Report of HURL Cruise KOK0510: Submersible Dives and Multibeam Mapping to Investigate Benthic Habitats of Tutuila, American Samoa

July 9-11, 2005

Dawn J. Wright
Oregon State University

Reference to this report in whole or in part should be made as follows:
Wright, D.J., 2005. *Report of HURL Cruise KOK0510: Submersible Dives and Multibeam Mapping to Investigate Benthic Habitats of Tutuila, American Samoa*. Technical Report, NOAA's Office of Undersea Research Submersible Science Program, Hawai'i Undersea Research Lab, http://dusk.geo.orst.edu/djl/samoa/hurl/kok0510cruise_report.pdf [Accessed MM/DD/YYYY].

Shipboard Scientific Party

Dawn J. Wright
Chief Scientist
Department of Geosciences
104 Wilkinson Hall
Oregon State University
Corvallis, OR 97331-5506
Telephone: 541-737-1229
Fax: 541-737-1200
dawn@dusk.geo.orst.edu
http://dusk.geo.orst.edu

John Smith
HURL Science Program Director
Sea Beam Specialist
University of Hawaii, 1000 Pope Rd., MSB 229
Honolulu, HI 96822
jrsmith@hawaii.edu

Emily Lundblad
GIS Specialist
NOAA Pacific Island Fisheries Science Center, Coral Reef Ecosystem Division
Kewalo Research Facility
1125 Ala Moana Blvd.
Honolulu, HI 96822
emily.lundblad@noaa.gov

Douglas Fenner
Corals/Invertebrates Specialist
Chief Biologist
Department of Marine & Wildlife Resources, American Samoa Government
P.O. Box 3730, Pago Pago, AS 96799
douglasfenner@yahoo.com

Leslie Whaylen
Reef Fish Specialist
Coral Reef Monitoring Coordinator
Department of Marine & Wildlife Resources, American Samoa Government
Now at 5432 N. Starlight Ave., Benbrook, TX 76126
lesliewhaylen@yahoo.com

Jan Ili
Observer
American Samoa Department of Education and Manuele Elementary School
P.O. Box 5094
Pago Pago, AS 96799
janili4eva@yahoo.com

William Thompson
Observer
American Samoa Department of Education and Manuele Elementary School
P.O. Box 7726
Pago Pago, AS 96799
tikibad@yahoo.com

Project Summary

Cruise KOK0510 consisted of three *Pisces V* dives to the submerged flanks of Tutuila, American Samoa, specifically the coral reef platform of Taema Bank, and the submerged caldera forming Fagatele Bay and Canyon. In addition, a night-time program of Sea Beam 210 bathymetric mapping was conducted along the north side of the island to fill in a data gap from previous multibeam surveys in that region. Night-time deployments of the *RCV-150* were also planned, but could not commence due to mechanical difficulties with the ROV. The overall objectives of the cruise were the characterization and ground-truthing of underwater features previously mapped in sonar, and for areas below the reach of SCUBA, the estimation of the amount of live bottom, the species identification of fish and invertebrates, and the assessment, where possible, of benthic change within the coral reefs encountered. These observations were made toward an ultimate goal of ground-truthing previous benthic terrain maps (geo) made in the region, as well as informing the preparation of future benthic habitat maps (biogeo). Research questions guiding the objectives include: (a) What are the significant deep-water coral reef habitats, relative to the territory's coastal ecology and current initiatives for sanctuary management (i.e., areas of 20% or greater coral cover as mandated for protection)? (b) Where are these critical habitats located, and with what major species are they associated with? (c) Which habitats appear to be "biological hotspots" (e.g., areas of high biodiversity), and what are the implications for coral reef conservation and management? For example, which sites should be deemed of special biologic significance (such as a no take zone within a pilot marine protected area)?

All three dives were extremely successful with a cumulative bottom time of 18 hours and identification at both sites of 32 species of invertebrates and 91 species of fish, at least 9 of which are "new records" for American Samoa. The base of extensive live bottom for Taema Bank (coral cover of 20% and greater) was identified at a depth of 36 m. Alternating sections of carbonate reef and basalt were observed at~185-220 m depth along the west walls of Fagatele Canyon, and large, grooved mass-wasting scarps were noted at ~300-400 m depth near the base of the south central wall of Taema Bank. No evidence of eutrophication or slurry from Pago Pago harbor was seen on the south side of

Taema Bank. Sea Beam mapping on the north flank of Tutuila revealed 3 new cones that will eventually be added to the Scripps Biogeosciences Seamount Catalog (EarthRef.org).

Subsequent benthic habitat maps that may be created with the aid of these data should be of great use for ongoing studies by the American Samoa Government's Department of Marine and Wildlife Resources (DMWR), the Fagatele Bay National Marine Sanctuary (FBNMS), the American Samoa Coastal Management Program, and the National Park of American Samoa (NPAS); including the selection of sites for habitat class designation and protection (e.g., no-take marine protected areas, a major American Samoa initiative), development of marine park monitoring protocols, and general understanding of species composition and abundance. In addition, we were pleased to have 2 local secondary school teachers join the cruise as observers. These teachers were recently involved in a marine science workshops co-funded by the Fagatele Bay National Marine Sanctuary and the American Samoa Coral Reef Advisory Group, and will be using selected videos, photos from the cruise, and perhaps some of the GIS data sets, directly in their classrooms. Local media coverage of the cruise included a radio interview and an article in Samoa News (facilitated by Nancy Daschbach of FBNMS and Peter Craig of NPAS).

Background and Setting of Dive Sites

American Samoa is small archipelago of 5 islands and 2 coral atolls located approximately 2000 miles south-southwest of Hawaii, the only U.S. territory south of the equator. The main island of Tutuila (Figure 1) is home to the FBNMS, the smallest, remotest, and only true tropical coral reef of the 13 U.S. national marine sanctuaries. Along the north shore is most of the NPAS, one of the few sites within the Department of Interior's national park system that includes both land and ocean. Geologically, the shallow flanks of Tutuila, and of the Samoan island in general, are characterized by outcrops of basalt and limestone, biogenic and volcanic silt, sand and gravel, calcareous pavements and calcareous ooze (Exon, 1982). Many of the "cookie cutter" bays that are found along the southern coast of Tutuila, such as Fagatele Bay, Larsen Bay, Pago Pago Harbor, and Faga'itua are thought to be the result of volcanic collapse and erosion (e.g.,

Stearns, 1944), and then as the island subsided due to crustal loading, large portions of these eroded valleys were flooded by the sea.

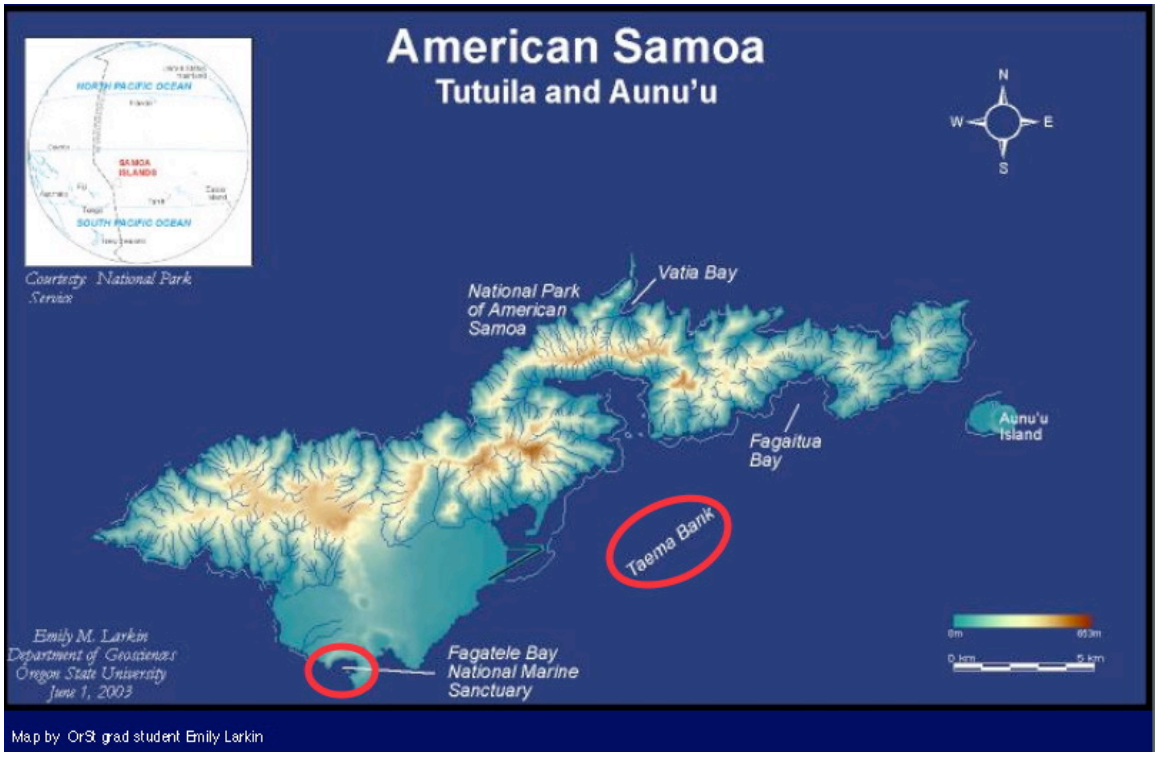

Figure 1. Index map of Tutuila, American Samoa with red circles showing the locations of the two dive sites of Cruise KOK0510, Taema Bank (dives P5-648 and P5-640) and Fagatele Bay and Canyon (dive P5-649). Map is based on a U.S. Geological Survey (USGS) 10-m digital elevation model (DEM) provided by A. Graves of Nuna Technologies, American Samoa. Cartography by Emily Larkin, Oregon State University. Map projection is Mercator.

Taema Bank and Fagatele Bay and Canyon were chosen as primary dive sites due to the occurrence of previous shallow (≤150 m) multibeam surveys in the area (especially by Oregon State University, OSU, and University of South Florida, USF, as described in Wright et al., 2002 and Wright, 2002; and the NOAA Coral Reef Ecosystem Division, CRED, crei.nmfs.hawaii.edu/hmapping/), their importance for coral monitoring and protection, and for safety. Indeed for Taema Bank the south side of the platform is in water suitably deep for the safe navigation of a research vessel such as the *Kai'imikai-o-Kanaloa* needing to track a sub almost directly below it (as opposed to anchoring and letting a sub navigate farther away through a transponder network already placed on the seafloor). For Fagatele Bay and Canyon, although this site is much closer to shore, the canyon plummets dramatically to steeper depths over a short distance, making it fairly easy for a research ship to get nearshore while still in safe depths for direct submersible

tracking. The bay is also uninhabited, allowing for surveying on a Sunday if need be (out of respect for Samoan cultural traditions and the wishes of village chiefs nearshore surveys are not allowed in the waters directly offshore of villages).

Taema Bank

Taema Bank (Figure 2) is a long narrow submarine platform located ~3 km off the south central coast of Tutuila. It is ~3 km long by 30 m wide rising ~30 m above a surrounding seafloor, averaging 100-200 m in depth (Wright et al., 2002). Because the platform is largely flat and fairly smooth, it is interpreted as an ancient reef terrace that may have once experienced wave erosion at sea level. According to Stearns (1944) and Flanigan (1983), Taema Bank has a geological connection to the caldera that collapsed and subsided to form what is now Pago Pago Harbor. They note how the southerly tilt of the caldera, the slope of the caldera fill, and the sizes and shapes of the volcanics governed the course of the prehistoric Pago Pago River. The river once eroded a deep valley along the northern and eastern caldera rim, and now, due to the subsidence of the island, can be traced out to sea as far as Taema Bank, where it has been obscured by subsequent coral growth (Stearns, 1944; Flanigan, 1983).

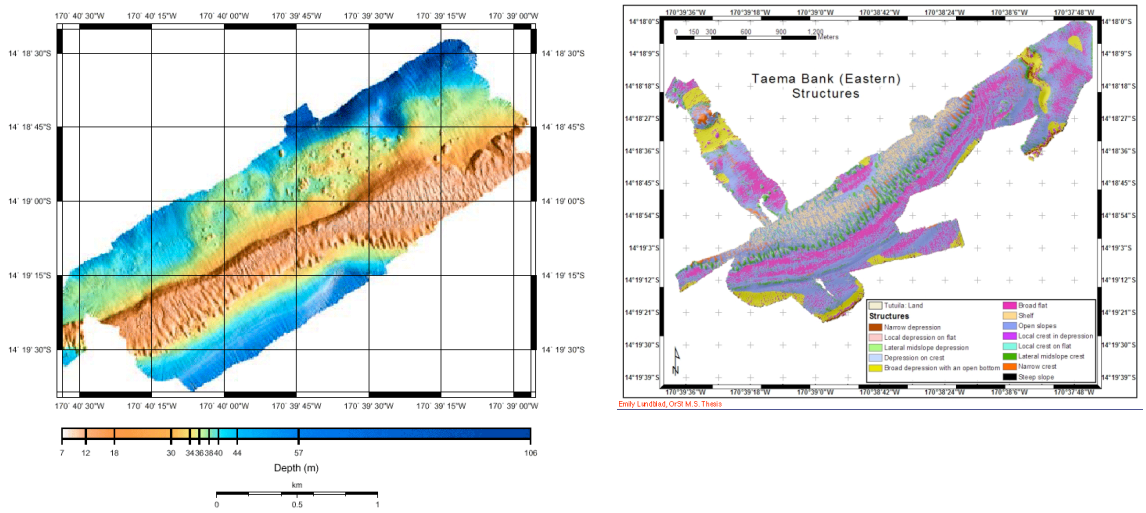

Figure 2. Right: Histogram equalized, shaded relief bathymetric map of west Taema Bank, created from the initial Kongsberg Simrad EM-3000 collected in 2001 (Wright et al., 2002). The bathymetry is illuminated at an azimuth of 270° using a shading magnitude of 0.4 to accentuate the northwest trending bank. Map projection is Mercator. **Left:** Classfication of east Taema Bank bathymetry (collected during a re-survey in 2002) into "structures," according to bathymetric position index (Lundblad, 2004). Map projection is Mercator. Submersible dives are critical for ground-truthing of portions of this kind of benthic terrain characterization.

Fagatele Bay and Canyon

Fagatele Bay (Figure 3), and its continuation deeper offshore as a canyon, is the result of an ancient caldera that collapsed and subsided, causing the seaward rim to be breached by the ocean and flooded (www.sanctuaries.nos.noaa.gov/oms/omsfagatele/). The fringing coral reef is of course of continuing interest and concern in this federal marine sanctuary, that is steadily recovering from a near-devastating infestation of crown-of-thorns starfish in the late 1970s (Green et al., 1999). The bay was also affected by hurricanes in 1990, 1991, 2004 and 2005. A coral bleaching event occurred in 1994, possibly due to high sea-surface temperatures from an El Niño. Although much of the coral cover is recovering from near total destruction, fish populations still thrive, particularly surgeonfish, damselfish and angelfish (Birkeland et al., 1987; Craig, 1998).

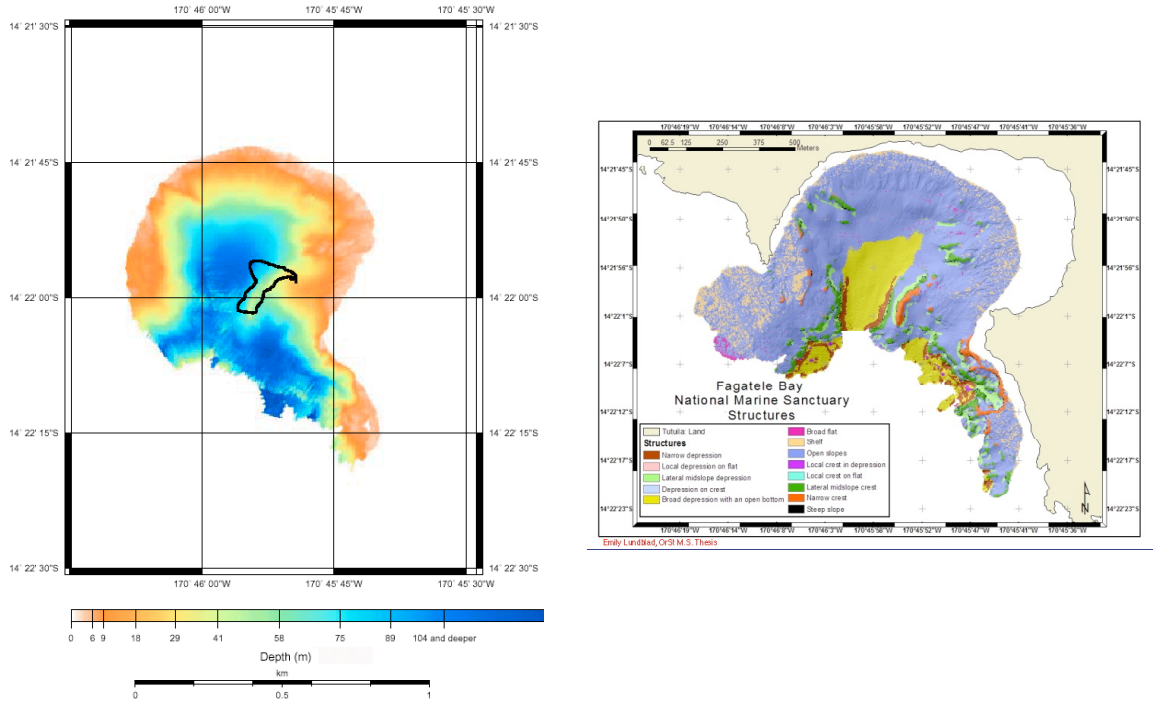

Figure 3. Right: Histogram equalized, shaded relief bathymetric map of the FBNMS, created from the initial Kongsberg Simrad EM-3000 collected in 2001 (Wright et al., 2002). Solid line delineates the estimated dive track of a rebreather diving mission in the sanctuary, immediately following bathymetric surveying (Pyle, 2001). Map projection is Mercator. **Left:** Classfication of FBNMS bathymetry (collected during a re-survey in 2002) into "structures," according to bathymetric position index (Lundblad et al., submitted). Map projection is Mercator. Submersible dives are critical for ground-truthing of portions of this kind of benthic terrain characterization.

Dive Summaries

Dive P5-648

Location: Taema Bank, Tutuila, American Samoa

On Bottom: **Latitude:** 14°19.912'S **Longitude:** 170°40.453'W

Mission Date: July 9, 2005 **Duration:** 6 hours 21 mins (bottom time)

Maximum Depth (m): 213 m

Pilot: Max Cremer

Observer 1 (port): Dawn Wright **Observer 2 (stbd):** Doug Fenner

Objectives:

- Video and photographic survey up west wall of Taema Bank noting depth at which main corals extend to (base of main reef on bank) then proceed to a deeper, safer contour of interest for sub/ships operations, following it to the east, making observations of biota and physical structure.
- Species identification of as many corals and fish as possible.
- Ground-truthing of previous benthic terrain classifications made with prior high-resolution bathymetric data collected by OSU and USF.

Final, Processed Dive Track from Sub Nav:

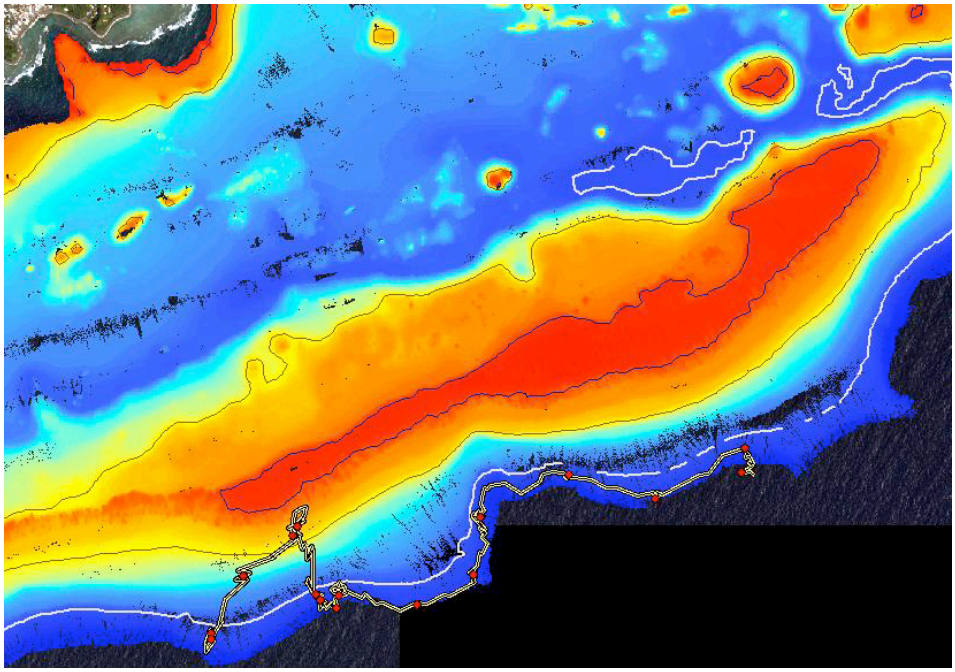

Figure 4. Track of Dive P5-648 to Taema Bank, overlain on NOAA CRED bathymetry and Ikonos satellite imagery, with waypoints shown in red. Contours are at 20, 50, and 100 m. Track was processed with Unix shell scripts and MS-Excel calculations to remove navigational errors, and then generalized in ArcGIS to reduce unnecessary vertices.

Summary of Observations/Findings:
Landed at 109.3 m depth on slope of Taema Bank in calcareous (halimeda algae sand). Proceeded up slope to 60 m contour, making observations along the way, in search of southern edge of main corals of Taema. Not finding this at 60 m, we proceeded further up slope to 36 m, finding the reef edge there. Stopped for brief video and photo session and then were advised by the ship that our depth was too shallow for ship operations and communications. We were also feeling significant wave surge. Proceeded down slope to SE, making observations along the way and stopping at 57 m to sample a large sea star, that may be a new record for American Samoa, certainly never seen before on shallow reefs. At ~106 m encountered a steep drop-off, the top edge of a large carbonate wall, proceeding to a maximum depth of 213 m. Not seeing where this bottomed out, we decided to move up to the 110 m contour where we had seen significant assemblages of gorgonians (sea fan corals) and fish. We followed the 110 m contour to the east, buoyed along by a nice current from the west, and observed/identified several sea fans, species of fish congregated at rubble piles (that may have been created by the fish as habitat), a black-blotched stingray (possibly a new record for American Samoa), sea cucumbers. We noticed a transition from west to east of sea fans being accompanied more to the east by crinoids attached to their tops, and with 3-armed, feathery brittle stars. There were also alternating "provinces" of barren, sloping halimeda sand plains, to slopes cut by deep crevices in sloped calcareous conglomerate blocks to sea fans assemblages. Our final main observation was of a huge pink sea fan, 5-6 ft. in width and in height (size of a tree) with knobs on its stems.

Sample:
11:02 a.m.**,** 14°19.520'S, 170°40.174'W, 57 m, sea star, photographed on board then returned to ocean

Fish Species List (by Leslie Whaylen and Doug Fenner, DMWR):
(highlighted ones are new records for American Samoa according to Wass list)
Anthias sp.
Black trevally – *Caranx lugubris*
Black-blotched stingray – *Taeniura meyeni*
Cardinalfish – *Ostorhinchus* sp. (new species – to be described soon)
Common lionfish – *Pterois volitans*
Gilded triggerfish – *Xanthichthys auromarginatus*
Greeneye *Chlorophthalmus priridens*
?Orange sea toad, *Chaunax fimbriatus*
Narrowstripe cardinalfish – *Pristiapogon exostigma*
Remora sp. –
Sand tilefish: larger, cream black tail and pectorals
Sand tilefish: smaller, black tail connected to single black stripe
Spotted lantern belly, *Synagrops argyrea* (?)
Stocky tilefish – *Hoplolatilus fronticinctus*
Tinker's butterflyfish – *Chaetodon tinkeri*
Whitetip reef shark – *Triaenodon obesus*

Edge of main corals on bank at ~36m
Blacktail snapper – *Lutjanus fulvus*
Bluestriped snapper – *Lutjanus kasmira*
Pale-tail chromis – *Chromis xanthura*

Pyramid butterflyfish – *Hemitaurichthys polylepis*
Redbreasted wrasse – *Cheilinus fasciatus*
Redfin (Oval) butterflyfish – *Chaetodon lunulatus*
Sidespot goatfish – *Parupeneus pleurostigma*
Threadfin butterflyfish – *Chaetodon auriga*
Whitetail (Thompson's) surgeonfish – *Acanthurus thompsoni*

Invertebrates List for Both P5-648 and -650 (by Doug Fenner, DMWR):

ID sources Chave and Malahoff (1998), Gosliner et al. (1996), Fabricius and Alderslade (2001), Colin and Arneson (1995). Figure numbers refer to Chave and Malahoff, (1998)
1. Coralline algae: disc
2. Sponge: small white plate: *Corallistes* Fig 55
3. Anemone
4. Anemone on hermit crab shell: *Stylobates aenus* Fig 141
5. Seafan: orange, net-like web (most common): *Annella reticulata*
6. Seafan: orange, branchlets not fused: *Annella*(?)
7. Seafan: large light purple, nodular stem: *Melithaea*
8. Gorgonian: *Iciligorgia*, thick branches
9. Soft coral: thin branch, white, on seafans
10. Soft coral: short thick tree: possibly *Dendronephthya*
11. Whip coral: *Cirrhipathes* (tentacles on all sides)
12. Comb jelly: Ctenophore: creeping, *Lyrocteis* Fig 80
13. Shrimp: red
14. Crab: galatheid: *Cyrtomaia smithi* Figure 100
15. Crab: large
16. Hermit crab: *Parapagurus dofleini* Fig 141
17. Tusk shells: Scaphopod, dead shells
18. Sea star: Doughbouy: *Choriaster granulatus* (also shallow)
19. Sea star: Lounge Cushion Star
20. Sea star: *Calliderma spectabilis* (?) Fig 101
21. Sea star: *Pentaceraster cumingi* (?)
22. Sea star: thin armed white, *Coronaster eclipes* Fig 10
23. Sea star: looks like crinoid, Brisingid, Fig 110
24. Sea Cucumber: *Holothuria edulus* (also shallow- smooth black)
25. Sea Cucumber: *Thelonota anax* (also shallow- flat lower surface)
26. Sea Cucumber: orange gelatinous
27. Urchin: big pentagonal
28. Urchin: shortspine Cidarid: *Actinocidaris thomasii* (short spine) Fig 114
29. Urchin: longspine Cidarid
30. Heart urchin: Spatangoid: "skunk urchin" *Eurypatagus ovalis* Fig 116
31. Crinoid: black
32. Crinoid: yellow with black stripe

Dive P5-649

Location: Fagatele Bay and Canyon, Tutuila, American Samoa

On Bottom: **Latitude:** 14°22.560'S **Longitude:** 170°46.411'W

Mission Date: July 10, 2005 **Duration:** 7 hours 26 mins (bottom time)

Maximum Depth (m): 463.9 m

Pilot: Terry Kerby

Observer 1 (port): Emily Lundblad **Observer 2 (stbd):** Leslie Whaylen

Objectives:

- Video and photographic survey counterclockwise along edge of Fagatele Bay and Canyon, starting from SW corner and reaching, if possible, the far SE portion of the sanctuary, making observations of biota and physical structure.
- Species identification of as many coral and fish as possible.
- Provide ground-truthing for benthic terrain classifications from prior high-resolution bathymetric data collected by NOAA CRED as well as OSU and USF.

Final, Processed Dive Track from Sub Nav:

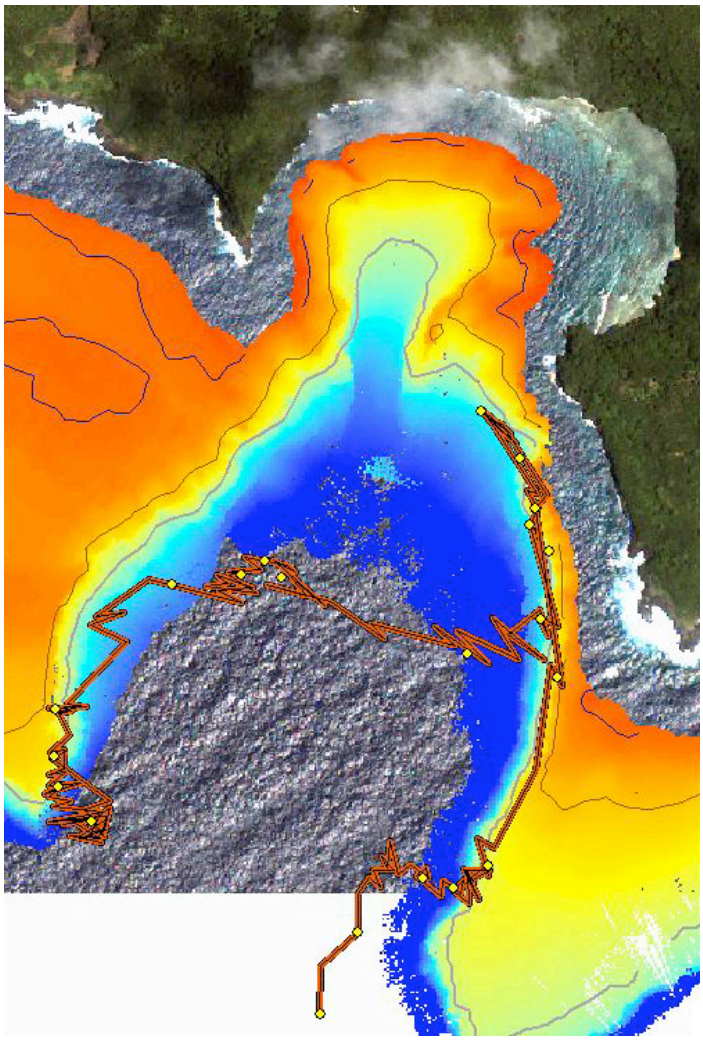

Figure 5. Track of Dive P5-649 to Fagatele Bay and Canyon, overlain on NOAA CRED bathymetry and Ikonos satellite imagery, with waypoints shown in yellow. Contours are at 20, 50, and 100 m. Track was processed with Unix shell scripts and MS-Excel calculations to remove navigational errors, and then generalized in ArcGIS to reduce unnecessary vertices.

Summary of Observations/Findings:
Landed at 222 m depth (19ºC) on carbonate shelf with sediment cover. From the west side of the canyon, proceeded due east over the edge of a sheer vertical wall that dropped about 200 meters. Headed back up the wall for a closer, more direct look. Then, upon reaching the edge of SCUBA divable limits, went back down to follow the 100 meter contour toward the mouth of the bay. Ship communicated that they were about to lose tracking range. Maneuvered straight down the cliff with plans to cross the bay's floor to the eastern wall and begin to survey up the eastern wall. Going down the western cliffs, an interesting transition from old carbonate reef transitioned to a basalt layer from about 185 m to 209 m where it turned into another carbonate layer before transitioning to sediment around 235 m. On the way up the eastern wall, approaching 80 m, chose to go back to the 100 meter contour to, again, follow the contour toward the mouth of the bay. With communications fading, but still getting some tracking points, we went as far as we could until feeling the need to turn around to get better tracking and to avoid possible entanglement hazards (encountered 2 large fishing lines hanging about 10-15 m down, then another line handing down from bottom of first two). Returned along the 70 m contour. The eastern wall is also a sheer cliff face. In addition to the dramatic drop, this side had several small box canyons cut into the side of it, making more complex topography. Back further outside the bay, we headed down the wall to observe the sediment bottom with a few large carbonate outcrops. Again, observing the wall on the way down, the same carbonate to basalt to carbonate to sediment pattern was observed. Continued S-SW down eastern wall of canyon from approximately 79 m down to 442 m. Sampled (well outside of sanctuary boundary) large tritan shell at 316 m and large nautilus shell near SE corner of canyon in midst of carbonate outcrops. The eastern cliffs seemed to have more intermediate shelves between cliff faces finally reaching a sediment slope to the bottom depth of 464 meters. Within view of the final depth for this dive, was the start of another vertical wall dropping from about 420 m toward the southwest. Left bottom at maximum dive depth of 463.9 m (7.5ºC).

Samples:
14:55, 14°22.714'S, 170°45.926'W, 316 m, Tritan shell, may be used for public display at DMWR
15:46, 14°22.714'S, 170°46.059'W, 442 m, Nautilus shell, for possible public display at FBNMS

Fish Species (highlighted ones are new records for American Samoa according to Wass list):
anthias? – pink anthias with extremely forked, yellow tail at 90m
Batfish (Ogcocephalidae) at 247m, pink with pink spots and white fringe
Batfish (Ogcocephalidae) at 325m. Pink with bumps. (1hr, 10min on 4th tape)
Big longnose butterflyfish – *Forcipiger longirostris*
Bigeye - *Heteropriacanthus cruentatus*
Bignose unicornfish – *Naso vlamingii*
Black snapper – *Macolor niger*
Black trevally – *Caranx lugubris*
Black-blotched stingray – *Taeniura meyen at 238m*
Blackfin hogfish – *Bodianus loxozonus*
Blacktail snapper – *Lutjanus fulvus*

Blue and yellow fusilier – *Caesio teres*
Bluefin trevally – *Caranx melampygus*
Blueline demoiselle – *Chrysiptera caeruleiolineata*
Bluepatch parrotfish – *Scarus forsteni*
Bullethead parrotfish – *Chlorurus sordidus*
Checkerboard wrasse – *Halichoeres hortulanus*
Clown trigger – *Balistoides conspicillum*
Crinmiea criseris (check spelling) at 450m
deepwater angelfish? at 221m. Dark upper body, white lower body with white bar through eye. 4-5 inches
Dogtooth tuna – *Gymnosarda unicolor*
Emperor angel – *Pomacanthus imperator* at 111m
Epinephelus timorensis? – deepwater grouper at 200m
Etelis cortuscans at 260m (2 individuals, swam right up to sub)
Fire dartfish – Nemateleotris magnifica
Flatfish - *Chastin opceta* (check spelling) white dots around fringe
Gold-lined (Moluccan) snapper – *Lutjanus rufolineatus*
Half and half chromis – *Chromis iomelas*
Harlequin grouper – *Cephalopholis polleni*
lanceolate tail goby? at 253m (3hr and 30min into dive)
Longnose butterflyfish – *Forcipiger flavissimus*
Longnose hawkfish – *Oxycirrhites typus*
Lori's anthias – *Pseudanthias lori*
Magenta dottyback – *Pseudochromis porphyreus*
Manybar goatfish – *Parupeneus multifasciatus*
Masked grouper – *Gracila albomarginata*
Merten's (Yellowback) butterflyfish – *Chaetodon mertensii*
Midnight snapper – *Macolor macularis*
Mimic surgeonfish – *Acanthurus pyroferus*
Moorish idol – *Zanclus cornutus*
Onespot snapper – *Lutjanus monostigma*
Orangefin anemonefish – *Amphiprion chrysopterus*
Orangelined trigger – *Balistapus undulatus*
Orangespine unicornfish – *Naso lituratus*
Orbicular platax – *Platax orbicularis*
Ornate angelfish – *Genicanthus bellus*
Pale-tail chromis – *Chromis xanthura*
Pennant bannerfish – *Heniochus chrysostomus*
Pinktail trigger – *Melichthys vidua*
Polymyxia (check spelling) – silver fish with barbels
pufferfish? at 370m (43min left on 4th tape)
purple wrasse? At 109m with white face, dark red/purple streak along back with white spots in streak. Tail was very lanceolate. (4hr and 30min)
Pyramid butterflyfish – *Hemitaurichthys polylepis*
Red snapper – *Lutjanus bohar*
Redlip parrotfish – *Scarus rubroviolaceus*
Regal angelfish – *Pygoplites diacanthus*
Rosio verdes – deepwater wrasse
Smallscale fusilier (False fusilier) – *Paracaesio sordida*
Snooty wrasse – *Cheilinus oxycephalus*
Squarespot anthias – *Pseudanthias pleurotaenia*
stingray? at 380m
Swallowtail (Lyretail) hawkfish – *Cyprinocirrhites polyactis*
tilefish? – white with dark lower lobe of caudal fin
Unknown fish inside nautilus shell (25min left on 4th tape). Also, a weird pink fish (1-2inches long) with very, very long nose bumped into sub.
White-edge lyretail – *Variola albimarginata*

Whitetail (Thompson's) surgeonfish – *Acanthurus thompsoni*
Whitetip soldierfish – *Myripristis vittata*
White spotted spikefish (possibly a species of the genus *Hollardia*)
Yellowbar parrotfish – *Scarus schlegeli*
Yellow-speckled chromis – *Chromis alpha*
From video:
Rainbow runner – *Elagatis bipinnulata*

Dive P5-650

Location: Taema Bank, Tutuila, American Samoa

On Bottom: **Latitude:** 14°19.886'S **Longitude:** 170°40.144'W

Mission Date: July 11, 2005 **Duration:** 4 hours 14 mins (bottom time)

Maximum Depth (m): 447 m

Pilot: Max Cremer

Observer 1 (port): Dawn Wright **Observer 2 (stbd):** Doug Fenner

Objectives:

- Investigate full extent of sheer carbonate wall encountered on P5-648. Find base and then video and photographic survey north, wall to ledge and then E at a contour of interest, making observations of biota and physical structure
- Species identification of as many corals and fish as possible

Final, Processed Dive Track from Sub Nav:

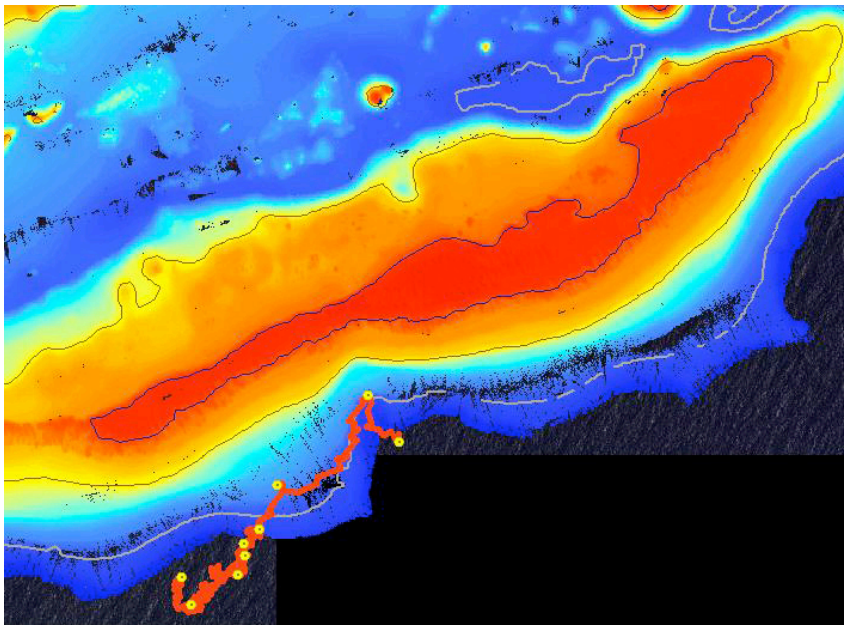

Figure 6. Track of Dive P5-650 to Taema Bank, overlain on NOAA CRED bathymetry and Ikonos satellite imagery, with waypoints shown in yellow. Contours are at 20, 50, and 100 m. Track was processed with Unix shell scripts and MS-Excel calculations to remove navigational errors, and then generalized in ArcGIS to reduce unnecessary vertices.

Summary of Observations/Findings:
Landed at 365 m depth, located carbonate wall and descended further down slope to the south. Found bottom of wall at ~439 m. Proceeded east along 440 m contour making observations, including galatheid and hermit crabs, urchins, shrimp, a few soft corals, sea cucumbers, small stars and an eel. Unfortunately we also encountered quite a few bottles and beer cans all along this contour. Proceeded up slope to explore entire vertical length of face. Encountered large carbonate blocks and rubble that looked as though it had been mass wasted down slope, then at 314 m came upon a distinct contact up to a solid, vertical wall, with many vertical grooves (scour marks from falling debris?). Continued moving up grooved face to ~268 m where large overhangs were noted where many of these large blocks must have broken loose and slid down slope. Several white, soft corals grew upside down from these overhangs. Reached ~217 m, which was maximum depth of previous Taema dive and encountered many wire corals, sea fans again, plus heart urchins (known to burrow but likely unsuccessfully on this hard carbonate substrate) Vertical grooves were no longer present above this depth. Reached top of ledge at ~115 m, noting family rubble piles with small fish. Large province of "discs," thought to be coralline algae, but took small sample to confirm. Moved up to 80 m and moved east, noting a few "lounge pillow" sea stars, "doughboy" sea star, sea cucumbers, damselfish, and a small ray. At 1230 moved from 82 m to 195 m in order to leave bottom.

Samples:
11:56, 14°19.607'S, 170°39.847'W, 92 m, small bits of coralline algae

Species List:
Anemone
Bat sea star
Cidarid urchin
Common lionfish – *Pterois volitans*
Coralline algae "discs"
Crinoid on black coral(?) (A "dichotoma"?)
Damselfish
Dendronephthya soft trees
Eel
Galatheid
Gorgonians (sea fans)
Hermit crab
Ray
Red grouper
Redtooth triggerfish
Sand tilefish
Sea cucumbers
Sea stars (large "lounge pillow" and "doughboy", 6-10 inches in diameter)
Shrimp
Spatanoids (heart urchins)
Soft corals (white, branching)
Toadfish
Tuna

Sea Beam Data Acquisition

HURL Science Program Director John Smith very kindly volunteered to oversee both night-time Sea Beam 210 surveys along a portion of Tutuila's north offshore platform. This was not only advantageous to our cruise (with its very small scientific party), but allowed for testing of Sea Beam system performance for the next cruises to Rose Atoll, Jarvis and Palmyra. Figures 7 and 8 show the coverage gathered during the cruise, which filled a gap between prior multibeam data: deeper water coverage collected to the north on Leg 10 of the Drift Expedition aboard R/V *Revelle* (EM120 data, USF and OSU, March 2002, dusk.geo.orst.edu/djl/samoa/) and both shallow- and deepwater data collected to the south and north respectively on R/V *Kilo Moana* cruise KM0505 of the Alia expedition (EM1002 and EM120 data, Scripps and Woods Hole, April 2005, earthref.org/ERESE/projects/ALIA/). The data were cleaned and ping-edited in MB-System by Smith while onboard. Further post-processing, final gridding and metadata preparation are in progress. In general, these multibeam data will help to fully characterize deeper volcanic/reef slope morphology. It will be interesting to note whether submarine features (such as the features in Figure 8) are of a constructional origin (e.g., volcanic or volcaniclastic cones) or whether they are the result of slumps or debris slides. Keating et al. (2000) have found that mass wasting plays an important role in the geologic development of volcanic edifices on the nearby Samoan island of Savai'i, and that it may be an important component of the geologic record for all of the Samoan Islands.

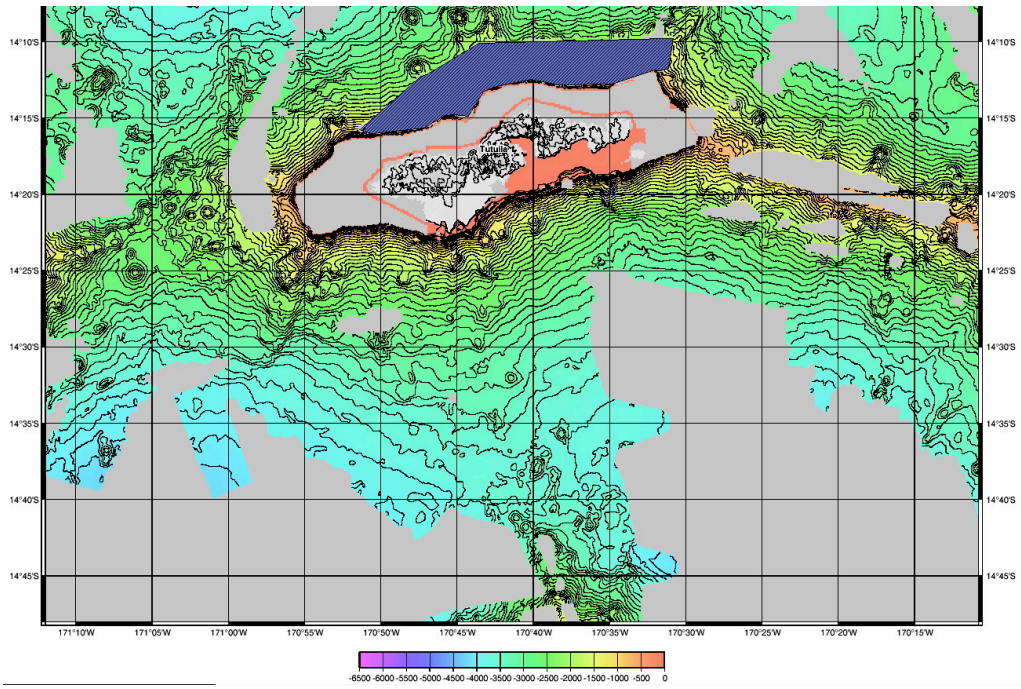

Figure 7. Location of Sea Beam 210 coverage during Cruise KOK0510 shown in blue shading, within context of prior multibeam data collected by the R/V *Revelle* (Drift 10, 2002) to the north of our coverage, and R/V *Kilo Moana* (KM0505, 2005) to the south of our coverage. After the map compilation of A. Koppers, Scripps, 2005, EarthRef.org Seamount Catalog. Map projection is Mercator.

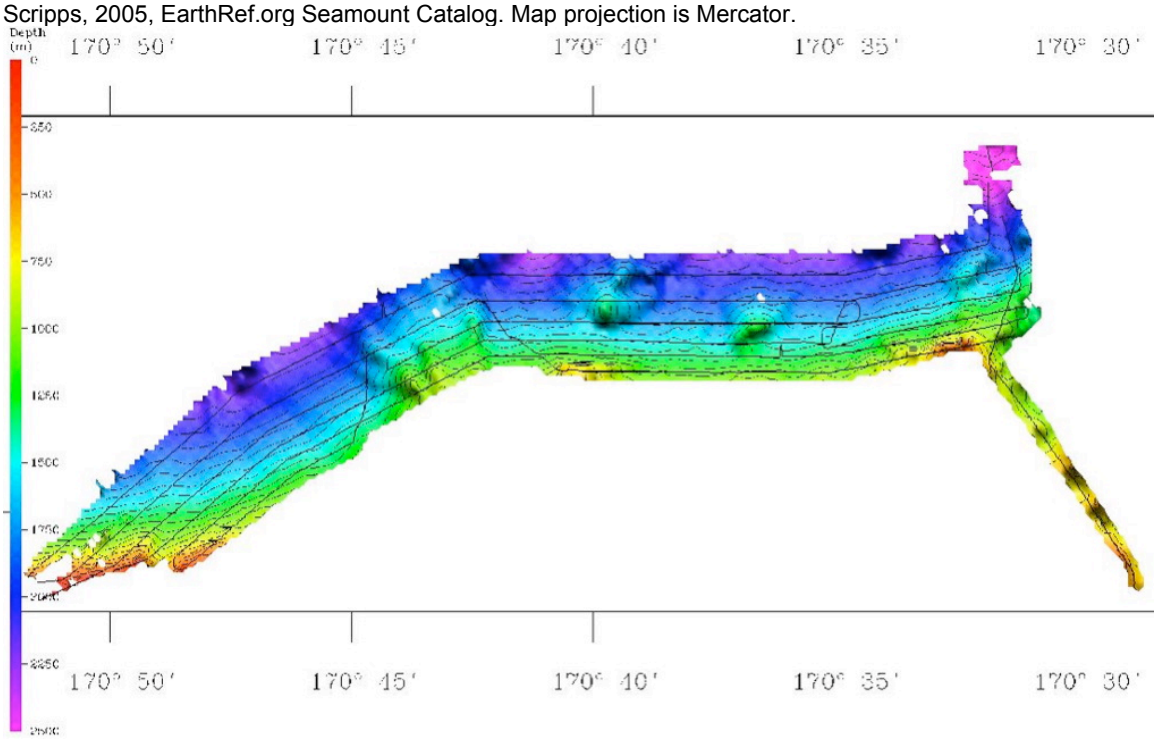

Figure 8. Preliminary snapshot of Sea Beam 210 data collected on Cruise KOK0510 at depths ranging from mainly from 750-2100 m, off the north coast of Tutuila.

Logistics and Support

Weather and water conditions were excellent throughout the entire cruise. No operations were adversely affected. There were no safety problems or concerns. Dive management and personnel cooperation was stellar. Many thanks to the HURL and KOK crews for excellent logistics and support.

Summary and Future Perspectives

HURL Checklist

A. Mission Significance in Relation to Research Goals. As mentioned earlier the results of the submersible dives should be very helpful to ongoing studies by the DMWR, the FBNMS, as well as the NPAS, and the American Samoa Coastal Management Program. These include selection of sites for habitat class designation and protection (e.g., no-take marine protected areas, a major American Samoa initiative), development of marine park monitoring protocols, and general understanding of species composition and abundance. Dive data and subsequent benthic habitat maps have been strongly encouraged by the NOAA Biogeography Program in support of NOAA's Coral Reef Initiative within the territory, and national Exclusive Economic Zone mapping efforts. The cruise addressed stated objectives of the *NURP Science Guidance* document (specifically NOAA Research Strategy #2, "Foster Ocean Stewardship", item 2.4 on habitat, diversity, and Marine Protected Areas; Strategy #3, Exploration, item 3.5 on characterizing deepsea communities). It is also very much in line with the NOAA Coastal Services Center's stated goals for "special technical, management, or planning projects that directly apply to the goals of the Pacific Island coastal management community," under the theme of "Habitat".

The mission was also strongly supported by NOAA CRED, which has been mapping in the region over the past 3 years and will continue to be an important collaborator on future projects. As ably summarized by NOAA CRED participant Emily Lundblad in an informal post-cruise report to CRED:

The submersible dive videos may be analyzed and classified in a similar way as the other video surveys. Dr. Wright expects that participants from CRED and DMWR will be able to classify/analyze the continuous videos and still photos with our own standards and protocol so the outcome will be compatible with existing *in situ* data. The hope is that the full range of *in situ* data will be used for benthic habitat maps and for meeting the needs of managers in the territory. Especially in the existing marine protected areas, the *in situ* data needs to be incorporated into the overall analysis. CRED, HURL, SOEST, and OSU have collected extensive bathymetry and CRED plans to finish coverage of the bathymetry in FY06. The backscatter that is extracted from the CRED bathymetry is an excellent resource that has yet to be ground-truthed although the *in situ* surveys exist from 2 different years. Approaching a third trip to the territory, I see an urgency in getting the back logged data classified. The territory has an initiative to designate 20% of its area as "no take" areas and managers have expressed that they hesitate to make any designation without reasonable *in situ* analysis. In order to reach milestones within CRED and for the territory, the videos need to be used.

B. Scientific Contributions of the Mission in terms of Species, Patterns, and Processes Observed or Measured. As summarized in prior sections, the initial research questions were well addressed and the methodology and/or technology used was successful and repeatable by others. Additional dives needed to extend our estimations of live bottom percentages and species identifications.

C. Extent of Data Analysis or Manuscript Preparation To Date. Dive navigation processing completed but videos and photos need to be classified along-track for species type, abundance, and habitat type (OSU M.S. thesis project and collaboration with CRED and DMWR). Existing seafloor classification schemes (e.g., Lundblad et al., in review) need to be adjusted accordingly. A journal article summarizing general results is planned for submission to the peer-reviewed journal *Ocean and Coastal Management*. Other articles specifically on the biology may be prepared by Fenner or Whaylen or specifically on classification schemes in concert with other data by Wright and students with Lundblad and NOAA CRED collaborators.

D. Advantages of NOAA's Undersea Research Program Research Investigations. Investigations would not have been possible without the submersible assets of HURL. Submersible and ROV enable observations to be made beyond the normal safety limits of SCUBA and rebreather diving (50-500 m).

E. Plans for Use Data Gathered on Mission and Applications, Products and/or Benefits to NOAA. In addition to the action items in (C), a suite of public education and outreach materials for the FBNMS incorporating the videos and photographs will also be developed (brochures, large posters, an interactive CD-ROM with static images and photographs, interactive 3-D visualizations, QuickTime movies, and glossy, finalized copies of education modules). This work will form the basis for a second M.S. thesis at OSU and is already partly funded by a $30K grant just received from the NOAA Coral Reef Conservation Grant Program.

Dissemination of results will include the posting shapefiles, selected photos and QuickTime movies on the FBNMS GIS Data Archive web site at OSU (http://dusk.geo.orst.edu/djl/samoa/hurl) and very likely from the web site of NOAA CRED. Results will made available for incorporation into academic curricula (especially at American Samoa Community College and OSU), used in management decision-making, and certainly published in the public press. Videos and photos and other educational materials, as they are developed, will be provided to the K-12 teachers who participated on the cruise (Jan Ili and Will Thompson), as well as to Tafuna High School oceanography class of Ms. Telesia Mauigoa, and the Leone High School marine science class of Mr. Wayne Salavea. These were two contacts made during a summer 2004 workshop visit of Wright and grad student Emily Larkin to American Samoa. Particularly exciting is a new collaboration with the laboratory of Dr. Mike Bailey in Computer Science at OSU (who has moved here recently from a post as Senior Principal Scientist at the San Diego Supercomputer Center), in which we will produce wooden models of American Samoa bathymetry (e.g., from OSU/USF shallow surveys and Sea Beam coverage) for use in local Samoan elementary and high schools. This will also be funded by the NOAA Coral Reef Conservation grant. Solid models will be extremely helpful to students in understanding topography and the processes acting upon it. This is especially important for local Samoan schools, as they do not have full, high-end computer access for all of their students.

Acknowledgments

Many thanks to HURL Operations Director and Chief Pilot Terry Kerby, Pilot Max Cremer, and the entire HURL technical group (Steve Price, Colin Wollerman, Doug Bloedorn, Pete Townsend, and Dan Greeson) for their stellar support, skill, and good humor at sea. We are grateful to Captain Ross Barnes and the crew of the R/V *Ka'imikai-o-Kanaloa* excellent service both in port and at sea. Special thanks to Nancy Daschbach, manager of the Fagatele Bay National Marine Sanctuary, for providing travel funding to D. Wright and E. Lundblad via the NOAA National Marine Sanctuary Program, as well as to Rosia Tavita of the FBNMS and Fatima Sauafea of the NOAA National Marine Fisheries Service, Pacific Islands Regional Office, for logistical support and arranging for the shipboard participation of K-12 educators Jan Ili and Will Thompson. Many thanks also to Peter Craig of the National Park of American Samoa for excellent pre- and post-cruise discussions.

References

Birkeland, C.E., R.H. Randall, R.C. Wass, B. Smith, and S. Wilkins, 1987. *Biological Assessment of the Fagatele Bay National Marine Sanctuary*, NOAA Technical Memorandum, 232 pp.

Craig, P., 1998. Temporal spawning patterns for several surgeonfishes and grasses in American Samoa, *Pacific Science*, 52:35-39.

Chave, E. H. and A. Malahoff, 1998. In *Deeper Waters, Photographic Studies of Hawaiian Deep-sea Habitats and Life-forms*, University of Hawaii Press.

Colin, P. L. and C. Arneson, 1995. *Tropical Pacific Invertebrates*, Coral Reef Press.

Exon, N.F., 1982. Offshore sediments, phosphorite and manganese nodules in the Samoan region, Southwest Pacific*, South Pacific Marine Geological Notes, SOPAC Technical Report*, Suva, Fiji, 103 –120.

Fabricius, K. and Alderslade, P., 2001. *Soft Corals and Sea Fans*. Australian Institute of Marine Science, Townsville, 263 pp.

Flanigan, J.M., 1983. *Earth, Fire, and Water*, unpublished report, American Samoa Community College, http://naio.kcc.hawaii.edu/jflanigan/EFW/theisland.html.

Gosliner, T.M., Behrens, D.W., and Williams, G.C. 1996. *Coral Reef Animals of the Indo-Pacific*. Sea Challengers, Monterey, 314 pp.

Green, A.L., C.E. Birkeland, and R.H. Randall, 1999. Twenty years of disturbance and change in Fagatele Bay National Marine Sanctuary, American Samoa, *Pacific Science*, 53(4): 376-400.

Keating, B.H., C. E. Helsley, and I. Karogodina, 2000. Sonar studies of submarine mass wasting and volcanic structures off Savai'i Island, Samoa, *Pure and Applied Geophysics*, 157(6-8): 1285-1313.

Lundblad, E., 2004. *The Development and Application of Benthic Classifications for Coral Reef Ecosystems Below 30 m Depth using Multibeam Bathymetry: Tutuila, American Samoa*, M.S. Thesis, Corvallis, OR, Oregon State University, http://dusk.geo.orst.edu/djl/theses/lundblad_abs.html. [Accessed 09/18/2005]

Lundblad, E., Wright, D.J., Miller, J., Larkin, E.M., Rinehart, R., Battista, T., Anderson, S.M., Naar, D.F., and Donahue, B.T., in review, 2005. Classifying benthic terrains with multibeam bathymetry, bathymetric position and rugosity: Tutuila, American Samoa, *Marine Geodesy*.

Stearns, H.T., 1944. Geology of the Samoan islands, *Geological Society of America Bulletin*, 55: 1270-1332.

Wright, D.J., 2002. Mapping the Seafloor in American Samoa, *Geospatial Solutions*, 12(7): 24-25.

Wright, D.J., B.T. Donahue, and D.F. Naar, 2002. Seafloor mapping and GIS coordination at America's remotest national marine sanctuary (American Samoa), in D.J. Wright (Ed.), *Undersea with GIS*, Redlands, California, ESRI Press, 33-63.