U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE/NOAA FISHERIES

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CRUISE REPORT[1]

VESSEL: *Oscar Elton Sette*, Cruise 05-12 (OES-34, Fig. 1)

CRUISE PERIOD: 3-9 October 2005

AREA OF OPERATION: Marianas Archipelago: (Island of Guam, Santa Rosa Reef, and Galvez Bank)

TYPE OF OPERATION: Personnel from the Coral Reef Ecosystem Division (CRED), Pacific Island Fisheries Science Center (PIFSC), National Marine Fisheries Service (NMFS), NOAA, conducted coral reef assessment/monitoring and mapping studies in waters surrounding the Island of Guam and its offshore banks of Galvez and Santa Rosa. This Marianas Archipelago Reef Assessment and Monitoring Program (MARAMP) cruise is part of NOAA's Coral Reef Conservation Program (CRCP) to conduct biennial coral reef ecosystem monitoring surveys at each of the U.S.-affiliated Pacific Islands.

ITINERARY:

Oct 3-5 Embarked Robert Schroeder (Chief Scientist/fish), Brent Tibbetts (fish), Valerie Porter (fish), Jean Kenyon (corals), Ray Boland (corals), Nick Pioppi (macroinvertebrates), Kim Page (algae), Elizabeth Keenan (algae), Craig Musburger (towboard/fish), Ben Richards (towboard/fish), Molly Timmers (towboard/ benthic), Jake Asher (towboard/ benthic), Jamie Gove (oceanography), Danny Merritt (oceanography), Oliver Dameron (oceanography), Kyle Hogrefe (night operations), Ronald Hoeke (divemaster), Michael Parke (data manager/ BOTCAM), and William Gordon (chamber operator). Launched small boats ~0800 (3 Oct) to conduct field surveys outside Apra Harbor with local escort boat (from Guam Fisheries Cooperative). Ship remained pier-side and refueled prior to departing harbor ~1500 on 3 October and joining small boats.

[1] PIFSC Cruise Report CR-06-004
Issued 11 October 2006

From 3-5 October, conducted 17 towed-diver habitat/fish surveys, along with 7 fish and 7 benthic rapid ecological assessment (REA) surveys. Completed one bottomfish digitalstereo-camera bait system (BOTCAM) deployment. Fifty shallow water conductivity-temperature-depths (CTDs) were made and water was sampled at 6 shallow water sites (24 samples total). Over the course of 3 nights, 11 shipboard CTD casts to a depth of 500 m were performed collecting water samples at each site for a total of 55 nutrient, 55 chlorophyll, and 12 dissolved inorganic carbon samples collected. A complete acoustic Doppler current profiler (ADCP) box transect was conducted during the three nights around Guam.

6 Oct. Arrived Galvez Bank ~0700 at. Completed three BOTCAM deployments. Five shipboard CTD casts were performed collecting water samples at all sites for a total of 10 nutrient, 25 chlorophyll, and 10 dissolved inorganic carbon (DIC) samples. A continuous ADCP box transect was conducted during operations around the bank.

7 Oct. Arrived Santa Rosa Bank at 0700. Conducted three towed-diver habitat/fish surveys, along with two fish and two benthic REA surveys. Completed four BOTCAM deployments. Twelve shallow water CTDs and 4 water sample profiles were collected. An Ocean Data Platform (ODP) was replaced at Santa Rosa; four shipboard CTD casts were performed collecting water for 20 chlorophyll samples. A continuous ADCP box transect was conducted during operations around the bank.

8 Oct. Arrived Guam at 0700. Conducted six towed-diver habitat/fish surveys, along with two fish and two benthic REA surveys. Completed two BOTCAM deployments. Thirty-three shallow water CTDs were collected and a subsurface temperature recorder (STR) was replaced. Nine Ek60 bioacoustic transects were completed along with three Isaacs-Kidd midwater trawls (IKMTs).

Oct 9 Arrived Apra Harbor, Guam, ~ 0700. Disembarked Schroeder, Tibbetts, Porter, Kenyon, Boland, Poippi, Page, Keenan, Musburger, Richards, Timmers, Asher, Gove, Merritt, Dameron, Hogrefe, Hoeke, Gordon, and Parke. End of MARAMP cruise (OES-05-12).

Table 1. Summary of 2005 cruise statistics for Guam (OES-05-12).

	Guam	*Galvez*	*Santa Rosa*	*Guam*	Total
	10/3-5	10/6	10/7	10/8	
Towed-Diver Habitat Surveys	17	0	3	6	26
Towed-Diver Fish Surveys	17	0	3	6	26
Fish Rapid Ecological Assessments	7	0	2	2	11
Benthic Rapid Ecological Assessments	7	0	2	2	11
STR deployed	2	0	1	1	4
CREWS	1	0	0		1
SSTs	1	0	0	1	2
WTR	17	5	4		26
ADCP	4	1	1	0	4
Deep water CTDs (500 meters)	11	5	4	0	20
Shallow water CTDs	50	0	12	33	95
SCUBA dives	110	0	24	36	170
EK60 Bioacoustic transects	0	5	5	9	19
BOTCAM	2	3	4	2	11
IKMTs	0	0	0	3	3

MISSION AND RESULTS (SUMMARY):

A. FISH: Used established quantitative methods (belt-transect, stationary point counts (SPCs), REAs) to estimate fish numerical and biomass densities and fish species richness, at habitat-representative stations, to contribute to an expanded baseline assessment and implement monitoring for temporal changes.

In general, fish diversity and abundance were relatively low around the large Island of Guam, while highest along the north and east sides where habitat rugosity and live coral cover were relatively better. Medium-large fish were very rare along the leeward west side of the island. Of all fishes surveyed, damsels, wrasses, and surgeons were the most common families. Santa Rosa Bank was characterized by low habitat relief with algal-

covered hard substrate predominating. Fish species diversity and abundance were also low at the bank. Medium-large fish were not common but were mostly spotcheek emperor (*Lethrinus rubropercularis*), as in 2003. No sharks were seen at Santa Rosa. (See Appendix A for further details of fish REA surveys.)

B. CORALS: Surveys were conducted to document the species composition, abundance, percent cover, size distribution, and general health of the shallow water corals. The REA survey protocol differed substantially from that used on previous CRED-sponsored cruises in CNMI (2003 and 2005) and in Guam (2003). The coral REA protocol, used at other U.S. Pacific locations by CRED since 2002, was employed at Guam and Santa Rosa Bank during OES-05-12 to better enable the comparison of Guam coral data with other regions surveyed by CRED.

In summary, twenty-six genera of scleractinian corals and several taxa of octocorals were enumerated in belt transects. *Porites* dominated the coral fauna at Guam. *Favia, Montastrea, Pocillopora,* and *Porites* dominated at Santa Rosa. Coral cover ranged from 12% on the southwest side of Guam to 38% on the north side. Colonies measuring <20 cm in diameter characterized the coral community structure at both Guam and Santa Rosa. (See Appendix B for further details of coral surveys.)

C. ALGAE: Quantitative photoquadrat sampling was used to collect species composition and baseline abundance data of reef algae to compare with previous samples.

Guam was found to have a relatively diverse algal flora with more genera than any of the other Mariana Islands visited. (See Appendix C for further details on algal surveys.)

D. MACROINVERTEBRATES: Non-coral, large marine invertebrate fauna was surveyed to assess their relative abundance and monitor reef communities. This was accomplished through procedures that quantify a set of target organisms and build a species inventory to document biodiversity.

Major groups recorded included species of porifera, cnidaria, polychaeta, molluska, crustacea, echinoidea, ophiuroidea, crinoidea, asteroidea, and holothuroidea. Various groups were more or less abundant in the various habitats around Guam and on the offshore banks. (See Appendix D for detailed descriptions of macroinvertebrates.)

E. TOWED-DIVER SURVEYS: Benthic and fish towed-diver survey methods were used to provide a general description of reef habitat composition (hard coral, stressed coral, soft coral, macroalgae, coralline algae, sand, and rubble), macroinvertebrates, and reef fishes over a large spatial scale. The methods provided assessments and the foundation for monitoring large-scale disturbances and general distribution and abundance patterns of macroinvertebrate taxa and reef fishes over 50 cm total length.

Hard coral cover along the southwest side of Guam was generally low (1-20%), while the southern outer reef slope of Cocos Island ranged from 40 to 63%. Soft coral cover was also low along most of the coastline (~1-5%). Coral cover along the northwest side

ranged from 5 to 50%, and areas along the north and northeast ranged up to 63% in hard coral cover. Crown-of-thorns (COTs) were highest between Togcha and Talofofo Bay; 223 COTs were observed, compared to none in 2003. Giant clam were relatively uncommon around Guam, typically 0-4 per tow. Santa Rosa Reef was characterized by low hard coral cover. Soft corals were also generally uncommon. No COTs were observed and giant clam were rare.

Guam and Santa Rosa Reef both indicated a paucity of large (>50 cm TL) fish, compared to the Northern Mariana Islands. Only 39 individuals of large fish were seen in 5-day of towed-diver surveys. The most abundant species was the twin-spot snapper (*Lutjanus bohar*). (See Appendix E for detailed descriptions.)

F. OCEANOGRAPHIC/NIGHT SURVEYS: Conducted near and offshore oceanographic surveys and deployed a variety of surface and subsurface oceanographic instruments with the goal to quantify, assess, and gain a better understanding of the overall hydrographic environment (e.g., water temperature, salinity, nutrients, currents). Shipboard conductivity-temperature-depth (CTD) casts were conducted both shallow (30 m, day) and deep (500 m, night) waters; water samples were collected for nutrient, carbon, and chlorophyll analysis. Shipboard acoustic Doppler current profiles (ADCP) were also obtained.

Preliminary findings indicate that no major oceanographic event or impact (e.g., that could cause mass coral bleaching) has occurred. Temperature was fairly consistent across the archipelago, including Guam and its offshore banks, lying in the well-mixed western Pacific warm pool. (See Appendix F for further details.)

G. BIOACOUSTIC SURVEYS: Shipboard bioacoustic (echosounder) transects were conducted around Guam and the offshore banks. These bioacoustic surveys, in conjunction with midwater trawl samples, were conducted at night to assess biomass in the water column to help understand physical and biological linkages supporting these reef ecosystems. Calibration bioacoustic surveys were occasionally conducted during the day. The highest acoustic backscatter was found to occur off the south and southwest sides of Guam. (See Appendix G for details.)

H. BOTCAM: A bottomfish digital stereo-camera bait system (BOTCAM) was deployed at 11 sites around Guam, Galvez Bank, and Santa Rosa Reef to trial test its utility in assessing relative abundance of deepwater (150-350 m) commercial bottomfish. This should help us to understand shallow-deep linkages in coral reef ecosystems. Some of the initial constraints with the BOTCAM continued, while a number were remedied during the preceding cruise in the Commonwealth of the Northern Mariana Islands (CNMI). In general, very few bottomfish were seen on the video, primarily kalekale (*Pristipomoides sieboldii*) and opakapaka (*P. filamentosus*). Several gindai (*P. zonatus*) and dog-tooth tuna (*Gymnosarda unicolor*) were also seen. The most productive sites appeared to be areas of high habitat quality, e.g., slopes from 40 to 70^{o} with hard bottom and high relief. Galvez Bank was characterized by steep drop-offs that made if difficult to locate suitable drop locations. Detailed bathymetry is needed to identify suitable drop sites. Existing

constraints and recommendations for improvements are provided. (See Appendix H for additional details on BOTCAM.).

SCIENTIFIC PERSONNEL:

Robert Schroeder, PhD, Chief Scientist, Fish REA Team, NOAA, University of Hawaii (UH)-Joint Institute for Marine and Atmospheric Research (JIMAR)/Coral Reef Ecosystem Division (CRED)
Brent Tibbetts, Fish REA Team, Guam-Division of Aquatic and Wildlife Resources (DAWR)
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Oliver Dameron, Oceanography Team, UH-JIMAR/CRED
Michael Parke, PhD, Data Manager/BOTCAM, NMFS-PIFSC
Kyle Hogrefe, Night Operations Team, UH/CRED
Ronald Hoeke, Divemaster, UH-JIMAR/CRED
William Gordon, Chamber Operator, NOAA-NOAA Dive Center
Phil White, Senior Survey Tech, NOAA ship *Oscar Elton Sette*

DATA COLLECTED:

Fish REA numerical and biomass densities by species
Digital images of fish-habitat associations
Target REA macroinvertebrate counts
Macroinvertebrate voucher specimens
Algal voucher specimens
Algal REA field notes of species diversity and relative abundance
Digital images from algal photoquadrats
Quantitative towed-diver surveys of large fish species (>50 cm TL)
Digital video surveys of fish from towed-diver transects
Benthic composition estimations from towed-diver surveys
Macroinvertebrate counts from towed-diver surveys
Digital images of the benthic habitat from towed-diver surveys
Habitat lineation from towed-diver surveys
Shallow-deep conductivity, temperature and depth (CTD) profiles

Water samples for nutrient analysis
Bioacoustic (echosounder) transects of sound-scattering layers
Trawl samples of mesopelagic boundary community organisms
BOTCAM digital video of bait-attracted deep-water bottomfish

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Attachments

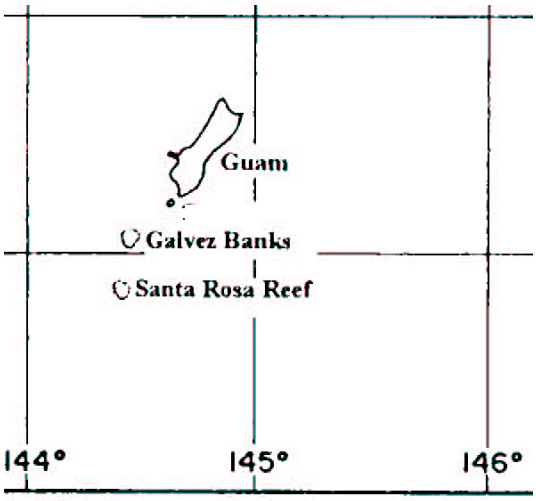


Figure1. Map of Guam and offshore banks.

Appendix A: Fish Rapid Ecological Assessment (REA) Team Field Activity Summary
(Robert Schroeder, Brent Tibbetts, Valerie Porter)

METHODS

From 3 to 9 October 2005, the fish census team (Robert Schroeder, Brent Tibbetts, Valerie Porter) surveyed 11 total stations: 9 around Guam and 2 at Santa Rosa Reef. (Dives were not possible at Galvez Bank due to depth and strong currents.) Quantitative belt transects (BLT), stationary point counts (SPC), and REA surveys (species presence) were conducted at station sites.

Fish transect stations consisted of three consecutive 25-m lines set along a single depth contour at 13–15 m. As each line was set, the observers swam about 5 m apart along either side along each side of the line, 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 around and, while remaining on either side of the line, began counting and recording size classes of all fishes within 2 m of their side of the line and 4 m off the bottom. Four SPCs were made at each transect station, generally ~15 m from the transect line. SPCs consist of the diver counting and recording the size classes for all fishes >25 cm total length observed in a cylindrical volume 10-m in radius during a 5-minute period. In addition, the divers recorded the species of fishes seen outside the transect area and outside the SPC counts on an opportunistic basis. During REA surveys, the divers record all species observed during the dive. These observations of the diversity are combined with fish observed by other divers (benthic team, tow team, or mooring team) to develop an island-wide cumulative listing of all fish species seen. Monitoring stations were selected primarily from the pool of stations visited during the first MARAMP cruise here 2 years ago and the potential for favorable conditions for future visits. The benthic team followed the fish team at all survey sites.

Results

Guam:
A total of 4 days were spent censusing fish on the outer reef slopes around this large island. The north and east sides of the island were characterized by relatively good habitat rugosity and more live coral cover than the west (except for the site just outside of Pago Bay). In general, fish diversity and abundance were relatively low, while higher along the north and east and in marine preserves. Sharks were rare; only one white-tip and one black-tip were seen. No Napoleon wrasse or bumphead parrotfish were seen by the REA fish team.

SPC survey replicates along the leeward, more accessible west side of the island recorded none to very few medium-large fish. Most were 25-30 cm TL parrotfish (*Chlorurus sordidus, Scarus schlegeli*) or wrasses. Slightly more were seen in the marine preserve areas (snappers, emperors, Nasos, parrotfish, goatfish). The Fouha site, along the southwest was impacted by over a decade of sedimentation, following shoreside road construction and annual hillside burning. Algae dominated the low relief substrate. Some corals were present along with a number of crown-of-thorns starfish. Fish diversity and abundance were low, except for a few small damselfish (*Chrysiptera tracyi, P. vaiuli, D. reticulatus*), and lesser surgeonfish, wrasses, and triggerfish.

Medium-large size fish were very rare here, only three individuals seen. The north side of Guam (Janapsin Beach) revealed a moderate diversity and abundance of medium-large fish (e.g., *Lethrinus xanthochilus, Caranx melampygus, Macolor niger, Aphareus furca, Kyphosus cinerascens*, plus several wrasses and parrotfishes). In the marine preserve along the northeast side, medium-sized (25-30 cm TL) parrotfish species were numerous and relatively diverse. Other taxa of medium-large size, such as *Lethrinus* spp. *Monotaxis grandoculis, Aprion virescens* and *Lutjanus* spp., were also of fair abundance. Medium-sized wrasses and surgeonfishes were also present. Large fish (e.g., *L. bohar, Naso* spp.) along the east seemed to appear less abundant than that recalled from 2 years ago. The Achang Reef flat preserve along the southeast side, just north of Cocos Lagoon, had a good diversity and abundance of medium-sized (25-30 cm TL) fish, especially parrotfishes. Other common taxa included snapper (*Aprhareus furca*), wrasses, surgeonfish, and rabbitfish.

The most common fish found at belt-transects along the west side of Guam were damsels (*Pomacentrus vaiuli, Stegastes fasciolatus*), wrasses (*Halichoeres margaritaceus, Thalassoma quinquevittatum*), and surgeons (*Acanthurus nigrofuscus, Ctenochaetus stiatus*), while fewer numbers of hawkfish (*Parrachirrhites arcatus*), parrotfish, and triggerfish were found there. Butterflyfish were rare. These same three families were also common along the north and east sides, while additional taxa (angelfish, butterflyfish, snappers, groupers, goatfish) were better represented as well. Planktivorous damselfish were also more abundant (e.g., *Pomachromis guamensis, Chromis acares, C. vanderbilti, Dascyllus reticulatus* [juveniles]). Damsels (*P. vaiuli, Plectroglyphidodon lacrymatus, Dascyllus reticulatus*), wrasses (*Cirrhilabrus katherinae, Halichoeres margaritaceus, Oxycheilinus unifasciatus*), surgeons (*Acanthurus nigrofuscus, Ctenochaetus stiatus, Naso lituratus*), and numerous parrotfish dominated the diversity and abundance of fish on the belt transect at Achang preserve (recovering from previous heavy exploitation).

Santa Rosa:
The top of this bank is composed of a low relief habitat with a moderate-sized area of diveable depth (30-60 ft). Live coral cover was low with algal-covered hard substrate predominating. Belt-transect and SPC surveys were conducted at two stations a few 100 m apart. Overall fish species diversity and abundance were low. As in 2003, medium-large fish were not common here but were mostly emperors, e.g., *Lethrinus rubropercularis*, and groupers. This emperor is the most common bottomfish caught on the offshore banks, but usually at deeper than 100 ft. Groupers (e.g., *Epinephelus fasciatus, Variola louiti*) appeared to be slightly more abundant than 2 years ago, but no sharks were seen this time. Small wrasses (e.g., *Cirrhilabrus katherinae* [spawning], *Halichoeres amblycephalum* juveniles, *Thalassoma quinquevitattum*) were most abundant on the belt-transects, followed by surgeonfish. Herbivorous fishes appeared to be uncommon relative to the considerable algal substrate present. Other groups that were also relatively common were fang blennies and hawkfish. The hawkfish *Cirrhitichthys oxycephalus* was present, while rare in the main island chain.

Benthic Rapid Ecological Assessment (REA) Team Field Activity Summaries:

Appendix B. Corals (Jean Kenyon and Ray Boland)

METHODS

The REA survey protocol used for corals was substantially different from the methods used on previous CRED-sponsored cruises in the Commonwealth of the Northern Mariana Islands (CNMI) (2003 and 2005) and in Guam (2003). During those cruises, the resident coral biologists (Peter Houk and Trina Leberer) employed a method in which a quadrat was randomly tossed at 5-m intervals along the transect lines, corals were classified to species, and the diameter in two dimensions of each colony was measured with a tape to the nearest centimeter. The size class distribution of all corals so measured at each island location revealed a general pattern in which >80% of the corals had a maximum diameter of <16 cm, i.e., the coral communities appeared to be dominated by very small colonies. At the Guam sites surveyed in 2003, 93.7% of the colonies measured within quadrats had a maximum diameter of <16 cm. However, when Kenyon viewed the videotransect tapes recorded by the coral team at Guam in 2003, it was clear that there were numerous large colonies present at most sites, and that the data recorded within quadrats might not accurately reflect the size class distribution of the site's coral community. Accordingly, the coral REA protocol used at other U.S. Pacific locations by CRED since 2002 was employed at Guam and Santa Rosa Bank during cruise OES-05-12 to better enable the comparison of Guam coral data with other regions surveyed by CRED. Even so, some modification of this standard CRED protocol was made in response to the difficulty of finding two expert coral biologists to participate on the Guam/Santa Rosa cruise; however, the taxonomic skills of one coral REA team member (Ray Boland) were not as comprehensive as those of the lead coral REA team member (Jean Kenyon). Moreover, neither of the coral REA team members had expertise in coral disease, an aspect of coral biology which has been increasingly incorporated by CRED into its REA methods; therefore, no dedicated observations regarding coral disease were made at Guam/Santa Rosa Bank.

At most Guam sites, Boland videotaped along two 25-m transects (deployed by the fish team) to archive as a permanent record the condition of the benthos and for later use for independently calculating percent coral cover. Kenyon followed behind and used the line-intersect method at 50-cm intervals along both lines (51 points/transect) to calculate substrate composition. Then both Kenyon and Boland swam in the reverse direction along the transect lines and tallied corals by genus, number of colonies, and maximum diameter. All corals whose colony center fell within 1 meter on either side of each transect line were enumerated and assigned to one of 6 size classes: <5 cm, 5-10, 10-20, 20-40, 40-80, and >80 cm. Boland surveyed for the genera *Acropora*, *Montipora*, *Pocillopora*, and *Porites*, while Kenyon surveyed for all other coral genera. These transect tallies are used to determine coral abundance by genus and coral community size class distributions. Digital still photos showing general overviews of the site were additionally taken as part of the data record.

On October 5, Boland did not participate in the GUA-7 survey due to malfunctioning dive equipment, and Kenyon did not participate on GUA-8 or GUA-11 surveys because of seasickness. The data records at these sites are accordingly attenuated to what could be accomplished by a single coral surveyor.

RESULTS

REA surveys were conducted at nine sites around Guam and two sites at Santa Rosa Bank. Site numbers, locations, and other site descriptive parameters are presented in Coral Table 1. Locations of REA sites around Guam are shown in Coral Figure 1.

Coral Table 1. Sites surveyed by REA team, OES05-12, October 2005. Depths and temperatures are from Kenyon dive gauges. NA = data not taken

Site #	Date	Latitude (N)		Longitude (E)		Transect depth (ft)	% coral cover	Max. depth (ft)	Temp, °F
Guam									
1	10/3/05	13	25.78	144	38.27	34	14.7	53	83
9	10/3/05	13	28.414	144	41.611	40-45	27.5	47	84
10	10/4/05	13	31.018	144	47.837	30-40	33.3	41	84
4	10/4/05	13	37.998	144	53.546	34-54	38.2	54	84
7	10/5/05	13	36.152	144	55.642	40-45	30.4	50	84
8	10/5/05	13	29.324	144	52.650	30-38	NA	42	NA
11	10/5/05	13	25.689	144	48.601	38-42	NA	42	NA
3	10/8/05	13	14.444	144	42.221	40-45	26.5	51	84
2	10/8/05	13	18.337	144	39.169	40-45	11.8	48	84
Santa Rosa									
1	10/7/05	12	48.769	144	25.485	33-43	25.5	44	84
2	10/7/05	12	48.678	144	25.416	42-45	12.7	45	84

Coral Figure 1. Location of REA survey sites around Guam

Population Parameters

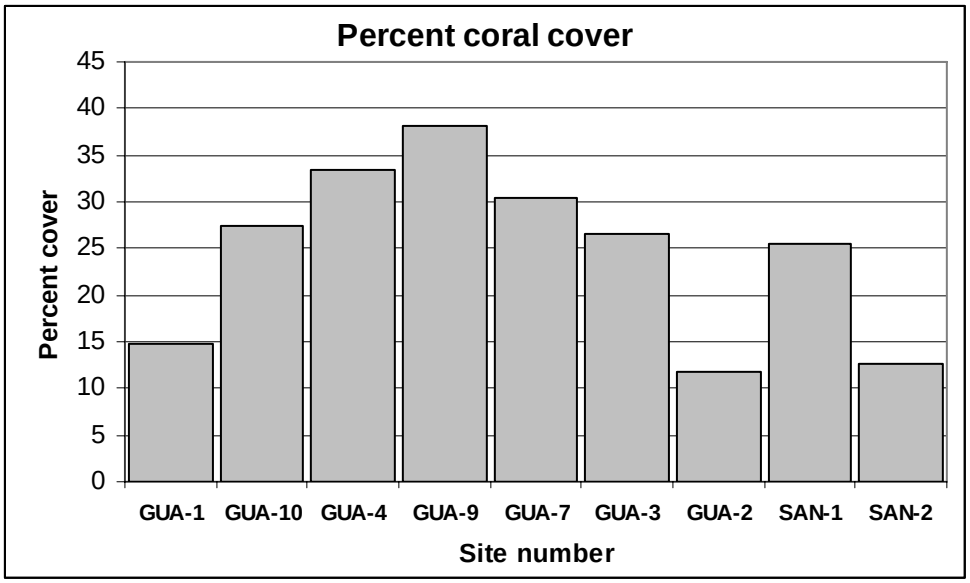
A total of 5017 anthozoan colonies were enumerated within belt transects covering 750 m^2 around Guam, and 843 anthozoan colonies were enumerated within belt transects covering 200 m^2 at Santa Rosa Bank. The number of colonies enumerated and percentage of coral colonies represented by each taxon are shown in Coral Table 2.

Coral Table 2. Number of anthozoans surveyed in belt transects during OES05-12. Taxa contributing more than 10% of the total number of coral colonies are in bold.

	Guam		Santa Rosa	
Taxon	# of colonies	Percent of total	# of colonies	Percent of total
Acanthastrea	27	0.5	0	0.0
Acropora	171	3.4	1	0.1
Astreopora	443	8.8	22	2.6
Cyphastrea	51	1.0	5	0.6
Diploastrea	9	0.2	0	0.0
Favia	341	6.8	175	**20.8**
Favites	13	0.3	11	1.3
Fungia	10	0.2	0	0.0
Goniastrea	336	6.7	0	0.0
Goniopora	12	0.2	3	0.4
Galaxea	64	1.3	0	0.0
Gardineroseris	1	0.0	0	0.0
Herpolitha	4	0.1	0	0.0
Hydnophora	19	0.4	0	0.0
Leptastrea	329	6.6	78	9.3
Leptoseris	0	0.0	1	0.1
Montastrea	0	0.0	153	**18.1**
Montipora	320	6.4	6	0.7
Oulophyllia	1	0.0	0	0.0
Pavona	67	1.3	5	0.6
Platygyra	48	1.0	59	7.0
Pocillopora	201	4.0	150	**17.8**
Porites	2354	**46.9**	135	**16.0**
Psammocora	8	0.2	1	0.1
Stylocoeniella	1	0.0	0	0.0
Stylophora	44	0.9	24	2.8
Heliopora	9	0.2	0	0.0
Other Octocorals	134	2.7	14	1.7
Total # colonies	5017		843	
Area surveyed, m^2	750		200	

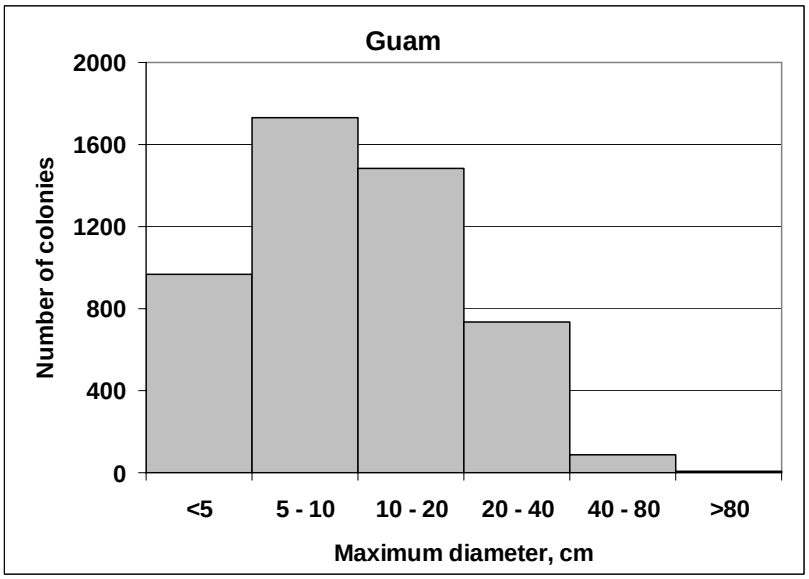
Twenty-six genera of scleractinian corals, as well as several taxa of octocorals including *Heliopora coerulea*, were enumerated within belt transects. In terms of number of colonies represented within transect belts, *Porites* dominated the coral fauna at Guam, while *Favia*, *Montastrea*, *Pocillopora*, and *Porites* dominated the two sites surveyed at Santa Rosa Bank.

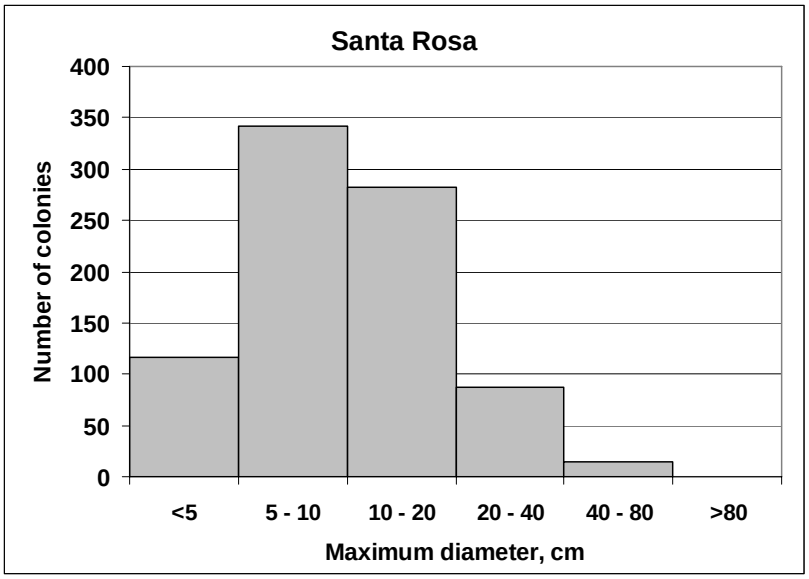
Coral Figure 2 shows the percent coral cover by REA site, calculated from the point-intercept method applied by Kenyon. Sites GUA-8 and GUA-11 were not assessed using this method as Kenyon was unable to conduct dives at those sites. Coral cover ranged from 11.8% at GUA-2 on the southwest side of Guam to 38.2% at GUA-9 on the north side of Guam.



Coral Figure 2. Percent live coral cover, by site, determined with the line-intercept method (102 points/site). GUA = Guam; SAN = Santa Rosa Bank

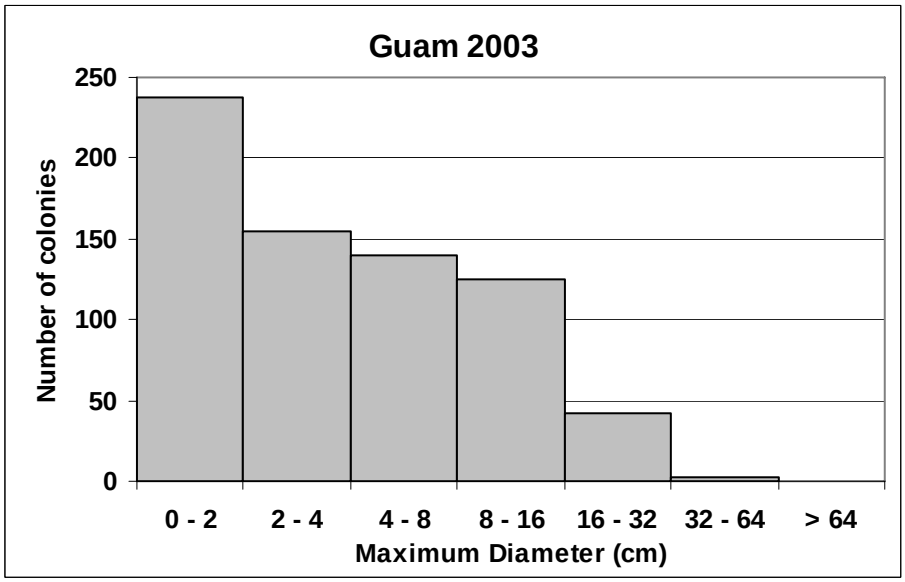
Size class distributions of all corals enumerated within belt transects by Kenyon and Boland are shown in Coral Figure 3; size class distributions from Guam and Santa Rosa Bank are highly similar. Colonies measuring <20 cm maximum diameter characterized the coral community structure at both Guam (83.4% of colonies) and Santa Rosa Bank (87.9% of colonies).





Coral Figure 3. Size class distributions of anthozoans within belt transects at Guam and Santa Rosa Bank.

During the 2003 surveys, Trina Leberer measured the maximum and perpendicular diameter of colonies within 15 quadrats randomly thrown at 5-m intervals along the transect lines at each site. She computed the geometric mean of each colony and batched these means into size classes different from those used by Kenyon and Boland: 0-2 cm, 2-4 cm, 4-8 cm, 8-16 cm, 16-32 cm, 32-64 cm, and >64 cm. In order to compare Leberer's 2003 data with that collected in 2005, Kenyon used the maximum diameter of each colony from Leberer's raw data to construct the following size class distribution for 2003 data (Coral Figure 4):



Coral Figure 4. Size class distributions of anthozoans within belt transects at Guam and Santa Rosa Bank based on data recorded by Trina Leberer during 2003 surveys.

Although the difference in the size class categories used by Leberer and by Kenyon/Boland make a strict comparison difficult, it appears that Leberer's quadrat method is better attuned to detect small colonies that could have been missed in the larger spatial areas surveyed by Kenyon/Boland. Conversely, Leberer's method appears to underrepresent the larger colonies present within the community: according to Leberer's data, 93.7% of the colonies measured within quadrats had a maximum diameter of <16 cm, whereas according to data collected by Kenyon/Boland, 83.4% of colonies within belt transects had a maximum diameter of <20 cm.

Appendix C. Algae (Kim Page and Elizabeth Keenan)

Guam

Algal Highlights:

- Guam has a relatively diverse algal flora with more genera than any of the other islands visited.
- *Padina* sp., rarely seen at the other islands, was locally abundant especially on the southwest side of the island. It appeared in 100 percent of the quadrats at GUA 2 with a rank of 2.33.
- Along with turf algae, blue-green algae, and crustose coralline algae, *Halimeda* spp. were the most ubiquitous algae. It was found at every site visited and in 95.34 percent of the photoquadrats.

Site Descriptions:

GUA 1:

This site was located on the west side of Guam just south of the military harbor. It was a sloping reef with very little live coral and high algal abundance. Only a qualitative survey was conducted. *Padina* sp. was the dominant alga. In addition, *Galaxaura* spp., *Liagora* sp., blue-green algae, *Neomeris* sp., *Jania* sp., *Dictyosphaeria versluysii*, *Amphiroa* sp., *Actinotrichia* sp., *Boodlea* sp., *Asparagopsis* sp., *Ventricaria ventricosa*, *Martensia* sp., *Udotea* sp., *Caulerpa filicoides*, and *Anadyomene* sp. were collected.

GUA 10:

This site was located just north of GUA 1 on the outer reef of the south end of Piti Bay across from the power plant. It was a knobby reef with little live coral and moderate relief. In addition to turf algae, blue-green algae, and crustose coralline algae, 18 genera of macroalgae were observed and collected during this qualitative assessment. *Avrainvillea* sp., *Halimeda* spp., *Tydemania* sp., *Cheliosporum* sp., *Caulerpa filicoides*, *Neomeris* sp., *Galaxaura* sp., *Jania* sp., Gelids, *Peyssonnelia* spp., *Dictyota* spp., *Haloplegma* sp., *Ventricaria ventricosa*, a coarsely branched coralline algae, *Portieria hornemannii*, *Amphiroa* sp., *Laurencia* sp., and an unknown iridescent calcified red with rolled margins were collected.

GUA 4:

This site was located on the outside of Tumon Bay on the west side of the island. It was a relatively flat/ knobby reef. In addition to turf algae and crustose coralline algae, blue-green algae, *Halimeda* spp., *Amphiroa* sp., *Dictyosphaeria* sp., *Caluerpa* sp., *Neomeris* sp., *Peyssonnelia* sp., *Portieria* sp., *Gracilaria* sp., *Galaxaura* sp., *Acanthophora spicifera*, and *Hypnea* sp. were recorded within the photoquadrat area. A large *Caulerpa racemosa* potentially var. *lamourouxi*, *Turbinaria ornata*, *Tydemania* sp., *Valonia* sp., and *Halymenia* sp. were collected during the random swim. CLOD (Coralline Lethal Orange Disease) was recorded from this site.

GUA 9:

This site was located on the north side of the island. It had relatively high coral cover with a high abundance and diversity of *Halimeda*. Turf algae, crustose coralline algae, blue-green algae, *Dictyota* sp., *Chlorodesmis* sp., *Neomeris* sp., *Dictyosphaeria* sp., *Amphiroa* sp., *Jania* sp.,

Caluerpa filicoides, *Portieria hornemannii*, *Turbinaria ornata*, and *Padina* were recorded quantitatively in addition to *Halimeda*. *Udotea* sp. and *Ventricaria ventricosa* were also recorded during the random swim. CLOD was recorded from this site.

GUA 7:
This site was located on the northeast side of the island. It was a flat reef sloping down at ~50 feet. There was relatively high coral cover. Turf algae, blue-green, *Halimeda* sp., crustose coralline algae, *Avrainvillea* sp., *Neomeris* sp., *Dictyosphaeria* sp., *Peyssonnelia* sp., *Dictyota* sp., *Portieria hornemannii*, *Chlorodesmis* sp., *Jania* sp., *Amphiroa* sp., and *Padina* sp. were recorded from the quadrat area. *Caulerpa racemosa* var. *lamourouxi*, *Ventricaria ventricosa*, and *Udotea* sp. were additionally collected from the random swim.

GUA 8:
This site was located on the east side. It was a very nice reef with relatively high coral cover and large adjacent sand patches. Turf algae, crustose coralline algae, *Peyssonnelia* sp., *Caulerpa* sp., blue-green algae, *Halimeda* sp., *Amphiroa sp*., *Neomeris* sp., *Dictyosphaeria* sp., and *Portieria hornemannii* were recorded quantitatively. A large Caulerpa racemosa, *Udotea* sp., *Halymenia* sp. and *Turbinaria ornata* were additionally collected during the random swim.

GUA 11:
This site was on the east side just north of Pago Bay. It had an extremely abundant and diverse assemblage of macroalgae. *Galaxaura* sp., *Codium* sp., *Halimeda* sp., *Dictyota* sp., *Portieria* sp., *Amphiroa* sp., *Jania* sp., *Bornetella* sp., Gelids, *Caulerpa* spp., *Martensia* sp., and an unknown calcified red alga were recorded within the photoquadrat area. Additionally, *Boodlea* sp. and *Avrainvillea* sp. were collected during the random swim.

GUA 3:
This site was located on the southern tip of Guam just to the east of Cocos Island. It had a relatively steep reef slope beginning to drop off around 60 feet. There was relatively high coral cover and lower visibility. *Halimeda* spp, *Asparagopsis taxiformis*, *Dictyota* sp., *Amphiroa* sp., *Galaxaura* spp., *Caulerpa* spp., *Padina* sp., *Udotea* sp., *Neomeris* sp., *Tydemania expeditionis*, *Martensia* sp., *Portieria hornemannii* and *Jania* sp. were recorded within the photoquadrat area. Additionally, *Gibsmithia hawaiiensis*, and a very large *Halymenia* sp. were recorded during the random swim.

GUA 2:
This site was located on the southwest side of the island. This site had lower visibility and a dominance of macroalgae, primarily *Padina* sp.. In addition to the *Padina*, turf algae, *Galaxaura* spp., *Amphiroa* sp., *Halimeda* sp., *Boodlea* sp., *Jania* sp., *Dictyota* sp., *Neomeris* sp., crustose coralline algae, *Caulerpa* sp., Gelid, *Botrycladia* sp., *Udotea* sp., and *Avrainvillea* sp. were recorded during the photoquadrat survey. *Martensia* sp. was additionally collected during the random swim.

Table 1: Algae of Guam. Bold numbers indicate the number of photoquadrats in which an alga occurred; italicized numbers indicate the alga's relative abundance (rank) in relation to other algae occurring in the same photoquadrat (the lower the number the more abundant the alga). Standard deviation of island averages are given in parentheses. Asterisks indicate algae found during the random swim that did not occur in photoquadrats sampled.

	GUA 1	GUA 10	GUA 4	GUA 9	GUA 7	GUA 8	GUA 11	GUA 3	GUA 2	Island average
Anadyomene	*									**0.00** **(0.00)**
Avrainvillea		*			**100.00** *3.75*		*		**8.33** *8.00*	**15.48** **(37.40)** *5.88* *(3.01)*
Boergesenia			*							**0.00** **(0.00)**
Boodlea	*						*		**33.33** *6.75*	**4.76** **(12.60)** *6.75*
Bornetella							**16.67** *8.50*			**2.38** **(6.30)** *8.50*
Caulerpa	*	*	**33.33** *6.50*	**41.67** *4.20*	*	**33.33** *5.00*	**16.67** *5.00*	**58.33** *5.00*	**16.67** *7.00*	**28.57** **(19.16)** *5.45* *(1.07)*
Chlorodesmis				**33.33** *5.25*	**8.33** *6.00*					**5.95** **(12.47)** *5.63* *(0.53)*
Codium							**91.67** *2.27*			**13.10** **(34.65)** *2.27*
Dictyosphaeria	*		**25.00** *7.33*	**8.33** *5.00*	**41.67** *6.00*	**25.00** *5.00*				**14.29** **(16.47)** *5.83* *(1.11)*
Halimeda	*	*	**100.00** *3.33*	**100.00** *2.00*	**100.00** *2.08*	**83.33** *3.40*	**91.67** *4.64*	**91.67** *3.27*	**100.0** *3.83*	**95.24** **(6.56)** *3.22* *(0.93)*
Neomeris	*	*	**66.67** *7.25*	**41.67** *7.60*	**58.33** *5.57*	**50.00** *5.33*	**16.67** *9.00*	**41.67** *8.60*	**41.67** *7.40*	**45.24** **(15.85)** *7.25* *(1.39)*
Tydemania		*	*					**8.33** *8.00*		**1.19** **(3.15)** *8.00*
Udotea	*			*	*	*		**16.67** *7.00*	**16.67** *7.00*	**4.76** **(8.13)** *7.00* *(0.00)*
Valonia				*						**0.00** **(0.00)**

	GUA 1	GUA 10	GUA 4	GUA 9	GUA 7	GUA 8	GUA 11	GUA 3	GUA 2	Island average
										0.00
Ventricaria	*	*			*				*	**(0.00)**
										1.19
			8.33							**(3.15)**
Acanthophora			*6.00*							*6.00*
										0.00
Actinotrichia	*									**(0.00)**
										1.19
									8.33	**(3.15)**
Amansia									*9.00*	*9.00*
										47.62
									100.0	**(39.00)**
			58.33	**8.33**	**16.67**		**75.00**	**75.00**	**0**	*5.31*
Amphiroa	*	*	*4.86*	*7.00*	*5.50*		*5.00*	*5.33*	*4.17*	*(0.95)*
										9.52
								66.67		**(25.20)**
Asparagopsis	*							*3.00*		*3.00*
										1.19
									8.33	**(3.15)**
Botryocladia									*10.00*	*10.00*
										0.00
Cheilosporum		*								**(0.00)**
										36.90
									100.0	**(42.45)**
			16.67				**75.00**	**66.67**	**0**	*5.47*
Galaxaura	*	*	*6.50*				*4.56*	*6.75*	*4.08*	*(1.35)*
										2.38
										(4.07)
							8.33		**8.33**	*6.50*
gelid		*					*4.00*		*9.00*	*(3.54)*
								*		**0.00**
Gibsmithia										**(0.00)**
										1.19
			8.33							**(3.15)**
Gracilaria			*8.00*							*8.00*
										0.00
Haloplegma		*								**(0.00)**
										0.00
Halychrysis			*							**(0.00)**
										0.00
Halymenia						*		*		**(0.00)**
										1.19
			8.33							**(3.15)**
Hypnea			*7.00*							*7.00*
										19.05
										(25.78)
			8.33	**8.33**	**25.00**		**8.33**	**8.33**	**75.00**	*6.43*
Jania	*		*4.00*	*8.00*	*6.67*		*8.00*	*6.00*	*5.89*	*(1.51)*
										1.19
Laurencia/			**8.33**							**(3.15)**
Chondrophycus		*	*5.00*							*5.00*

	GUA 1	GUA 10	GUA 4	GUA 9	GUA 7	GUA 8	GUA 11	GUA 3	GUA 2	Island average
Liagora	*									**0.00 (0.00)**
Martensia	*						**8.33** *4.00*	**16.67** *8.00*	*	**3.57 (6.56)** *6.00 (2.83)*
Peyssonnelia		*	**16.67** *5.00*		**25.00** *7.33*	**8.33** *3.00*				**7.14 (10.12)** *5.11 (2.17)*
Portieria		*	**8.33** *8.00*	**33.33** *6.25*	**25.00** *5.33*	**16.67** *4.50*	**100.00** *4.92*	**8.33** *11.00*		**27.38 (33.92)** *6.67 (2.46)*
branched upright coralline		*								**0.00 (0.00)**
crustose coralline	*	*	**91.67** *2.73*	**91.67** *3.09*	**83.33** *3.00*	**75.00** *2.67*		**66.67** *4.25*	**41.67** *6.20*	**64.29 (33.23)** *3.66 (1.37)*
Dictyota		*	**8.33** *8.00*	**75.00** *4.56*	**41.67** *6.40*		**50.00** *5.17*	**100.0** *3.75*	**33.33** *6.75*	**44.05 (35.26)** *5.77 (1.57)*
Padina	*		*	**16.67** *6.00*	**16.67** *6.50*			**41.67** *7.60*	**100.0** *2.33*	**25.00 (36.32)** *5.61 (2.28)*
Turbinaria			*	**16.67** *4.50*		*				**2.38 (6.30)** *4.50*
Blue-green	*	*	**91.67** *3.45*	**50.00** *3.83*	**58.33** *5.43*	**100.00** *2.33*	**58.33** *6.29*	**8.33** *5.00*		**52.38 (37.80)** *4.39 (1.45)*
turf	*	*	**100.00** *1.00*	**100.00** *1.50*	**100.00** *1.08*	**100.00** *1.50*	**100.00** *1.00*	**100.0** *1.00*	**100.0** *1.33*	**100.00 (0.00)** *1.20 (0.23)*

Santa Rosa Bank

Algal Highlights:

- These banks were macroalgae dominated.
- *Caulerpa sp., Avrainvillea sp., Dictyosphaeria* sp., *Halimeda spp., Microdictyon sp., Udotea sp.,* turf algae, and blue-green algae were each seen in greater than 50 percent of the quadrats.
- Very little crustose coralline was observed along the transit.

Site Descriptions:
SAN 1: This site was located to the northeast of SAN 2. It had more rugosity and higher coral abundance and diversity. *Caulerpa cupressoides* and a bright green *Avrainvillea* were very abundant. In addition to these, *Halimeda* spp., *Dictyosphaeria cavernosa*, *Udotea* sp., *Microdictyon* sp., *Neomeris* sp., branched coralline algae, *Lobophora variegata*, *Anadyomene* sp., and *Codium* sp. were recorded within the quadrat area. After the first transect there was a sand/pavement channel with a large field of *Liagora* sp. Additionally, *Ventricaria ventricosa* and a very tough *Laurencia* sp. were collected outside of the survey area.

SAN 2:
This site was located to the southwest of SAN 1. It had less rugosity and less coral cover than did SAN 1. It was dominated by the tough *Laurencia* sp. as well as *Caulerpa cupressoides*. *Halimeda* sp., *Udotea* sp., blue-green algae, *Dictyosphaeria cavernosa*, *Microdictyon* sp., *Avrainvillea* sp., *Codium* sp., *Liagora* sp., and *Bornetella* sp. These corals were additionally recorded within the quadrat area. Unfortunately the photos from both SAN 1 and 2 were distorted for an unknown reason.

Table 2: Algae of Santa Rosa Banks. Bold numbers indicate the number of photoquadrats in which an alga occurred; italicized numbers indicate the alga's relative abundance (rank) in relation to other algae occurring in the same photoquadrat (the lower the number the more abundant the alga). Standard deviation of island averages are given in parentheses. Asterisks indicate algae found during the random swim that did not occur in photoquadrats sampled.

	SAN 1	SAN 2	Island average
			4.17
	8.33		**(5.89)**
Anadyomene	*7.00*		*7.00*
			62.50
			(17.68)
	75.00	**50.00**	*4.86*
Avrainvillea	*4.22*	*5.50*	*(0.90)*
			8.33
		16.67	**(11.79)**
Bornetella		*7.00*	*7.00*
			62.50
			(5.89)
	66.67	**58.33**	*3.88*
Caulerpa	*3.63*	*4.14*	*(0.37)*
			20.83
			(17.68)
	8.33	**33.33**	*5.63*
Codium	*6.00*	*5.25*	*(0.53)*
			79.17
			(29.46)
	100.00	**58.33**	*4.63*
Dictyosphaeria	*4.83*	*4.43*	*(0.29)*
			91.67
			(11.79)
	100.00	**83.33**	*2.92*
Halimeda	*3.33*	*2.50*	*(0.59)*
	75.00	**58.33**	**66.67**
Microdictyon	*4.33*	*4.00*	**(11.79)**

	SAN 1	SAN 2	Island average
			4.17
			(0.24)
			37.50
	75.00		**(53.03)**
Neomeris	*8.11*		*8.11*
			58.33
			(11.79)
	66.67	**50.00**	*6.29*
Udotea	*6.75*	*5.83*	*(0.65)*
	*		**0.00**
Ventricaria			**(0.00)**
			37.50
	*	**75.00**	**(53.03)**
Laurencia/Chondrophycus		*1.56*	*1.56*
			25.00
	*	**50.00**	**(35.36)**
Liagora		*6.17*	*6.17*
			25.00
	50.00		**(35.36)**
branched upright coralline	*5.50*		*5.50*
			8.33
	16.67		**(11.79)**
Lobophora	*7.00*		*7.00*
			58.33
			(23.57)
	41.67	**75.00**	*4.62*
Blue-green	*4.80*	*4.44*	*(0.25)*
			87.50
			(17.68)
	100.00	**75.00**	*1.92*
Turf	*1.50*	*2.33*	*(0.59)*

Appendix D. Macroinvertebrates (Nicholas D. Pioppi)

Site GUA 1
Site 1 was located off the western coast of Guam, due south of Apra Harbor. The bottom habitat was reef slope, which leveled off at ~100 ft. The coral cover was low, with the majority of space taken up by algae (macro, turf, cyano). Overall relief was minimal. The vermetid gastropod *Dendropoma maxima* was moderately abundant whenever colonies of massive scleractinian corals were present, as was the polycheate *Spirobranchus* sp. The crustacean order decapoda was well represented, with coral-associated snapping shrimp *Alpheus deuteropus* found in abundance, as well as unidentified hermit crabs and different species of Trapezid crabs. The ascidian *Rhopalaea* sp. was also found in large numbers on both transects. Larger macroinvertebrates included the echinoid *Echinostrephus aciculatus* and the asteroid *Acanthaster planci*. Overall, macroinvertebrate diversity was fairly low.

Site GUA 2
Site 2 was located off the southwestern coast of Guam, outside Fouha Bay. The bottom habitat was reef slope, with a dramatic dropoff at ~70-80 ft. Coral cover was extremely low, likely due to high levels of sedimentation. Bottom relief was low, with most of the substrate covered with algae or sediment. Macroinvertebrate abundance and diversity were low, and the dominant species were sessile individuals from the phyla Ascidiacea and Porifera. Some of the ascidians were not identified, but the ones that were, *Ascidia ornate* and *Polycarpa* sp., were present here but at none of the other surveyed sites. Several molluscs were also visible, such as the coral-eating snail *Coralliophila* sp. and multiple vermetids. Several large COTS were present, and abundance was higher at this site than any of the others surveyed.

Site GUA 3
Site 3 was located off the southern end of Guam, outside the Achang marine protected area (MPA). Bottom habitat was composed of a gradual reef slope dropping off at ~90 ft., with medium relief and high coral cover. Coral diversity was also high, as was algal diversity. This site had diverse macroinvertebrate fauna, as well as a large abundance of several species. Specifically, the urchin *Echinostrephus aciculatus* was present in great numbers, as was the vermetid gastropod *Dendropoma maxima*. Other prominent macroinvertebrates included the holothuroid *Holothuria edulis* and the gastropods *Trochus noctilus*, *Lambis* sp., *and Tridacna maxima*. Smaller molluscs also were common, including the vivid nudibranch *Phyllidia* sp. Also present were the alcyonacean soft corals *Dendronephthya* sp. and *Stereonephthya* sp., both observed only at this surveyed site.

Site GUA 4
Site 4 was located outside the Tumon Bay MPA, off the midwestern coast of Guam. Bottom habitat was composed of a gradual reef slope, with both high relief and coral cover. Occasional coral towers and sand channels were also observed. Holothuroids were the dominant macroinvertebrate at this site, with both *Holothuria whitmaei* and *Stichopus chloronotus* found in abundance. The asteroid *Linckia guildingi* was also moderately abundant. Sessile species included sponges and the alcyonacean soft corals *Lobophytum* sp. and *Sarcophyton* sp., all forming a low percentage of total cover. The opisthobranch *Thuridilla bayeri* was seen more

than once along the second transect, and the vermetid *Dendropoma maxima* was again prevalent in association with massive hard corals.

Site GUA 7
Site 7 was located off of Padi Point, on the northeastern shore of Guam. Bottom type was reef slope. Coral cover and algal cover were both high, as was bottom relief. In addition, branching corals were seen more often than at most other sites surveyed. Coral-associated macroinvertebrates, such as the burrowing vermetid *Dendropoma maxima*, the polycheate *Spirobranchus* sp. and the coral hermit crab *Paguritta* sp. were observed in abundance. The alcyonacean soft corals *Sinularia* sp. and *Lobophytum* sp. also formed a higher portion of total cover than at any of the other sites surveyed. Other notable species included the ophiuroid *Opiothrix purpurea* and the snail *Drupella* sp.

Site GUA 8
Site 8 was located north of the golf course in Mangilao, off the mideastern coast of Guam. This site's coral cover and diversity were as high, if not higher, than the previous site (GUA 7). The bottom type was spur and groove reef, with sand channels dropping to ~60 ft. Soft coral species were again present, as were other coral-associated invertebrates, including the snapping shrimp *Alpheus deuteropus*, the vermetid *Dendropoma maxima*, and the serpullid *Spirobranchus* sp. Other notable species included the fire coral *Millepora* sp., the colorful asteroid *Linckia multifora*, and several trapezid crabs.

Site GUA 9
Site 8 was located off of Jinappsan beach on the far northeastern shore of Guam. Coral cover rivaled the last two sites (GUA 7 & 8), while bottom relief was the highest of the three. The bottom type was spur and groove reef, with sand channels at ~60 ft. While the soft corals *Lobophytum* sp. and *Sinularia* sp. were again present, overall macroinvertebrate diversity and abundance were low. A few large COTS were present on the first transect, as was the asteroid *Echinaster luzonicus*. Other species of note included the ophiuroid *Opiocoma pica* and the crab *Carpilius* sp., both observed solely at this site.

Site GUA 10
Site 10 was located outside the southern edge of the Piti Bombholes MPA, on the midwestern shore of Guam. The bottom type was a gradual reef slope. The coral cover and bottom relief were both low, with most of the substrate either exposed or covered with algae. Large, conspicuous macroinvertebrates dominated this site, with holothuroid diversity higher than any other surveyed site. Specifically, *Stichopus chloronotus* was present in high abundance, while *Actinopyga echinites*, *Bohadschia argus*, and *Thelenota ananas* were also observed. In addition, several *Linckia laevigata* were visible on the first transect, contrasted with a few large COTS seen on the second transect. The alcyonacean soft corals *Lobophytum* sp. and *Sarcophyton* sp. were again present, as were the coral-associated vermetid *Dendropoma maxima* and other unidentified vermetids.

Site GUA 11
Site 11 was located north of Pago Bay, off the mideastern shore of Guam. The bottom type was reef slope, dropping to ~60 ft. before leveling off. Bottom relief was minimal, with the majority

of substrate overgrown with algae. The only site with lower coral cover was GUA 2. Macroinvertebrate diversity was also low, with members of the phyla Crustacea and Echinoidea being the most abundant. The urchins *Echinothrix calamaris* and *Echinostrephus aciculatus* were both observed in great numbers. The coral-associated decapods *Trapezia* sp. and *Paguritta* sp. were also prolific, as were *Calcinus* sp. and other species of hermit crab. Other species of note included the crab *Etisus* sp. and the polyclad worm *Thysanozoon nigropapillosum*, which was present at a few previous sites.

Site SAN 1 & 2

Both of these sites were located on the Santa Rosa Banks, an area lying 30+ miles southwest of the southern tip of Guam. SAN 1 and 2 were both in ~30-60 ft. of water. Coral cover and relief were both minimal, while algae grew in abundance. Bottom contours formed large mounds separated by channels of exposed rock. This surveyor was unable to collect data because of dive-related issues, but observations were taken from other members of the REA teams. Divers recalled seeing small colonies of sponges, as well as the molluscs *Tridacna* sp., *Phyllidia* sp, and the cephalopod *Octopus* sp. The crustaceans *Etisus* sp. and *Trapezia* sp. were also observed, as well as a species of brachyuran crab. In addition, the echinoids *Diadema savignyi*, *Echinomerta mathaei*, *Echinostrephus aciculatus*, and *Echinothrix calamaris* were identified from pictures taken during the surveys.

	GUA 1	GUA 2	GUA 3	GUA 4	GUA 7	GUA 8	GUA 9	GUA 10	GUA 11	SAN 1 & 2*
PORIFERA										
Porifera spp	+	+	+	+	+	+	+	+	+	+
CNIDARIA										
Actinaria		+								
Dendronephthya sp.			+							
Heteractis spp.				+					+	
Hydroida	+		+	+	+	+	+			
Lobophytum sp.				+	+	+	+	+	+	
Millepora spp.			+			+				
Sarcophyton sp.		+		+				+		
Sinularia spp.			+		+	+	+	+		
Stereonephthya sp.			+							
POLYCHAETA										
Chaetopterus spp.			+	+		+			+	
Loima medusa						+		+		
Polychaeta									+	
Sabellidae		+	+			+				
Spirobranchus spp.	+	+	+	+	+	+	+	+	+	
MOLLUSCA										
Charonia tritonis	+									
Conus imperialis			+		+					
Conus spp.							+		+	
Coralliophila sp.		+								
Cypraea spp.		+							+	
Dendropoma maxima	+		+	+	+	+	+	+	+	

	GUA 1	GUA 2	GUA 3	GUA 4	GUA 7	GUA 8	GUA 9	GUA 10	GUA 11	SAN 1 & 2*
Drupella spp.					+					
Gastropoda							+			
Lambis sp.			+							
Octopus sp.		+								+
Phyllidia spp.		+	+	+	+					+
Phyllidiella spp.				+				+		
Prosobranchia		+			+				+	
Opisthobranchia	+									
Thuridilla bayeri			+	+			+	+		
Thysanozoon nigropapillosum			+			+			+	
Tridacna spp.			+	+	+	+	+	+	+	+
Trochus niloticus	+		+	+						
Vermetidae		+	+		+			+		
CRUSTACEA										
Alpheus deuteropus	+		+	+	+	+	+			
Brachyura					+					
Calcinus spp.									+	
Carpilius spp.							+			
Decapoda - hermit crabs	+	+		+	+	+		+	+	
Decapoda - shrimp							+			
Etisus spp.									+	+
Odontodactylus scyllarus	+									
Paguritta spp.		+	+	+	+	+	+	+	+	
Trapezia lutea						+				
Trapezia rubropunctata	+		+							
Trapezia spp.	+					+			+	+
ECHINOIDEA										
Diadema savignyi										+
Echinomerta mathaei									+	+
Echinostrephus aciculatus	+	+	+	+	+	+	+	+	+	+
Echinothrix calamaris									+	+
Echinothrix diadema			+							
OPHIUROIDEA										
Ophiocoma pica							+			
Ophiothrix purpurea					+		+			
Ophiuroid sp.	+	+								
ASTEROIDEA										
Acanthaster planci	+	+		+	+		+	+		
Echinaster luzonicus							+			
Linckia guildingi				+						
Linckia laevigata		+		+				+		
Linckia multifora	+					+				
HOLOTHUROIDEA										
Actinopyga echinites		+						+		

	GUA 1	GUA 2	GUA 3	GUA 4	GUA 7	GUA 8	GUA 9	GUA 10	GUA 11	SAN 1 & 2*
Bohadschia argus			+					+		
Holothuria edulis			+							
Holothuria whitmaei				+						
Stichopus chloronotus				+	+			+		
Thelenota ananas								+		
ASCIDIACEA										
Ascidiacean		+								
Ascidia ornate		+								
Polycarpa sp.		+								
Rhopalaea spp.	+	+		+						

*** See site description for explanation of data collection**

Appendix E. Towed-Diver Fish/Habitat Activity Summary (Jake Asher, Molly Timmers, Ben Richards, and Craig Musburger)

Shallow water habitats were surveyed using pairs of towed divers on towboards equipped with a downward high resolution digital still camera with dual strobes (benthic towboard) and forward-looking digital video camera (fish towboard) to quantify habitat composition and complexity and abundance and distribution of ecologically and economically important fish and macroinvertebrate taxa. The downward-looking camera was maintained 1-2 m off the bottom and was programmed to photograph benthic substrate every 15 seconds. The diver on the benthic towboard observed and recorded habitat composition (hard coral, stressed hard, soft coral, macroalgae, coralline algae, sand and rubble) and tallied conspicuous macroinvertebrates (crown-of-thorns starfish (COTS), urchins, sea cucumbers, and giant clams) along a 10-m swath. The diver on the fish towboard recorded fish greater than 50 cm total length along a 10-m swath for 4 minutes followed by a 1 minute all around search in the same 5-minute ensembles. Both towboards were instrumented with precision temperature and depth recorders (Seabird SBE39). GPS positions, temperature, and depth were recorded every 5 s along each transect. The data were downloaded and presented in ArcView GIS and overlaid on high resolution IKONOS imagery. Each tow was approximately 50 minutes long and covered approximately 2 km of habitat.

During this survey period, a total of 26 towed-diver surveys were conducted around Guam and Santa Rosa Reef covering a total of 61.6 km of habitat. (See Table 1)

Island	**Surveyed Km**	**# of Tows**
Guam	54.5	23
Santa Rosa Reef	7.10	3
Total	**61.6**	**26**

Benthic Observations: (Jake Asher and Molly Timmers)

Guam

Hard coral cover south of Apra Harbor to Cocos Island was generally low, ranging from 1 to 20%. However, a survey transect along the southern coast of Cocos Island showed an increase in hard coral cover, ranging from 40 to 62.5%. The majority of stressed hard coral through all surveys remained at $\leq$ 1%. A singular exception was noted just south of Apra Harbor, which noted 5-20% stressed coral in the vicinity of a localized increase in COTs (24 between two time segments) and a local increase in water temperature (87^{o}F). Soft coral cover was also low through these surveys, ranging from 1 to 5% with a singular 10% exception.

Surveys north of Apra Harbor found increased hard coral cover near Adelup Point, Agana Bay and around Tumon Bay, with cover ranging from 5 to 50%. Large *Montastrea* mounds and monotypic stands of *Porites rus* were noted for the area between Adelup Point and Agana Bay. Haputo Point, which is a small arms safety drop zone, was also an area of high coral cover ranging from 40 to 62.5%, with *Porites lobata* being the prevalent hard coral encountered. The

frequency of stressed hard coral remained between 1 and 5% for most surveys. Soft coral cover remained low, typically ranging from 1 to 5%.

Hard coral cover was surprisingly prevalent in a number of other locations around Guam. The northern coast and portions of the northeastern coast had high diversity in some places, with four out of six transects recording up to 62.5% hard coral cover coverage. High coral coverage was also recorded along three tows conducted between Tagachan Point and Jalaihai Point with percentages ranging from 20 to 75%. Fields of wire corals were also noted between these two points. Although hard coral coverage was high in this area, the amount of stress on these corals was up to 50% during several tow segments. Factors for these stressed corals included disease, sedimentation, and predation. COTS predation was the greatest between Togcha and Talofofo Bay. Divers recorded over 100 COTS during a 5-minute segment of a tow just south of Togcha Bay. In 2003 no COTS were recorded along tows between Togcha and Talofofo Bay. This year 223 COTS were observed.

Giant clam observations were relatively uncommon during surveys around Guam, typically ranging from 0 to 4 clams recorded. The exception was one tow survey in Agat Bay which recorded 20 giant clams during the 50-minute tow.

Additional observations included the sighting of a large trawl or seine net, located in 70-100 feet of water and extending deeper to an undetermined depth, during the southern survey of Cocos Island. An area of damaged coral was noted in shallower water upslope of the net, suggesting that it had previously tumbled to deeper water.

Santa Rosa Reef

Santa Rosa Reef was characterized by low hard coral cover, ranging from 1 to 10% for two out of three surveys. The third tow recorded a range of coral cover from 10 to 30%. Stressed hard corals never exceeded 1% for all recorded hard coral cover. Soft corals were generally uncommon and were recorded from 1 to 5% total bottom cover. There were no recorded observations of crown-of-thorns starfish. Finally, giant clams were also infrequent, with two, four, and seven clams recorded for each respective survey.

Fish Observations: (Ben Richards and Craig Musburger)

In 5 days of field work, a total of 26 towed-diver surveys were conducted at Guam and Santa Rosa Reef. Both of these locations showed a paucity of fish when compared to other areas of the Marianas Archipelago. All told, a total of 39 individuals greater than 50 cm overall length were seen. The most numerically abundant species were the Twinspot Snapper (*Lutjanus bohar*) and the Spotted Sweetlips (*Plectrohinchus picus*) with six individuals each followed by the Spotted Eagle Ray (*Aetobatis narinari*) and Humphead Wrasse or Napoleonfish (*Cheilinus undulatus*) with four individuals. It is fair to note that the sightings of *Plectrohinchus picus* and *Aetobatis narinari* occurred on single dives. The only truly unusual observation was the dramatically low number of large fishes seen.

SP_Code	GUA	SAN	Grand Total
PLPI		6	6
LUBO	5	1	6
AENA	4		4
CHUD	4		4
DIHY	1	2	3
URAR	1	1	2
NATO	2		2
VALO	1		1
CALU	1		1
GYSP	1		1
SPBA	1		1
APVI	1		1
FICO	1		1
PLAR	1		1
PLEC	1		1
ARHI	1		1
GYJA	0		0
LEOL	0		0
Grand Total	*26*	*10*	*36*

Appendix F. (Jamison Gove, Danny Merritt, Olliver Dameron, Kyle Hogrefe, and Phil White)

The volcanic island arc/subduction zone topography and associated steep slopes of Guam and the Marianas Archipelago greatly modify the near-shore oceanographic conditions of the islands. Sea-water chemistry fluctuations because of freshwater inputs, terrigineous runoff, anthropogenic sources and the upwelling of subsurface waters potentially influence nutrient levels and biological productivity in Guam's near-shore coral reef ecosystem; however, the effects of these inputs and the associated ecosystem response are poorly understood. Seasonal, interannual, and climatic variability as well as episodic events, such as typhoons and nearby volcanic eruptions, likely affect Guam's marine ecosystem and require further investigation. In order to better understand the linkages between oceanography and ecology, scientists on board are taking a two pronged approach: 1) conduct intensive assessment of oceanographic conditions and water quality parameters at each island, simultaneously with ecological assessments, and 2) maintain existing long-term monitoring stations established during MARAMP 2003, enhanced by deployment of selected new stations.

Intensive oceanographic assessments at each island and throughout the archipelago are accomplished by:

1. Shallow water (~30-m water depth) conductivity (salinity), temperature, and depth (CTD) profiles, including transmissometry (water clarity) measurements, at regular intervals around the islands, which provides information on small scale distributions of water masses, circulation, and local seawater chemistry changes.
2. Shallow water chlorophyll and nutrients samples collected at 1-m, 10-m, 20-m, and 30-m water depths at regular intervals around selected islands. This links water quality with water masses and provides insight into localized nutrient enrichment and/or eutrophication.
3. Shipboard (> 500-m water depth) CTDs and ADCP (acoustic Doppler current profiler) transects around each island and in surrounding waters. This provides information on overall oceanographic structure, including dissolved oxygen and chlorophyll, and circulation patterns surrounding the islands.
4. Shipboard chlorophyll, nutrient, and dissolved inorganic carbon (DIC) samples taken at 3 m, 80 m, 100 m, 125 m, and 150 m at shipboard CTD locations around the islands and in surrounding waters. This provides ground truth information for the CTD profiles as well as insight into local nutrient levels and local carbon cycles.
5. Continuous recording of surface and subsurface water temperatures as a function of depth during all towed-diver operations, providing a broad and diverse spatial and thermal sampling method. Refer to the Towed-Diver Habitat/Fish Survey Team Activity summary information.

Long-term oceanographic monitoring will be accomplished by deploying a variety of both internally recording and near real-time telemetered instrument platforms and oceanic drifters. These instruments include:

1. Coral Reef Early Warning System (CREWS) Buoys: Surface buoys measuring the primary meteorological and oceanographic parameters, as well as solar irradiance measurements. These buoys telemeter their data in near real-time.

2. Sea Surface Temperature (SST) Buoys: Surface buoys measuring high-resolution water temperature. These buoys telemeter their data in near real-time.
3. Wave and Tide Recorders (WTRs) measure subsurface temperatures, spectral wave energy, and high precision tidal elevation.
4. Subsurface Temperature Recorders (STRs) measure high-resolution subsurface temperatures.
5. Satellite Drifters, Lagrangian devices providing surface layer circulation information and water temperatures. The drifters telemeter their data in near real-time.
6. Ocean Data Platforms (ODPs) record high-resolution spectral wave energy, current direction and velocity, and subsurface temperatures.

Moorings, shallow water CTDs and water samples are collected from a small boat during daylight hours. Shipboard CTD, ADCP, and shipboard water samples are typically collected during nighttime hours and are generally termed "Night Ops," along with bioacoustics data collection that is addressed in another section.

Site Summary:

A brief log of data collection follows. An overview is also given in tables following this section. For brevity, temperature data collected during towboard operations have been omitted:

Guam:
Small boat oceanographic operations were conducted in the near-shore waters of Guam on the 3rd-5th and 8th of October. In the 4-day period, a total of 83 shallow water CTD casts and 10 water sample profiles (40 samples total) were obtained around the perimeter of the island. The 10 water samples were taken at 8 sites (one site was a triplicate). Three of the water sample profiles were colocated with REA locations. The SST buoy deployed in Tumon Bay during the 2003 MARAMP cruise became detached from its mooring in late May 2004 and was picked up by Guam's Department of Aquatic and Wildlife Resources. The buoy will be retrieved during the *Oscar Sette*'s upcoming port call in Guam. A new SST buoy was deployed at a location in the northern portion of Tumon Bay less exposed to large swell events. There were no previously existing STRs in place but three STRs were deployed; one just southeast of the northern tip of Guam at REA site 9, one near the anchor of the newly deployed SST buoy in Tumon Bay and 1.3 kilometers north of REA site 4, and one at the southern tip of the island near REA site 3.

Over the course of 3 nights (Oct. 3 - 5), 11 shipboard CTD casts were performed collecting water samples at each site for a total of 55 nutrient, 55 chlorophyll, and 12 DIC samples collected. Six of the sites were located on the corners and at midpoints of the ADCP box transect completed around the island. The remaining five casts were conducted along a Pacific Marine Environmental Laboratory (PMEL) transect north of the island running from the northwest to the southeast which closed the northern portion of the transect. Additionally, the northeasternmost cast site was sampled on both 4 and 5 October for replicate sampling, and on the second night triplicate samples were collected from each sample depth.

Shipboard data collection on the night of 4 October focused on bioacoustics data.

Galvez Banks:
On October 6, five shipboard CTD casts were performed on the corners of the ADCP box transect around the bank. At the northeast corner of the bank, chlorophyll samples were collected during all casts while nutrient and DIC samples were collected on replicate casts. The total number gathered were 10 nutrient, 25 chlorophyll, and 4 DIC samples. One of the replicate casts was conducted at ~1300 and the other at ~0300 for a day/night comparison. Nutrient sampling was discontinued because of a shortage of sampling bottles and the prioritization of their use on the Wake Island leg.

Santa Rosa Reef:
Small boat oceanographic operations were conducted on the 7th of October and consisted of a single instrument replacement. The ODP deployed at Santa Rosa Reef during the 2003 MARAMP cruise was recovered and replaced with a new ODP at the same location. As the ODP anchor was deemed to be in good condition, only the instrument plate was replaced.

Four shipboard CTD casts were performed on the corners of the ADCP box transect around the reef. Chlorophyll samples were collected during all casts and total gathered were 20 chlorophyll samples. Nutrient sampling was discontinued because of a shortage of sampling bottles and the prioritization of their use on the Wake Island leg.

Table 1: Instrumentation Summary

Site	SST	STR	ODP	Comments
Guam	1	3	-	Previously deployed SST broke free last year and was recovered by DAWR. New SST was deployed a few km to the north of old location. Three new STR deployments were made
Galvez Bank	-	-	-	No small boat oceanographic operations
Santa Rosa Reef	-	-	1	Existing ODP was recovered and replaced with a new ODP in the same location.

Note: All instrumentation numbers represent replacement deployments unless otherwise indicated in the comments column.

Acronyms: ODP = Ocean Data Platform, SST = Sea Surface Temperature (buoy), STR = Subsurface Temperature Recorder

Table 2: Shallow Water Oceanographic Sampling Summary

Site	CTD sites	Water sample sites	Chlorophyll samples collected	Nutrient samples collected	Comments
Guam	83	10	40	40	This is a water sampling area of focus.
Galvez Bank	-	-	-	-	No small boat oceanographic operations were performed
Santa Rosa Reef	-	-	-	-	Area well covered by shipboard CTDs/ADCP

Note: all water sample sites are concurrent with CTD sites.

Table 3: Shipboard Oceanographic Sampling Summary

Site	CTD sites	Water sample sites	Chlorophyll samples collected	Nutrient samples collected	DIC samples collected	Comments
Guam	11	11	55	55	12	CTD profiles and concurrent water samples were obtained on the corners and mid points of an ADCP box transect around the island over 3 nights. A PMEL transect was completed and constitutes the N line of the box transect. Replicate nighttime casts were conducted on the NE corner with triplicate samples collected on the second cast.
Galvez Bank	5	5	25	10	4	CTD profiles and concurrent water samples were obtained on the corners of an ADCP box transect around the bank. Replicate casts were performed at the NE corner for a day/night comparison. Nutrient sampling discontinued after second cast.
Santa Rosa Reef	4	4	20	-	-	CTD profiles and concurrent water samples were obtained on the corners of an ADCP box transect around the reef. Nutrient sampling discontinued.

Note: all water sample sites are concurrent with CTD sites.

Appendix G. Bioacoustic Surveys (Kyle Hogrefe and Phil White [data collected for Marc Lammers])

Sound-scattering layers (SSLs) are communities of organisms composed of various combinations of zooplankton, planktonic larvae, and micronekton. SSLs are found in many parts of the world's oceans and are characterized by a diel vertical migration from daytime subphotic habitats into surface waters at night. Since 2003, nightly migrations of nearshore SSLs into shallow water habitats have been documented at nearly all locations surveyed during RAMP cruises. This suggests that an important trophic link exists between coral reefs and the biomass occurring at the boundary between the neritic and pelagic habitats, commonly referred to as the mesopelagic boundary community (MBC). The goals of the bioacoustics effort are to collect physical samples and video images of the organisms that comprise the MBC, further document the diel migration of the MBC, and to collect oceanographic data to help gain a better understanding of the interaction between the coral reef habitat and the MBC as it occurs near the islands and atolls throughout the Mariana Islands Archipelago.

The four objectives of the bioacoustics effort are as follows (in order of priority):

1. Obtain biological samples of MBC organisms around island/atoll slopes and in the water column over coral reef banks using an IKMT trawl net, with an effort to sample from layers occurring at different depths in the water column. This is because some organisms, such as micronekton, may limit the extent of their vertical and horizontal migrations.

2. Document the diel migration of mid-water biota near the different islands and atolls of the Mariana Islands by utilizing an EK60 echosounder as on previous RAMP cruises across the Pacific. This is accomplished by sampling preset transect lines, both during the day and at the midpoint of the night, to establish the presence or absence of the MBC and document its vertical and horizontal migration.

3. Obtain data on the properties of the water column where MBCs are observed using deep water CTD casts that include water sample profiles. One CTD cast is usually conducted along or near the transect line sampled acoustically. Acoustic Doppler current profiles may also serve to explain the distribution of the MBC around islands, atolls, and banks.

4. Obtain video recordings with a cabled video camera that is able to capture images in depths of up to 75 meters of the organisms of the MBC in shallow water conditions where a trawl is not feasible,.

Site Summary:

Note: Great effort is being made to collect physical specimens, bioacoustics data, and oceanographic data that may affect the MBC, but the collection of ADCP/CTD/water sampling data in accordance with established CRED protocols has been prioritized over the bioacoustics effort during night operations. However, these oceanographic data are collected in close proximity to MBC sampling activity and should support the effort to understand MBC

interactions with reef communities. All daytime survey activity and BOTCAM operations take precedence over any night operations.

A brief log of data collection follows. Overview is also given by tables following this section.

Guam:
Thirteen EK60 transects were conducted: one during the day, nine at night, and three during trawls. The daytime and first night transect were situated off the northeast coast of the island on the night of October 5-6 and were not repeated or trawled. The majority of the bioacoustics activity occurred off the south and southwest coast of the island on the night of October 8–9. Early evening EK60 transects proceeded to the south and east along transects "Guam EK60 008, 007, 006, and 005" with no MBC apparent. On the return trip, more or less along the same course, "Guam EK60 005" was moved another ¼ nmi offshore and the MBC was obvious. It was also very apparent on the reverse runs of transects "Guam EK60 007 and 008 which occurred later than 2300. IKMT trawls were conducted on this sign and samples of the MBC were collected from each trawl. However, as the last trawl was brought aboard, the bottom of the PVC codend popped out and the sample went all over the deck. The scientist and technician conducting the trawl spent ~ 45 minutes salvaging the sample, but many of the smaller organisms were lost.

Galvez Banks:
Five EK60 transects were conducted, all of them at night on October 6-7. We saw some marginal sign at the south end of transect "Galvez EK60 001," but decided to run the next EK60 transect since it would set us up in a good position to conduct the final CTD of our plan, run the final ADCP leg back toward the MBC sign, and then attempt a trawl. The sign was gone once we returned at 0300.

Santa Rosa Reef:
Five EK60 transects were conducted, two during the day and three at night. The day transected were repeated at night. We had the IKMT trawl ready, but we did not see any good MBC sign on which to trawl.

Table 1: Bioacoustics Sampling Summary

Site	EK60 Day Transects	EK60 Night Transects	EK60 Trawl Transects	IKMT Trawl Samples	CTD / ADCP / Water samples	Comments
Guam	1	9	3	3	Nearby	Repeat transects run with evidence of MBC migration. Trawl samples collected and frozen.
Galvez Banks	0	5	0	0	Nearby	No good MBC sign on which to trawl.
Santa Rosa Reef	2	3	0	0	Nearby	No good MBC sign on which to trawl.

Appendix H. Bottomfish Baited Camera (BotCam) Trials: Summary (Danny Merritt and Michael Parke)

From October 3 to October 8, 2005, the BotCam was deployed 11 times – 4 drops at Guam, 3 drops at Galvez Banks, and 4 drops at Santa Rosa Bank. In addition, a stereo-video calibration was performed for all video collected with this system to date.

With the exception of two drops at Santa Rosa Bank, very few fish were seen. The primary species seen were kalekale and opakapaka. Gindai were also at multiple locations but in small numbers. Several Dog Tooth Tuna were also seen ranging from 71 meters to 238 meters.

On two occasions, GUA01 and GUA03, the BotCam was dropped on relatively flat (<30 degrees), soft sediment plains and no fish were seen. The most productive sites that were readily filmed appeared to be slopes between 40 and 70 degrees with hard bottoms and high relief.

The lines on the video persisted through this leg but it seems that the problem is most likely related to power issues as the problem was always found to be worse as the video progressed. Cable routing was also identified as a possible problem.

The early bait release problem and nonprogrammed video recording issue also seemed to have been solved. It appeared that the industrial timer needed to be placed in the override off (O) position during programming. If this had not been done, the unit prematurely turned on and started the BWR. This took valuable Viperfish Deep battery time and caused the bait to be released before recording started.

Because of an extremely steep slope combined with a strong subsurface current, drop GUA02 never reached the bottom. A recovery was attempted with the BotCam surface line still attached to the gypsy head. The deck crew felt the anchors were causing too much strain on the surface line so the acoustic signal was sent to release the concrete anchor blocks. This caused the BotCam to surface directly beneath the boat. Divers were deployed to free the BotCam and surface line from the Ships propellers and propeller shafts. It is not recommended that the ship attempt a recovery of the BotCam until the unit is on the surface unless the ship is safe while dead-in-the-water.

Drop GAL03 resulted in another problem. The steep edges of Galvez Bank made it very difficult to locate suitable drop locations. A drop was started at approximately 180 meters. During deployment, the ship and BotCam were moved onto the bank by the current and wind. The BotCam hit the bottom at just 50 fathoms (~ 2.5 sections of line). The remaining 190 fathoms of line was then pulled out. With about 80 fathoms of line remaining on the ship, the line began tending under the ship; therefore, the line weight was added with 60 fathoms of line remaining. This likely caused the line weight to hit the bottom. When a recovery was attempted a few hours later, the BotCam did not return to the surface. The acoustic signal was sent several times from various locations with no surfacing. Therefore, with daylight fading, a manual recovery was attempted with the ship. The surface line was attached to the gypsy head and hauled up. The line weight came up missing and the line still had tension with 80 fathoms of line

on board. With about 100 fathoms of line aboard, the BotCam was briefly spotted on the surface but with continued hauling, it again disappeared underwater. It was assumed the surface line was caught on the bottom, therefore, one section of surface line was put back in the water and the floats were reattached. The BotCam did not reappear so a small boat was deployed with divers to search for the BotCam. The BotCam was eventually found submerged approximately 1 meter below the surface. The unit was unclipped from the surface line and brought back to the ship. The surface line was then able to be recovered. No damage was done to the BotCam. The line weight should never be placed on the line deeper than the bottom and no more than a two to one scope should be used on the surface line.

The first drop at Santa Rosa Bank ended up in water that was too deep (246 m) for the early morning light (7:30 am) to provide adequate illumination for the BOTCAM video.
The last drop at Santa Rosa provided no video because the camera timer was set improperly.

Efficient deployment of the BOTCAM from the *Oscar Elton Sette (OES)* presented a few challenges. Without detailed bathymetry, it is difficult for the scientists to select study sites that meet the proper criteria, and is also difficult for the *OES* operators to approach any areas that may have narrow contours and are closer to land or shallow areas. A winch that is optimized for BOTCAM line deployment and retrieval would cut possibly 45 minutes off of deployment and retrieval time. Because of the lack of rapid maneuverability of the *OES*, certain potential sites could not be surveyed due to the fact that the OES could not risk being dead in the water during deployment and retrieval. Perhaps a small boat with a removable pot-hauler could be dedicated for BOTCAM use if we plan to deploy multiple units. Finally, multiple deployments of the BOTCAM from the *OES* may be possible, but scheduling such deployments around the other CRED operational demands will remain a constraining factor.

Tables 1 and 2 below summarize the drops from MARAMP 2005 Leg III.

TABLE 1. BOTCAM FIELD LOG - MARAMP 2005 OES0512 Leg III

Time, Date and Location - On Bottom											Record Time				Time, Date and Location - Recovery				
Date (UTC)	Location Name	Drop #	Acoustic Release Serial Number (S/N)	RF 700C1 Frequency	Latitude	Longitude	Date (UTC)	Time (UTC)	Depth Sounding (fa)	# Surface Line Sections Used	Start Date (UTC)	Start Time (UTC)	Stop Date (UTC)	Stop Time (UTC)	Latitude	Longitude	Date (UTC)	Time (UTC)	Comment
10/4/2005	Guam	GUA01	198	154.585	N 13 39.637	E 144 50.584	10/4/2005	1409	197m	12	10/4/2005	0420	10/4/2005	0455	N 13 39.398	E 144 50.300	10/4/2005	1805	
10/5/2005	Guam	GUA02	198	154.585						12									Unit drop near shear wall with strong current. Unit did not hit bottom and a recovery was attempted. The anchors were released and the BotCam surfaced underneath the ship. Divers were deployed in order to free the BotCam from the ships props and shafts
10/5/2005	Galvez Banks	GAL01	198	154.585	N 13 06.064	E 144 29.078	10/5/2005	2202	125m	12	10/5/2005	2215	10/5/2005	2250	N 13 05.700	E 144 29.200	10/5/2005	?	
10/6/2005	Galvez Banks	GAL02	198	154.585	N 13 05.794	E 144 29.414	10/6/2005	0024	98m	12	10/6/2005	0030	10/6/2005	0105	N 13 06.160	E 144 29.107	10/6/2005	0152	
10/6/2005	Galvez Banks	GAL03	198	154.585	N 13 05.603	E 144 29.119	10/6/2005	0212	60m	12	10/6/2005	0230	10/6/2005	0305	N 13 05.736	E 144 29.186	10/6/2005	0800	Unit was deployed while ship was in approximately 180 meters of water but drifting onto the bank. The unit hit the bottom with only 50 fathoms (2.5 sections of line) of line in the water. The remainder of the 12 sections were put in the water. With onl
10/6/2005	Santa Rosa Banks	SAN01	198	154.585	N 12 47.676	E 144 26.431	10/6/2005	2147	246m	12	10/6/2005	2240	10/6/2005	2315					Early morning drop was too deep. Video too dark.
10/7/2005	Santa Rosa Banks	SAN02	198	154.585	N 12 47.930	E 144 26.538	10/7/2005	0158	121	12	10/7/2005		10/7/2005		N 12 47.743	E 144 25.941	10/7/2005	0333	Only one half of bait container open. Fish seem to linger around bait can as bait lasts longer.
10/7/2005	Santa Rosa Banks	SAN03	198	154.585	N 12 47.716	E 144 25.958	10/7/2005	0358	201	12	10/7/2005		10/7/2005		N 12 47.644	E 144 25.643	10/7/2005	0550	
10/7/2005	Santa Rosa Banks	SAN04	198	154.585	N 121 48.719	E 144 24.619	10/7/2005	0622	206 m	12	10/7/2005		10//7/05		N 12 48.797	E 144 24.739	10/7/2005	0834	Timer not set properly. No video.
10/8/2005	Guam	GUA03	198	154.585	N 13 16.267	E 144 45.951	10/8/2005	0:40	200m	12	10/8/2005	00:50	10/8/2005	1:25	N 13 16.536	E 144 46.046	10/8/2005	0200	
10/8/2005	Guam	GUA04	198	154.585	N 13 20.639	E 144 37.518	10/8/2005	4:55	155m	12	10/8/2005	5:15	10/8/2005	5:50	N 13 20.601	E 144 37.410	10/8/2005	0652	

TABLE 2. PRELIMINARY BOTCAM DATA ANALYSIS - MARAMP 2005 OES0512 Leg III

								Species Identified											
#	Date	Drop Location	Drop #	Seabird Pressure (dbar)	Seabird Temp. (deg. C)	Bottom Description	Slope (degrees)	Onaga	Opakapaka	Ehu	Gindai	Kalekale	Lehi	Grouper	Butaguchi	Kahala	Hogo	Other	Deployment Notes
32	10/4/2005	Guam	GUA01	203	15.6	Gentle slope, soft bottom, possible light biological covering	20 to 30												Featureless plain, no fish
33	10/5/2005	Guam	GUA02																Did not hit bottom, emergency recovery, video of bottom of Ship
34	10/6/2005	Galvez Banks	GAL01	285	14.5	Hard bottom with biological cover. Channels and rocky outcrops and small sediment patches	45				x								
35	10/6/2005	Galvez Banks	GAL02	238	14.5	Hard Bottom, Very Steep, Anemone, Gorgonians, Resting on Cave Like Features	45 +											Big Dog Tooth Tuna, Small Unidentified On Bottom	
36	10/6/2005	Galvez Banks	GAL03	72	28.2	Near edge of Bank, Good Coral Cover	40 to 75											Grey Reef Shark, Emporer, Multiple Unidentified Reef Fish, Dog Tooth Tuna, Black Jack,	
37	10/7/2005	Santa Rosa Bank	SAN01	385	9.0														Too Deep. Video too dark to identify anything.
38	10/7/2005	Santa Rosa Bank	SAN02	194	20.5	Hard Bottom, many small and mid-size rocks.	45		x		x	x						Small Unidentified Dark Fish, Black Jack,	
39	10/7/2005	Santa Rosa Bank	SAN03	214	16.4	Hard Bottom with thin sediment cover, small bank in background, small rocks	30 to 40	x			x	x						Dog Tooth Tuna, Grey Reef Shark?,	
40	10/7/2005	Santa Rosa Bank	SAN04	206	18.9														Camera timer set improperly. No video
41	10/8/2005	Guam	GUA03	214	17.7	Soft Bottom, Gentle Slope, No Features	20 to 30												No Fish
42	10/8/2005	Guam	GUA04	185	17.6	Hard Bottom, Small Rocks, Possible Biological Growth	45 +	x?					x						