service. Five sites were surveyed at Tutuila, 8 sites at Ta’u, 4 sites at Ofa, and 3 sites at Oloega. The survey sites were chosen in consultation with Andy Cornish, Coral Reef Initiative Coordinator with the Territorial Government of American Samoa Department of Marine and Wildlife Resources. Sites were chosen based upon the lack of surveys in the general area by previous investigators and/or by their location within the boundaries of the National Park of American Samoa.

All of the survey sites at each island were species inventories and rapid ecological assessments (REAs) of coral populations. In addition, a total of 72 samples from 7 species of Acropora were collected from Tutuila, Ta’u, and Ofa and fixed in formalin in order to assess their sexual reproductive status. The benthic team for all surveys consisted of the author focusing on corals, Andy Cornish focusing on soft corals, Peter Vroos focusing on benthic algae, and Scott Godwin focusing on other benthic invertebrates. The final dive off Oloega Village was conducted to a depth of 90 feet by the author, Brian Zgliniczki, Bob Schroeder, and Andy Cornish. Co-workers assigned to the benthic team during the surveys were Bruce Mokio, Eric Davis, and Jeff Sage.

Rapid Ecological Assessments (REAs) of coral populations
With the exception of the final, deep dive to 90 feet off Oloega Village, at each survey site the 5th team would lay out three, 25m-long transect lines along a 45-foot depth contour; the beginning of the second and third transect lines were separated from the end of the previous transect by 3-4 meters. As a precaution to minimize disturbance to fish populations along the lines, the fish team would begin fish counts 10-15 minutes before the benthic team entered the water. The author would then videotape all three transect lines using a Sony PC digital PC100 canncorder in an underwater housing while slowly swimming -1 meter above the length of the line; these video sequences will enable later, computer-assisted quantitative analysis of percent coverage of corals, algae, and substrate types. Additionally, at the beginning of each of the three transect lines, a 360° pan of the surrounding reef area was slowly videotaped to document the topography and general nature of the surrounding area. The author then swam back along as many of the transect lines as bottom time permitted and listed coral species (or genus, when species identification in the field was ambiguous) occurring within 0.5m of each side of the transect lines, the size class to which the maximum diameter of the colony belonged (≤ 5 cm; 5-10 cm; 10-20 cm; 20-40cm; 40-80 cm; 80-160 cm; or ≥ 160 cm) and the relative abundance of the species/genus using the DADiSP protocol (dominant, abundant, common, occasional, and rare). These size classes were chosen based on a 1996 report by Craig Mundy1, so as to make results of the present study comparable with Mundy’s surveys of other reef sites around Tutuila and the Manu’a Group.

1
Analyses of coral frequency, cover, and size distributions from nominal and numerical data collected during the surveys will be accomplished as time permits during the remainder of the TC02-01 cruise. Analysis of digital video taken along the transect lines will be conducted using duplicates of the videotapes rather than the originals, which will be archived as a permanent record of the state of the reefs in early 2002. Given the constraints of time, working conditions onboard the Townsend Cromwell, availability of tapes with which to make duplicates, and priorities allocated to other digital video analyses, analysis of the transect videos will be conducted at a future date after returning to the Honolulu Lab. However, preliminary analyses suggest that the two most numerically abundant coral genera in Mundy’s study, Montipora and Porites, continue to comprise the largest percentage of all coral colonies recorded. Similarly, these two genera appear to represent the highest overall proportion of coral cover. However, variations from this general pattern existed at several sites; for example, at a site along the eastern coast of Ta’u (~3/4 mile NNE of Tufu Point) the lamellar species Turbinaria reniformis was dominant while species of both Montipora and Porites were either rare or only occurred occasionally. A site close to Asaga Strait on the south coast of Ofu also exemplifies divergence from the general overall pattern, as members of the genus Gonastrea formed a large number of small colonies, while members of the genera Montipora and Porites were only occasionally noted.

Mundy’s report of his surveys conducted in October and November 1995 concluded that the reefs of American Samoa were in a recovery phase following a combination of natural and anthropogenic impacts. Chief among these impacts was an outbreak of the coralivorous Crown-of-thorns starfish (Acanthasterplanci) in the mid-1980s and two severe tropical cyclones (“Vall” in 1990 and “Ofu” in 1991). As evidence of this recovery he points to the size class distribution of more than 18,000 colonies measured during his surveys (Figure 1, re-drawn from Mundy, 1996). Although the number of coral colonies measured during this survey (n = 2268) is substantially less than in Mundy’s surveys, a comparison of their overall size class distribution (Figure 2) suggests that this process of recovery is continuing, as existing colonies continue to increase in size and new coral recruits enter the reef community.

Figure 1. Re-drawn from Mundy, 1996

Figure 2.
Coral Surveys off western Tutuila, Island, American Samoa, Feb 27-Mar 3, 2002
By
Jim Maragos, USFWS

Stony coral biologist Jim Maragos conducted surveys of corals as part of a larger benthic team during the visit of the Townsend Cromwell at Tutuila Island, American Samoa on February 27- March 3, 2000. Nine sites (6 through 14) were surveyed to depths of 15m, all off the western half of the island. Jean Kenyon accomplished coral surveys off eastern Tutuila during the cruise in early February and is reporting her results separately.

The 9 survey sites consisted of rapid ecological assessments (REA), generally following established protocols developed in 2000. As part of the benthic team, the coral biologist took wide-angle photographs, using a Nikon RS camera with a 13mm lens, along the first two 25m transect lines previously laid out by the fish team at each site. These photos will be processed and later analyzed to calculate quantitative data on coral cover, population size distribution, frequency, and generic-level richness and diversity indices. Unfortunately a camera was not available for surveys at the first 3 sites, and instead corals were counted insitu along each of the two transects at each site. All corals with their centers within one meter of each side of the line were assigned to one of 7 size classes and each identified to the genus level. Data were collected on about 150 to 200 corals in this manner along each line. These data have been collated and will be used to calculate the same coral parameters as those using the photographs.

In addition, the stony coral biologist listed all coral species within the general dive area (roughly 5,000m) and assigned each species an abundance level visually approximated at the end of each dive. These levels are dominant (D), abundant (A), common (C), occasional (O), and rare (R). At each site the coral biologist also estimated the overall percent live coral cover, diameter data on the largest corals at each site, and recorded notes on bleaching, predation, competition with algae, tunicate, and diseases, if any.

The corals of Tutuila have been surveyed several times over the past 25 years using SCUBA gear, including Lamberts in 1979, Birkeland et al. over several times since the early 1980's, Maragos et al in 1991-2, Mundy in 1995, and Maragos 2002 as a part of the present Cromwell expedition. The locations and methodologies of these studies vary, rendering comparisons difficult. However, 6 of the 9 sites surveyed in 2002 were also surveyed in 1992 by the same investigator, following very similar protocols and allowed comparisons over a decade of coral cover and species richness at these sites.

A total of 173 species of corals were reported at the nine 2002 sites including 162 stony coral species. This compares to 175 species reported in 1991-2 at 40 sites using very similar techniques. Adding 1991-2 and 1995 species not seen in 2002, a total of 235 species of corals have now been recorded from Tutuila over the past decade with the assistance of SCUBA. Additional species were reported by earlier investigators, but major uncertainties remain for consistent and accurate identification of many corals, especially for the plethora of Acropora and Montipora species. Many of the named (nominal) are sure to be combined with other species. Nevertheless, there are likely
between 250 and 300 stony coral species in American Samoa, including species only reported elsewhere in American Samoa. These totals are high compared to those of other U.S. coral reefs in the eastern and central Pacific, but are comparable to other archipelagos bordering the western Pacific where reef biodiversity is higher.

Species of Acropora and Montipora accounted for nearly half the species and a majority of the coral cover at most sites. Other common corals included Pavillogoria, Astreopora, Favia, Porites, Pavanoa, and Montastrea. Large colonies of most of these species were present, and exceptionally large (and old) colonies of Lobophyllia, Echinopora, and Merulina were also noted at some sites. Coral cover was high at all sites, between 60-80%, except at one exposed basaltic headland (TUT-13) on the north coast where corals covered only 10% of the bottom. Coral cover was also high at the one site close to heavily urbanized Pago Pago Harbor (TUT-10). The highest abundance and diversity of corals were reported off southwest corner of Tutuila, with the highest off Amanave Bay (87 species 80% coral cover). At least 50 species of corals were reported at every site, an exceptional level of diversity compared to other U.S. reefs to the northeast of Samoa.

Maragos conducted surveys at 40 Tutuila sites in 1991-2 shortly after 2 devastating hurricanes and a decade after a severe crown-of-thorns starfish (Acanthaster) infestation. In fact, the hurricanes struck before coral populations could recover from the earlier infestation. Moreover, eutrophication from heavily urbanized Pago Pago Harbor also stressed adjacent reefs in 1992. However, the 2002 surveys revealed that coral populations have almost completely recovered from the earlier stresses and natural catastrophes. At the six same sites surveyed in 1992 and 2002, coral cover and species richness nearly doubled during the decade at all but one site (see table below). The fact that as many coral species were reported at 9 sites in 2002 vis-à-vis 40 sites in 1992 is additional evidence of corals on the road to recovery off western Tutuila.


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Octocoral surveys of American Samoa.

Progress report 6-16 February (Manu’a group and 5 sites on Tutuila)

Andy Cornish Ph. D

Goals
1) To catalogue the shallow water reef octocoral fauna of American Samoa.
2) To quantify the diversity and abundance of octocorals in the shallow waters of American Samoa and examine patterns in their distribution.

Methodology
1) Describing the octocorals of American Samoa is a continuation of a study initiated on Tutuila and Ofu in late 2001. The Townsend Crotwell cruise allows collections to also be made in Ta’u, Olosega and two atolls that make up the territory, greatly increasing the coverage and value of this baseline study. Collections are made opportunistically during the quantitative surveys and are therefore limited to 15 m depth, although deeper dives will be made where possible. Specimens are photographed in the field and collected when they are not recognized as being previously encountered. These specimens will be examined at a later date (as a high-powered microscope is required to examine the spicules for species-level identifications) and a checklist compiled. Specimens will later be deposited in The Museum and Art Gallery of the Northern Territory, Australia, where Dr P. Aldersdale, a prominent octocoral taxonomist, is a curator.

2) The methodology used to examine the distribution of octocorals is a an adaption of the semi-quantitative rapid assessment methodology employed by Fabricius and De'ath (2000) to survey octocorals on the Great Barrier Reef. Swim surveys of ne less than 100 m in length are made at 3 depths at each site. NOAA dive tables and the need to buddy with another member of the benthic team limit the deepest depth to 15 m with another at 8 m. The reef crest (0-3 m) is surveyed (where one is present) by snorkeling. Octocorals are surveyed at different depths as their distribution varies more with depth than along the reef, at least on small scales (Fabricius & Aldersdale 2001). Octocorals are identified to genera and the abundance of each along the swim survey (and within + and – 1 m of the depth contour) estimated into one of five abundance categories. Hard and soft coral cover are estimated in the categories 0-5%, 5-10%, 10-20%, 20-30% etc. Estimates of horizontal visibility and sediment levels are also made.

Progress to date
The semi-quantitative surveys were performed at 19 sites (6 at Ta’u, 6 at Ofu/Olosega and 5 at Tutuila). Around 10 specimens have been collected during these surveys and during an additional deeper dive to 28 m on the southern shore at Olosega. The results so far show that the shallow water octocoral fauna at these locations is dominated by four genera (Sinularia, Cladiella, Sarcophyton and Lobophytum), all from the family Alcyoniidae. Specimens believed to be of another genera in iris family of leathery soft corals, Klyxum have been collected and were quite abundant while one colony of Rumphella, a gorgonian in the family Gorgoniidae, was also recorded.
While the data has yet to be analyzed, there appears to be a pattern of higher octocoral abundance and diversity in sites with higher coral cover. Many of the reef sites in Manu’a appear to be recovering from one or several mass mortality events and the soft corals unsurprisingly are richest at sites where the hard corals appear to have been less affected, or where recovery has been quicker. Octocorals were not the dominant benthic fauna at any site, with cover always being estimated at less than 10%. With regards to depth, soft coral communities were richest at either the 8 or 15 m depths. Octocorals were scarce along the reef crest at most sites, especially in Manu’a where all of the surveyed reefs had high exposure.

The deeper dive at Olosega was disappointing in revealing no sea fans or tree corals (Nepthieidae) despite apparently suitable habitat. These octocorals are often encountered on reefs in the depth range 15 – 45 m with good water flow on Tutuila (pers. obs) and their absence was intriguing, although little conclusion can be drawn from a single site.
Octocoral survey progress report 9-10 Feb., 27 Feb.-3 March 2002 : Rose Atoll

Andy Cornish

14 sites were surveyed around the main island of Tutuila, 7 on the northern shores and 7 on the southern. As with the other sites, 100 m semi-quantitative swim-surveys were conducted at 0-3, 8 and 15 m depths. Sites were conducted primarily on coral reef slopes in bays but also along exposed rocky shorelines.

From this and ongoing surveys by the same researcher, Tutuila has the highest soft coral and sea-fan diversity of any of the islands and atolls that make American Samoa. Five genera were recorded during this survey, Lobophyllum, Cladiella, Sarcophyton, Sinularia, Rumphella and another type believed to be Klyxum (samples will need to be identified with a high-power microscope). Collections made previously in dives to 40 m have also found Dendronephthya, Kerovides and Andella, genera not recorded at Manu‘a, Rose Atoll or Swains Island. Lobophyllum, Cladiella, and Sinularia were the most abundant genera with Klyxum (?) and Sarcophyton encountered in small amounts occasionally and Rumphella being rare. Tutuila had the only site where octocorals had a % cover higher than hard corals, at 8 m at the Nuuuli site (TUT 10) on the southern shore where octocorals, primarily Cladiella, which was dominant, were estimated at 30-40% cover. As with all other locations apart from the pinnacles in the Rose Atoll lagoon, soft corals were more abundant at 8 and 15 depths than on the reef crest.

Further observations will have to wait until more detailed analysis of the data can be made. Tutuila has the most diverse array of habitats of any of the reefs in American Samoa and while many of the sites appear to have healthy octocoral communities, there were also areas, particularly those more exposed sites, where diversity and abundance were low. Such a variety of octocoral communities obscures any differences with the other islands and atolls other than those noted in previous progress reports for those localities.

Andy Cornish

The swim-survey methodology conducted at Tutuila, Manu’a and Swains was repeated at Rose Atoll. 8 sites were surveyed on the reef slope around the well while 4 pinnacles were surveyed within the lagoon. Additionally, coral bommies within the lagoon were snorkelled around in several locations while 2 deeper REA dives, both to 30 m, were made on the reef slope, one on the south-west shore and the other just to the north of the lagoon channel.

Sinararia and Lobophytum were the most abundant octocorals, being present on nearly all of the reef slope transects at 8 and 15 m depths. Both genera were particularly abundant on the eastern shores although were not estimated to exceed 5% cover at any site. Sarcophyton was present in small quantities on some transects. All three genera were recorded on both deep dives in addition to 2 patches of around 10 Rumphella colonies also encountered on the dive close to the lagoon pass. Only Lobophytum was recorded on reef crest transects, and only then in small quantities. Sediment levels were negligible on the reef slope, unlike within the lagoon where there were considerable amounts.

Octocorals were absent at depths of 15 m (the lagoon was only deep enough to allow a transect to be surveyed at 15 m on one of the four pinnacles) and at 8 m within the lagoon, apart from one pinnacle where a small amount of Sarcophyton was recorded. Soft coral diversity and abundance were greater, although still generally low, on the pinnacle crests. Sarcophyton was the most common genera on the crests. Some colonies were bleaching, probably due to the high water temperature (95 °F). Casual observations around large bommies in the shallow of the back reef suggested that Sarcophyton was the also most abundant genera in that habitat and were concentrated just under the low water mark.

Overall, octocoral communities appear healthy on the reef slopes at Rose Atoll. These communities are regenerating, as indicated by the small size of most colonies, in contrast to larger colonies (>1 m diameter) encountered on the deeper dives in the 25 - 30 m depth range. The most likely source of the disturbance to the shallower reefs would be the hurricanes in the early 90s which appear to have caused considerable damage to Manu’a and Swains. The lack of sea-fans, gorgonians apart from Rumphella, and tree corals in the family Neptiheidae, which were observed to be absent on the two deep dives to depths of 40 m is probably due to a paucity of larval supply or unsuitable environment (the habitat itself was similar to deeper reef on Tutuila where such octocorals thrive).

The complete lack of Cladiella, which is abundant in Tutuila, and to a lesser extent, Manu’a was also of interest and is probably related to the nutrient-poor environment of atolls (J. Maragos, pers. comm.).

Within the lagoon, the environment appears to be less than optimal habitat for most octocorals with its high sediment levels and elevated temperatures. It is no surprise that Sarcophyton was the dominant genera there as these corals are known to be able to thrive with high sediment loadings (Fabricius & Aldersdale, 2001).
Ref.
Octocoral survey progress report 17-20 Feb. 2002: Swains Island

Andy Cornish Ph.D.

The swim-survey methodology conducted at Tutuila and the Manu'a group was continued at Swains Island. Six transects spaced widely around the atoll, three along the northern shores and three on the southern, were surveyed with the fish and benthic teams. In addition, two deeper collecting dives were made off the SW coast (depths between 20 and 28 m) and observations made whilst assisting with other surveys at 3 additional sites.

Swains Island proved to be remarkably depauperate with regard to octocorals, none were recorded on the reef slope to 15 m depth, either along the 12 x 100 m swim-surveys at 8 and 15 m or during any of the dives to this depths. Furthermore, no octocorals were observed by Scott Godwin and Linda Prescott in their survey of the intertidal zone, nor by the tow-board teams. Indeed, the only octocorals encountered were a small community of Sinularia colonies, some long established, on a vertical wall at 25 m on the NW tip of the atoll. Several specimens were taken for more detailed identification.

The total absence of octocorals on the Swains shallow reef slope is in stark contrast to similar habitat in Tutuila and Manu'a, where octocorals were present at 16 of the 17 sites. The only site where octocorals were absent there was a highly exposed reef at Ta'u where live coral cover was estimated to be less than 5%. It was noted from the previous sites that there was a general trend of increasing soft coral diversity and abundance with increased hard coral cover. This trend clearly did not hold for Swains where soft corals were absent but where hard coral cover was consistently high, being estimated at between 40-50%, and 80-90% on all 8 and 15 m depth transects.

The most likely explanation for the scarcity of octocorals at Swains Island is that communities were largely wiped out by the widespread mortality event that seems to have devastated the hard corals (see this report). This theory is supported by the presence of an established octocoral community on deeper reef where old scleractinian coral colonies were also present. Several pioneering hard coral species are now flourishing at Swains, the octocorals in contrast show no signs at present of recolonising the shallow reef slope. This is likely due to a
paucity of larvae reaching the shallow reef slope propagated by surviving colonies in deeper waters, or other nearby reefs (which are notably few). Another explanation may be that octocorals have always been scarce at Swains due to poor larval flow (the habitat would seem to be suitable), a theory which is hard to disprove without historical data showing the presence of soft corals in the shallows at Swains. The available literature will be examined for this in future. In the meantime, these surveys will be invaluable in acting as baseline data in documenting any colonization of the reef slope by octocorals in the future.
Summary Report - American Samoa 2002
Tutulua, and Rose Atoll

Marine Invertebrates Survey
Scott Godwin, Bishop Museum, Honolulu, Hawaii

Survey Dates:
Rose Atoll – February 22-26
Tutulua – February 27
March 1-3

Surveys focusing on marine invertebrates other than corals were performed in conjunction with surveys of coral and macroalgae, collectively termed the benthic survey.

Methods
Surveys for marine macroinvertebrates were done qualitatively along two separate 50 meter transect lines. A zig-zag pattern that extended roughly 2 meters on either side of the transect line was done for each of the two lines. Once this was accomplished, a brief swim of the general area was done to account for species away from the transect area. Species were recorded and the qualitative abundance was given using the DACOR method (D=dominant, A=abundant, C=common, O=occasional, and R=rare).

Intertidal surveys for invertebrates and algae were conducted in the lagoon at Rose Atoll. These were done at low tide and began at the shallow lagoon in 5 feet of water and proceeded to the buttresses at the reef edge.

Accomplishments
During period between February 22 and March 3 the U.S. Fish and Wildlife Service’s nature reserve at Rose Atoll was surveyed and the continuation and completion of the survey around Tutulua was accomplished. A total of 15 benthic surveys were done at Rose Atoll and 9 at Tutulua.

Favorable weather gave unlimited access to windward and leeward sides of Rose Atoll. Eight sites evenly spaced around the outside of the reef were surveyed, as well as the site of a shipwreck that has caused environmental changes at the site of the grounding.

Five survey sites were previously done February 9 and 10 and a total of 14 were planned. The remaining 9 sites were completed February 27 and March 1-3.

The breakdown of the sites for Rose Atoll and Tutulua are as follows:

Rose Atoll
- 6 sites at a maximum of 50 feet, evenly spaced on the outside reef
- 1 site at 95 feet
- 1 new permanent transect set up in the vicinity of the wreck site at 35 feet
- 4 surveys of previously established transects on lagoon patch reefs at a maximum of 35 feet
- 1 new permanent transect set up on a deep lagoon patch reef at 35 feet
- 2 surveys of invertebrates and algae from the shallow lagoon (5 feet) to the reef buttresses.

Tutulua
Standard REA sites:
1. Amanave Village
2. Poloa Village
3. Aolau Bay
4. Airport runway
5. Road construction site
6. Larsen Bay
7. Massacre Bay
8. Mulilo Point
9. Afono Bay

General Impressions
Rose Atoll
Rose Atoll is a classic atoll with a clear division between outer reef zone and lagoon. The surveys began by focusing on the outer reef, proceeded to lagoon patch reef habitats, and finished with an intertidal survey.

Outer Reef
There was a great deal of reef structure on the windward side of the atoll composed of coralline algae, which created an extremely rugose terrain, and the leeward sides had typical carbonate structure. The macroinvertebrate fauna on the outer reef was dominated by plumulid and stylasterid hydroids. As far as mobile invertebrate fauna, hermit crabs and molluscs were occasional to common. The molluscs were primarily in the 15-25 foot range and were typically composed of Conidae, Cypereaeidae and Thaliidae gastropods. Trochus was seen occasionally in the 15-25 foot range and surprisingly was common at a depth of 95 feet at a single site. Giant clams were rare on the outer reef slope.

Lagoon patch reefs
The lagoon was a vast expanse of sand with periodic patch reefs that ranged from 10-45 feet deep at the base. These islands of habitat had abundant populations of spondylid oysters, giant clams, and chaetopterid tube worms. One exception was a single patch reef located close to the channel entrance, which was almost devoid of giant clams. At the base of the patch reef in the sandy areas there were signs of abundant Tonna, with shells being everywhere. Also in the vicinity of the patch reefs there were common occurrences of sea cucumbers and sea urchins.

Intertidal
The shallow lagoon areas on the east and west sides of Rose Island were high in giant clam abundance. Reef flats on the east and west sides differ by their species composition. The east flat had an even distribution of gastropods, urchins and hermit crabs, while the west side was dominated by holothuroids. Giant clams were rare on the reef flats on both sides of Rose Island.

Tutuila
As with the previous surveys, most sites were embayments near villages but a site near the airport runway, a road repair project, and an exposed point were also surveyed. The surveys began with the west and southwest, proceeded to the south, and then finished in the north and northwest. There was no conformity of species between sites of the similar embayment habitat. The only species common to each embayment site were hydroids, whereas the gastropods, hermit crabs, and echinoderm distribution differed greatly. The airport site was a gently sloping low reef that had an abundant and diverse community of gastropods and hermit crabs. The site of the road project had a large number of sessile organisms such as zoanthids and tunicates, while didemnid tunicates and gastropods dominated the exposed area at Mulilo Point. Giant clams were occasional to common at all sites surveyed.
Summary Report – American Samoa
Tutuila, Ta‘u, Olosega, and Ofu

Marine Invertebrates Survey – Scott Godwin, Bishop Museum

Survey Dates:
Tutuila – February 9-10
Ta‘u – February 11-12
Olosega – February 13
Ofu – February 14-15

Manua Islands

Surveying focused on marine invertebrates other than corals were performed in conjunction with surveys of coral and macroalgae, collectively termed the benthic survey.

Methods
Surveys for marine macroinvertebrates were done qualitatively along two separate 50 meter transect lines. A zig-zag pattern that extended roughly 2 meters on either side of the transect line was done for each of the two lines. Once this was accomplished, a brief swim of the general area was done to account for species away from the transect area. Species were recorded and the qualitative abundance was given using the DACOR method (D=dominant, A=abundant, C=common, O=occasional, and R=rare).

Accomplishments
A total of 2 sites for Tutuila and 10 for the Manua Islands were surveyed during the period between February 9 and February 15. The focus was to cover as much area at each site as possible. No permanent transects were set up during this survey period. The accomplishments for each survey site are as follows:

Tutuila
Surveys were begun east of Pago Pago and continued to the central north shoreline.
- Sites surveyed
  1. Alega
  2. Fagaitua Bay
  3. Alao
  4. Fasausi
  5. Masafau Bay

Manua Islands
Ta‘u
Surveys were begun at the southeast shore and proceeded to the southeast, then a second set was begun on the northeastern shore and completed on the central western shore.
- Sites surveyed
  1. Due north of Tufo Point
  2. Laufuli waterfall
  3. S‘u‘a‘alele Point
  4. North east shore
  5. Loto Point
  6. Ta‘u Village
Closeup
One site was surveyed on the east shore and one on the west shore.

- Sites surveyed
  1. Central east shore
  2. Sili village

Ofu
Beginning on the central north shore and moving to the central south shore, five sites were surveyed around Ofu.

- Sites surveyed
  1. North shore
  2. Proposed airport extension
  3. South shore due east of Papioloa Point
  4. South shore near To'aga
  5. South shore near To'aga (deep dive >80 ft) in conjunction with snorkel survey of intertidal area.

General Impressions
From interviews with local residents and with the American Samoa Bureau of Marine and Wildlife Resources, there does not appear to be heavy near-shore fishing pressure from local residents at any of the sites. Stresses to the near-shore communities appear to be from natural events. Damage attributed to storms and heavy wave action appear to be the most influential and predator activity, such as Crown-of-Thorns starfish, seems to have minimal impact. The populations of macroinvertebrates do not appear to be impacted by human activities.

The distribution of marine macroinvertebrates does not appear to be evenly distributed between the shallow back-reef area and the shallow reef slope (20-45 feet). Many more species regularly occur in the reef flats and not on the reef slope. This is especially true of echinoderms, which are rare to absent on the shallow reef slope. The one macroinvertebrate species that is an exception is the giant clam. These appear rarely in the reef flats and exist more commonly on the shallow reef from 15 to 30 feet. On Tutula, giant clams were rare on the south shore and common on the north shore, and they were common to abundant throughout sites in the Manua Islands.

Overall, the macroinvertebrates on the shallow reef slopes tended to be hermit crabs, gastropod molluscs, and giant clams. The back-reef flat areas had large numbers of sea cucumbers and sea urchins, and comparable numbers of other species found throughout the habitat from the reef flat to the reef slope.
Specimen Collections – American Samoa 2002
Tutuila, Ta'u, Olosega, Ofu, Swain’s Island, and Rose Atoll

Marine Invertebrates Survey
Scott Godwio, Bishop Museum, Honolulu,Hawaii

Survey Dates:
Tutuila – February 9-10
February 27
March 1-3
Mama Island
Ta'u – February 11-12
Olosega – February 13
Ofu – February 14-15
Swain’s Island - February 17-20
Rose Atoll – February 22-26

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Species that could not be identified in the field were collected and brought back to the research vessel Townsend Cromwell for further analysis. Organisms that were identified back at the ship were returned to the field the next day and species that could not be identified were saved for analysis at Bishop Museum in Honolulu, Hawaii.

Specimens saved for identification at Bishop Museum were preserved in ways suitable for each taxonomic group. Molluscs were preserved in 75% Ethanol of frozen, crustaceans and echinoderms were frozen, and soft-bodied organisms were preserved in 10% Formalin.

The analysis at Bishop Museum will involve the use of taxonomic literature to make tentative identifications and then specimens will be sent to experts throughout the world for confirmation of these identifications. This loan process will be monitored by the Bishop Museum registrar and Invertebrate Zoology collections manager until the specimens are returned. The specimens will be permanently housed within the Bishop Museum Invertebrate Zoology collection at the end of the process. These findings and the field identifications will be given to the NOAA National Marine Fisheries Office in Honolulu, Hawaii in the form of a final report.

Specimen Collections

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<td>Calcinus</td>
<td>sp.</td>
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</tr>
<tr>
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<td>Unknown</td>
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Summary Report – American Samoa 2002
Swain’s Island

Marine Invertebrates Survey – Scott Godwin, Bishop Museum

Survey Dates: February 17-20

Surveys focusing on marine invertebrates other than corals were performed in conjunction with surveys of coral and macroalgae, collectively termed the benthic survey. A freshwater lake exists in the central portion of Swain’s Island, and this was roughly surveyed by snorkeling.

Methods

Surveys for marine macroinvertebrates were done qualitatively along two separate 50 meter transect lines. A zig-zag pattern that extended roughly 2 meters on either side of the transect line was done for each of the two lines. Once this was accomplished, a brief swim of the general area was done to account for species away from the transect area. A single intertidal survey was accomplished by swimming two transects from the shoreline to the reef crest. Swain’s Lake was surveyed by swimming two transects from the shoreline to the center of the lake. Species were recorded and the qualitative abundance was given using the DACOR method (D=dominant, A=abundant, C=Common, O=occasional, and R=rare).

Accomplishments

A total of ten surveys for marine invertebrates were done while at Swain’s Island, which are summarized as follows:

- Eight outer reef surveys on north, south, east, and west sides of the island
- Seven surveys ranging from 15-50 feet
- One survey ranging from 50-70 feet
- One intertidal survey from shoreline to reef crest on the southernmost portion of the island
- One survey of Swain’s Lake from shoreline to the center, which included a bottom survey and plankton tow

General Impressions

Outer Reef

The outside reef areas of Swain’s Island had impressive coral cover but a low diversity. This coral reef community appears to be a pioneer stage following a large scale disturbance that has affected the entire reef around the island. Marine invertebrates were not very abundant and not very diverse over all sites. The sites will be summarized by a breakdown of taxonomic groups.

Molluscs

Gastropods ranged from common to occasional with there being an even makeup between the families recorded. The gastropod species recorded were mostly distributed in the 15-30 foot depth zone. Giant clams were extremely rare across the 8 sites surveyed and only appeared in the 15-20 foot depth zone.

Crustaceans

As with most coral reef habitats, most decapod crustaceans, with the exception of hermit crabs, are cryptic during daylight hours. With this in mind, hermit crabs are the most likely crustaceans noted during the surveys. It is possible to observe lobsters as well, if holes, overhangs, and other recesses are examined during surveys.

Hermit crabs were common through the 15-30 foot depth zone but were rare in the deeper areas. Judging by cursory morphological examination, there are only two
common species observed during surveys. No lobsters were seen during surveys but a segment of a mollusk was found during the 50-70 foot survey dive.

Echinoderms

There was a surprising lack of sea urchins, sea cucumbers and sea stars through out all habitats surveyed. The only species commonly occurring through all sites surveyed was a single species of rock-boring urchin. Thse urchins occurred in small numbers on the walls of surge channels. A single species of sea cucumber was noted below 70 feet on a sandy area of the slope but at no other sites surveyed. The Crown-of-Thorns sea star was the only commonly seen sea star, and it tended to be at depths below 40 feet. Brittle stars were found irregularly at the bottom of surge channels.

Other species

There were other species commonly seen at all sites surveyed, which tend to be grouped under the sessile fouling organism category. There was a single species of yellow sponge seen regularly and two species of hydroids. Other common sessile species normally found in this habitat were conspicuously absent.

Intertidal

The intertidal area surveyed was hard carbonate pavement with sparse coral rock and abundant holes scoured into the surface. The same taxonomic groups common on the outer reef were present in the intertidal.

Molluscs

Gastropods were more abundant and diverse in the intertidal but still less than would be expected. Giant clams were completely absent in this habitat at Swain’s island.

Crustaceans

A single species of hermit was abundant in the habitat. Lobster carapace was noted occasionally, as was carapace of a large xanthid crab.

Echinoderms

Expectations were to find the echinoderm groups absent from the reef slope in the intertidal. Although a single species of sea cucumber was found commonly, the echinoderm fauna was truly lacking in the intertidal zone. The rock-boring urchin seen on the reef habitat was rare to absent in the intertidal area surveyed. Lastly, there was a single species of brittle star associated with rare coral boulders located in this habitat.

Swain’s Lake

This was an unusual habitat dominated by blue-green algae mats located on the lake bottom. There was an abundance of three different bivalve shells and a single snail shell on the bottom but no live specimens were found. Two fish specimens (Gobiidae) were obtained during the survey.
Marine Algae of American Samoa
Peter S. Vroom

American Samoa has a rich algal flora that is in much need of detailed scientific research. Although a few studies have documented species composition from select areas, published species records probably vastly under represent actual species numbers. From our recent investigations, sites around Tutuila Island and the Manua Island group revealed a diverse turf community that undoubtedly consists of several dozen filamentous red, green, and brown algal species. Macroalgae varied in abundance between sites, and although laboratory confirmation is still required, represent over 43 species in 35 genera. Additionally, crustose coralline red algae were of major importance at all sites, forming pavements that cement the reef together.

One of the most interesting aspects of algal collections from Samoa is the paucity of brown algae. Although brown algae are usually present in smaller numbers than green and red algae in tropical locations, only one species of Dictyota was collected during our 7 days of field surveys. Future laboratory analysis of preserved specimens may reveal additional genera; however, the percentage of browns will remain unusually low compared to the percentage of greens and reds collected.

Tutuila Island

Samples still being collected.

Tau Island

Sites TAU1 (east side), TAU2 (south side), TAU4 (north side), and TAU5 (north side) all ranged from between 30 to 50 feet deep, and exhibited diverse coral communities with a surprisingly high number of algal species compared to other islands in the Manua group. The green algal genera Dictyosphaeria, Chlorodesmis, and Halimeda were found at essentially all
**Algal Collection, American Samoa February 9 – March 3, 2002**

**Principle Investigators:** Peter Vroom, February 9-16; Linda Preskit, February 17- March 3; University of Hawaii, Department of Botany

**Purpose of Collection:**
Identification. Samples are collected for analysis and as a record of species. Pressed samples will be kept in the University of Hawaii, Botany Department, Physiology lab’s herbarium. Frozen samples will be analyzed to identify species and either pressed for the herbarium, preserved, or discarded.

**Algae Collection and Preservation:**
One to two plants of each species are collected: one is pressed for a herbarium specimen, and one is frozen for later laboratory analysis. It is difficult to impossible to identify many algae to species without compound microscope analysis. Therefore, the following collection list is identified to genera and species whenever possible. Otherwise, genus or a simple description of the sample is provided.

**Sample size:**
Each sample is one complete plant. If the plant is crustose (ex. Lobophora or Peyssonnelia) or a mixed turf, a small piece is scraped off the substrate. Sample sizes differ according to the plant’s size: calcified plants average 10gms, non-calcified plants average 5gms.

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**Tutuila, February 9 – 10, February 27 – March 3, 2002**

**Number of samples collected at each site**

<table>
<thead>
<tr>
<th>Site</th>
<th>TUT 1</th>
<th>TUT 2</th>
<th>TUT 3</th>
<th>TUT 4</th>
<th>TUT 6</th>
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</thead>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td>2</td>
<td>2</td>
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<td>TUT 08</td>
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<td><strong>Chlorophyta:</strong></td>
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<tr>
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**Tuu Island, February 11 – 12, 2002**

**Number of samples collected at each site**

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<th>TAU 2</th>
<th>TAU 3</th>
<th>TAU 4</th>
<th>TAU 5</th>
<th>TAU 6</th>
<th>TAU F</th>
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<td>OLO 2</td>
<td>OFU 1</td>
<td>OFU 2</td>
<td>OFU 3</td>
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<tr>
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**Rhodophyta:**

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<th>OFU 1</th>
<th>OFU 2</th>
<th>OFU 3</th>
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**Ofu/Oloasega Islands, February 13 - 14, 2002**

**Number of samples collected at each site**

**Chlorophyta:**

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<th>OFU 1</th>
<th>OFU 2</th>
<th>OFU 3</th>
<th>OFU 4</th>
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**Rhodophyta:**

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<th>OFU 1</th>
<th>OFU 2</th>
<th>OFU 3</th>
<th>OFU 4</th>
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**Swain's Island, February 17 – 21, 2002**

**Number of samples collected at each site**

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**Rose Atoll, February 23 – 27, 2002**

**Number of samples collected at each site**

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these sites. Other genera included: Dictyota sp. (brown alga); Acetabularia sp., Boodlea sp., Bryopsis sp., Caulerpa taxifolia, Cladophora sp., Tydemania expeditionis, and Valonia sp. (green algae); Actinotrichia sp., Amphiroa sp., Chondria sp., Haloplegma sp., Halymenia sp., Hypnea sp., Jania sp., Laurencia sp., Martensia sp., Peyssonnelia sp., Portieria homomanni, and Wrangelia sp. (red algae).

Site TAU3 was located on the southwest corner of the island, and obviously was an area subjected to extreme water motion. The site was scoured clean of essentially all but small corals and turf algae. The only macroalgae found consisted of small clumps of Dictyosphaerias versluysii located within depressions in the carbonate pavement, and a few small clumps of Laurencia. Site TAU6, located on the west side of the island, exhibited an environment in between that of TAU3 and the four previously described sites. Although it looked as if it had been recently scoured (perhaps by a hurricane?), it exhibited a richer algal flora than site TAU3. Genera found included: Acetabularia sp., Chiorodesmis sp., Dictyosphaerias sp., Halymeda sp., Neomeris sp. (green algae); Chondria sp., Jania sp., and Laurencia sp. (red algae).

Otfu/Olosega Islands

All sites consisted of typical spur and groove reef formations (30 – 50 feet deep) with fairly diverse coral communities, but relatively little macroalgal cover. The one exception was site OFU4 where dense and extensive beds of Halymeda species occurred. The most common algal genera encountered included: Chiorodesmis sp., Halymeda discoidea, and Halymeda opunia (green algae); and Actinotrichia sp. and Peyssonnelia sp. (red algae); and an unknown cymophyte. Other genera that were not as abundant, but could probably be found in any of the regions sampled included: Dictyota sp. (brown alga); Neomeris sp. and Tydemania expeditionis (green algae); Chondria sp., Halymenia sp., Hypnea sp., Jania sp., Laurencia sp., and an unidentified geniculate coralline (red algae).
Algal Community Summary

Linda Preskitt, University of Hawaii, Botany Department

The perimeter of Rose Atoll is comprised of steep reef slopes with waves breaking over the reef crest and falling quickly to 150 ft with good visibility. The visibility at Rose Atoll is very high providing light to the algal community at deeper depths. It may be for this reason that there is little vertical zonation in the algal community on these reef slopes. Any zonation appears to be horizontal, with the macroalgae abundance changing as one moves around the perimeter of the atoll. The outer reef slopes of Rose Atoll are dominated by algae. Crustose and upright columnar forms of coralline algae dominate the reef community at all of the outer reef locations, averaging around 40% of the substrate, with the abundant macroalgae changing around the reef perimeter.

On the northeastern reef slope near the lagoon channel, the most abundant algae in the macroalgal community are species of Halimeda. On the eastern outer reef (NE of Rose Island), where the trade winds blow across the atoll and the surge and wave action is the heaviest, the most abundant macroalgae is Microdictyon setchellianum, with Caulerpa sp. the second most abundant. Right around the Eastern corner, the Caulerpa sp. becomes the most abundant macroalgae, growing over much of the receded substrate and between coral heads and coralline algae mounds with Microdictyon setchellianum as the second most abundant. On the southern side of the atoll, Microdictyon setchellianum again is dominant, with very little of the Caulerpa sp. present and more crustose forms, such as Peyssonnelia sp. and Dictyosphaerium versluysii more evident. Moving west around the southern tip, the Microdictyon setchellianum and Caulerpa sp. disappear and a number of Halimeda sp. are more abundant. The southwestern reef slope of the atoll changes dramatically, however, with macroalgae giving way to heavy coverage of small turfs and Lobophora sp., both epiphytized by bluegreens. This side of the atoll was the site of a shipwreck in October, 1993. The debris, much of it iron, remained on the reef until salvage removed most of it in 1999. It is likely that the debris has affected the water quality, thus the predominance of bluegreens. Once the debris has completely disintegrated and the water quality normalizes, the bluegreens will mostly likely disappear.

The lagoon is often covered with a layer of very warm water (~94°F at Rose Atoll) that is heated as it moves over the wide, carbonate pavement reef flat. The calm, lagoon water is heavily stratified in thermoclines, with the upper 3 to 9 ft very warm. The pinicles also show a zonation in the algal community. The deeper depths from 16 – 40 ft have large masses of bluegreens in the form of ropes, balls and mats covering much of the sides of the pinicles. Mats of bluegreens stretch across the lagoon bottom as well. Other algae at these depths are Halimeda sp. and Peyssonnelia sp., with red turfs on the underhangs. The upper 5-10 ft of the pinicle and the flat pinicle top is riddled with holes and recesses. These areas were home to species of Bryopsis, Halimeda, Dictyosphaerium versluysii, crustose corallines, and turfs. The reef flat was mainly bare carbonate pavement subjected to the hot sun at low tide. A few species of algae were found in
pools and holes in the pavement. These were mainly species found on the reef slopes: Halimeda, Caulerpa, and Bryopsis, with turfs.

Though the atoll is small, the changing character of the algal community on the reef slope around the perimeter was surprising. Microdictyos and Caulerpa sp. were more prevalent in high energy regimes, while the calmer areas had more turfs and crustose macroalgae forms. All of the perimeter was dominated by coralline algae, which often grew in fantastic and coral-like shapes. The lagoon, on the other hand, had little variety, with the only zonation occurring with the thermocline. Further observations of the area around the shipwreck for a possible recovery of the coral and algal community is recommended.
Marine Algae – Linda Freskitt, UH Botany
Swain’s Island:
This investigation provides the first inventory of algae at Swain’s Island. With no
previous algal records, algal surveys focused on sample collection for herbarium archives
and laboratory identification, and field photography of algal communities to initiate a
formal record of species composition at Swain’s Island. Nine surveys conducted with the
benthic coral team were located around the perimeter of the island to sample a variety of
locations with varying exposure. The sites were surveyed by SCUBA at 20 to 50 feet,
with one site at 70ft. All the sites were on reef slopes subjected to constant surge from
wave action and little current. Snorkel surveys on two reef flats and in the lagoon lake
were also done.

All nine reef slope sites were heavily covered by corals and the algal community has a
surprisingly low diversity. The algal community was dominated by a number of crustose
and upright species of coralline algae, and the non-coralines were represented primarily
by a few species of green macroalgae and red filamentous algae. The sites were quite
homogenous, with a handful of macroalgae species found at all sites. The macroalgae
community consisted of Microdictyon setchellianum, Halimeda sp., Udotea sp.,
Dictyosphaeria cavernosa and versluysii, and Caulerpa sp. (green algae). The most
common algae was Microdictyon setchellianum, which was located in open exposed
areas where it forms dense, tightly packed turfs tucked in among the spreading Montipora
corals, and was sometimes covered with microscopic algal epiphytes and red filamentous
algae. Species of Udotea, Caulerpa and Halimeda grew in small communities and
individual stands in the more shaded, protected areas under overhangs and coral heads.
Much of the coral rubble and open hard substrate was covered with many species of
crustose and upright coralline red algae. Peyssoneliales sp. (red) and small, diverse turfs
were attached to the base of the uprights. The underside of most of the Montipora plates
was covered with thick red turfs. The few red macroalgae that were found included
small epiphytic calcareous species of Jania, Lawrencea sp. in the turfs, and one sample of
a Dasys sp. attached to the underside of a Montipora coral plate. At all sites red
filamentous algae were attached to the edges of coral and coralline algae or in thick,
spreading mats attached to coral rubble. The filamentous and turf algae require additional
laboratory analysis for identification.

The reef flat was a shallow (approximately 1 meter deep) carbonate pavement with
occasional grooves with coarse sand and some algae attached to the neds. The algal
community on the reef flat comprised of Dictyosphaeria cavernosa and versluysii,
Caulerpa sp., Boodlea sp., Microdictyon setchellianum, and diverse turfs. The reef flat
also produced two additional species of red macroalgae: a calcareous goopy (possibly a
Trichogloosopsis sp.), and another Jania sp.

The lagoon lake was a lens of fresh water over a deeper layer of salt water. From the
coral rubble and mollusk shells scattered on the substrate, it appears to have at one time
been an open saltwater lagoon. The freshwater lake’s substrate was completely covered
with cyanobacteria colonies, either as a solid sheet in which small fish lived in burrows.
or in the form of irregular small masses that congregated on the bottom and formed a thick, loose moving layer, estimated at over 2 feet deep in some areas. Cyanobacteria colonies in marine turf conditions are known to be high in photosynthesis activity and important nitrogen fixers. These successful strategies may be partly responsible for this unusual phenomena on the lake bottom. Samples of the different colonies were made, but additional laboratory analysis is necessary for identification.
During coral reef towboard surveys conducted by the Coral Reef Ecosystem Investigation Program (CREI), digital videotapes are acquired using (a) a forward-pointing camera to document the fish in the water column and the general topography of the reef, and (b) a downward-pointing camera to document the benthic habitat. A complete towboard survey is 50 minutes in length. Divers maneuvering the towboards on which the cameras are mounted record selected data pertaining to fish and to habitat, using datasheets mounted on the towboards. These *in situ* observations are used to assist with preliminary summaries of the fish communities and the reef habitat, and as a general reference during more detailed, computer-assisted analyses. The habitat towboard is additionally equipped with two lasers, mounted so as to project 2 small, red dots that are 20 cm apart onto the benthos; these dots, recorded on the digital video, will allow calibration of the area included within each video frame.

The quantitative analysis of the benthic habitat, as documented by digital videotapes recorded by the downward-pointing camera, involves three major steps: (1) the selection of single, still frames at 30-second intervals; (2) the import of individual still frames into the computer program SigmaScan for identification and tracing of key benthic components, and calculation of their percent cover within each still frame, and (3) the compilation and summarization of SigmaScan's quantitative data using Microsoft Excel.

In step (1), a sampling unit of single frames “captured” at 30-second intervals provides a sample size of 100 frames (50 minutes x 2 frames/minute) by which to characterize the habitat over which the towboard passes. Two computer programs have been successfully used by CREI scientists to “capture” and save frames at 30-second intervals: DVRaptor-RT Video, and Sony’s DVGate Still. If the frame is too blurry to be properly analyzed, due to excessive speed during that portion of the tow, the scientist toggles forward frame by frame until the next frame is reached that, in the scientist’s opinion, can be successfully analyzed.

In step (2), each of the 100 frames is imported into SigmaScan. Using the red laser dots known to be 20 cm apart, this program enables rapid calibration of the area covered within each frame and, by extension, enables the calculation of percent cover of each component delineated within each frame. The user must possess some prior familiarity with the important components of the reef habitat in a particular geographical location that can be reliably identified through their appearance on digital video (e.g., *Porites*, *Porolithon*, coralline algae, macroalgae, sand, etc.). After deciding upon these components, the user must set up a spreadsheet structure that will receive the calculated coverage of each component after it has been identified on the still frame under analysis and traced with a stylus. The power of the SigmaScan program is that, after a discrete component (e.g., a head of pocilloporid coral) is traced with a stylus, its percent cover is immediately calculated and entered into the pre-designed spreadsheet.

In step (3), the SigmaScan spreadsheet for each frame is saved as a tabbed textile and imported into Microsoft Excel for proofreading and archiving. Excel is further used to compile and summarize the quantitative habitat data over whatever spatial/time scale is
desired. For example, a single "pie chart" can be generated to graphically describe the components of the benthos over the course of the entire track; alternatively, a series of pie charts can be generated to describe the benthos over finer time and spatial scales, e.g., every 5 minutes, every 10 minutes, etc.
Preliminary Summary of Towboard Surveys at Rose Atoll, and western portions of Tutuila, American Samoa

Between 23 and 26 February, 2002, 18 underwater surveys were conducted at Rose Atoll, using a technique in which two SCUBA divers are towed behind a small boat while maneuvering boards that are equipped with digital video cameras, data sheets, CTD recording devices, and other time/depth instruments. This towboard technique allows wide spatial coverage of the reef habitat, but cannot provide the degree of fine-scale resolution afforded by more stationary, drop dives. This preliminary report summarizes the salient observations regarding the benthic habitat as directly noted by divers during the towboard surveys.

Of the 18 surveys, 14 were conducted along the outer reef slope of Rose Atoll, at 3 different depth ranges: 15 to 35 feet, 35 to 60 feet, and 60 to 90 feet. Habitat "complexity", a subjective assessment of the 3-dimensional ruggedness of the reef structure, varied from medium-high to very-high throughout all surveys. Assessments of habitat complexity attempt to integrate both the fundamental architecture of the reef structure and the finer-scale microhabitats that are available to reef organisms for space and shelter. The outer reef slope at Rose Atoll therefore provides a rich spatial heterogeneity in which a wide variety of reef organisms can potentially exist. Seawater temperature was a consistent 85°F at all depths surveyed along the outer perimeter of the atoll.

Along all four edges of the diamond-shaped atoll, at most depth ranges, average live coral cover varied from 20 to 30%. Noteworthy exceptions are along the southeast outer reef slope between 70 and 80 feet, where live coral cover ranged from 45 to 60%, and along the northwest outer reef slope between 50 and 60 feet, where live coral cover ranged from 40 to 50%. In shallow (<50 foot) depths, members of the genus Pocillopora dominate the coral fauna, followed by faviids, Porites, Montipora, Acropora, and soft corals. The higher percentage of live coral along the two transects noted above can be attributed to the presence of massive colonies of Porites. Live coral had a healthy appearance, with few indications of bleaching or crown-of-thorns starfish (Acanthaster) predation. No crown-of-thorns starfish were noted during any of the dives.

The carbonate platform that forms the basis of the atoll is heavily encrusted with coralline algae and, to a substantially lesser extent, flexile and turf algae. Assessments of 40-60% cover by coralline algae are common throughout the surveys. At shallow (<50 foot) depths, the coralline algae community forms 3-dimensional "rosettes", an intriguing structure never seen elsewhere by the author. Among the flexile algae observed, encrusting Lobophora and calcareous Halimeda are dominant. Virtually no barren carbonate platform exists; it is invariably covered with encrusting coral or algae.

The site along the southwest reef slope where the longliner Jin Shiang Fa grounded in 1993, and which was the focus of clean-up efforts several years ago, merits special comment. The effects of the wreck can be clearly seen throughout approximately 15 minutes of a tow along this edge; as the tows are conducted at ~2 knots, this constitutes a "footprint" of half a nautical mile. Well before the physical scars and denuded reef directly caused by the wreckage are seen, a dark layer of cyanobacteria (blue-green algae) appears. Live coral cover drops precipitously, from 20-30% to 5%. As one continues to move towards the center of the wreck site, the gouged carbonate pavement is increasingly covered and dominated by the dark cyanobacteria, aside from a
few small coral heads and the cyanobacteria-covered carbonate, little other benthic life exists. As one passes through and moves out of the wreck site, this trend reverses, with the cyanobacteria gradually decreasing and coral cover increasing to 20-25%.

Portions of two towns included the channel between the lagoon and the outer atoll barrier. The benthos had a very scoured, barren appearance, with only a few small colonies of Pocillopora or Acropora managing to survive in this narrow pass that is daily subject to currents that are reported to reach 5 knots.

The remaining 4 towboard surveys were conducted within the lagoon; two surveys crossed the lagoon across its major axes (NW to SE, and NE to SW), while two surveys encompassed the shallow (<50 feet) lagoon perimeter. The benthos was chiefly comprised of sand (85-90%) with scattered rubble, and occasional very small pieces of carbonate with a maximum 3-4% live coral cover. The live coral primarily included Astreopora myriophalma, Montipora verrucosa, Favia pallida, and Acropora kirstyae. Additionally, these pieces of carbonate were heavily populated with giant clams.

Between 27 February and 3 March, 2002, 9 towboard surveys were conducted along the west, northwest, and southwest coast of Tutuila, American Samoa. Tows were conducted within the 15- to 60-foot depth range. With the exception of a tow conducted between Sail Rock Pt. and Vaitogi along the south coast, underwater topography varied considerably in the course of a tow, which generally covered slightly less than 2 nautical miles. The topography can be generally characterized as a series of spurs and grooves, with occasional steep walls, along with their associated fauna, these topographical characters provided regions of high to very high habitat complexity. Punctuating these high-complexity areas, however, were flat, relatively featureless stretches of carbonate pavement or basalt with only sparse coverage of live coral. The tow conducted between Sail Rock Pt. and Vaitogi along the south coast had a uniformly low relief, with a large proportion of carbonate pavement, sand, rubble, and coralline algae, and a live coral cover that never exceeded 25%.

Topographic complexity was typically mirrored by the degree of live benthic coverage. On the high-complexity spurs of the spur-and-groove structure, coral coverage ran as high as 60%, with the chief components comprised of Acropora, Pocillopora, Astreopora, favids, encrusting Montipora, Porites, and soft corals. Impressive stretches of large table acroporids stood in stark contrast to their absence along the tracks of towboard surveys conducted in early February along the east, southeast, and northeast portions of Tutuila. A low level (<2%) of encrusted dead coral was generally noted, assessed to be the result of bleaching rather than crown-of-thorns starfish predation. No crown-of-thorns starfish were noted on any of the tows.

In contrast to Rose Atoll, where carbonate pavement was invariably covered with live coral or algae, and barren pavement was extremely rare, substantial amounts of bare carbonate pavement were noted on tows conducted along the southwest, west, and northwest sections of Tutuila, particularly in areas of low relief. Not uncommonly, this bare carbonate pavement was covered with a thin veneer of sediment. This difference is likely attributable to both the different geographic nature of the two reef areas (i.e., atoll vs. volcanic) and the effects of human populations utilizing Tutuila.
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RTTR nest contents could not be identified = 7  
Adult RTTR sitting on empty nest spot = 10

*Buoby Nests with 1 chick and 1 Egg were noted by the growth stage of the hatchling.
U.S. Fish and Wildlife Service (Service) Refuge Operations Specialist, Dominique Horvath, and NOAA Ship Townsend Cromwell Senior Survey Technician, Philip White, went ashore at Jarvis Island National Wildlife Refuge (NWR) from 1400 on 9 March to 1600 on 10 March 2002. Both landings at the north cut on the west side of the island occurred with no incidents. The high temperature during the stay on island was 95°F and the low was 79°F. There was a brief rain shower on the afternoon of 9 March and another brief shower overnight. There was a large rainfall beginning at 1130 on 10 March and continuing past 1600 on the same day.

The shore party conducted several wildlife surveys including direct counts of Masked Boobies, Red-footed Boobies, Brown Boobies, and Red-tailed Tropicbirds on approximately 90% of the island. There was one area of standing water in the southeast corner of the island which, although ephemeral, provides additional habitat for visiting shorebirds. In general the island habitat looked healthy, and all seabird species that were expected to be present were. There were no signs of feral cats or of human trespassers. No skinks were seen, but house mice were observed in daylight and night hours. The Phoenix Petrel caller that was deployed in February 2001 was in good condition and still functioning and was left in place. There were no signs that it had attracted any Phoenix Petrels to nest on Jarvis Island. From 0500 to 0500 on 10 March, Horvath and White listened for White-throated Storm Petrels near the day beacon, where three birds were sighted in 2000. No petrels were heard. Both the Phoenix Petrel and the White-throated Storm Petrel nest at nearby Christmas Island (193 nm northeast of Jarvis) where they are preyed upon by feral cats. The Service, since eradicating feral cats from Jarvis Island NWR, hopes to attract and provide safe nesting habitat to these two species of pelagic seabirds.

Finally, in addition to general observations and wildlife surveys conducted, a University of Hawaii (UH) provided Global Positional System (GPS) unit was used to collect data at the Lilihi GPS monument that was erected in February 2001. Over 24 hours of data were collected. Philip White also used the Service GPS unit to mark several items on shore that can be seen from offshore. These locations can be used for ship navigation purposes.
Rose Atoll Site Visit

National Wildlife Refuge wildlife biologists, Beth Flint and Jeff Burgett, traveled to Rose Atoll National Wildlife Refuge for a standard short monitoring visit courtesy of the NOAA Vessel Townsend Cromwell. They boarded at Pago Pago on 21 February 2002 and returning 27 February to Tutuala Island and Pago Pago. The primary objectives of this visit were to assess wildlife and wildlife habitat at the refuge and document any problems that might be affecting ecosystem health. Priorities for the visit included maintenance and repair of the 30-meter sampling grid in place on Rose Island, census of active nests of all breeding birds using the two islands as the atoll, continuation of the study monitoring the resposse and recovery of the plant community following the eradication of the Polynesian rat (Rattus exulans) that was initiated in 1990, and continuation of a study evaluating the efficacy of iron enrichment from the 1993 wreck of the F/V Jin Shiang Fu, a Taiwanese longline vessel, on the coral reef at Rose Atoll. Two scientists from the American Samoa Department of Marine and Wildlife Resources also accompanied refuge staff with the objectives of documenting the current status of the terrestrial arthropods and some aspects of the plant community (to be reported separately).

The bird community at Rose appeared to be thriving with 10 of 12 seabird species observed actively breeding at the colony. Most numerous breeders during this visit were Black Noddies with 362 active nests followed by Brown Boobies with 232 nests. Five migrant shorebird species were using the atoll along with resident Pacific Reef Herons and a migrant Long-tailed Cuckoo from New Zealand.

At least 2 Green Sea Turtle nests hatched on the island during our stay and numerous turtle nests were observed around the island perimeters. Land crabs (Coenobita sp.) numbers continued to be depressed from those observed in the early 1990's.

The plant community appeared generally healthy with the exception of the grove of Pisonia grandis, a tall coastal tree much favored by nesting seabirds which is suffering from a severe infestation of a scale insect. This insect was collected for identification and refuge staff will formulate management actions to try and save the few remaining Pisonia trees on Rose Island.

Dr. Burgett quantitatively assessed the algal abundance and species composition on the intertidal reef flat of the atoll, most importantly on the southwest area which was directly affected by the 1993 shipwreck and oil spill. Previous surveys of this type were conducted in 1995, 1996, and 1998. He also measured the concentration of dissolved iron in 1000 meters of the reef front in order to detect any changes subsequent to cleanup efforts in 2000. The cleanup removed tons of corroding steel that had produced a plume of iron-rich water flowing onto the reef. We suspect that this iron source has produced the persistent and anomalous growth of cyanobacteria on the reef flat and within the...
lagoon noted on previous trips. Quantitative results must await analysis of survey data and water samples, but his general impression is that there has been no substantial recovery of the reef flat since his last visit in 1998. We observed a large area of cyanobacteria on the reef flat, and fragments of the ship remain in the intertidal and subtidal zones. We suspect that the iron anomaly persists despite the cleanup effort and is suppressing the recovery of the normal algal community of the Refuge.

There were no obvious signs of recent trespass on the refuge. We removed a raft with netting and a transmitter, presumably used as a fish aggregating device (FAD), from the reef top to prevent wildlife entanglement and further coral damage.