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 05-10 (OES-32; Fig. 1) and Cruise 05-11 (OES-33; Fig. 2)

PERIOD: 16 August–1 October 2005

AREA OF OPERATION: Marianas Archipelago: (Saipan, Guguan, Pagan, Asuncion, Uracas, Maug, Supply Reef, Agrihan, Alamagan, Zelandia Bank, Sarigan, Anatahan, Pathfinder, Arakane, Tinian, Aguijan, and Rota)

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 Commonwealth of the Northern Marianas (CNMI) Archipelago. 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:

16 Aug. Embarked *Oscar Elton Sette* officers and crew (no scientists aboard). Departed Snug Harbor ~0900 to commence cruise OES-05-10, en route to Saipan.

17-30 Aug. Transited Honolulu to Saipan, with CRED field equipment and supplies. Arrived in Saipan, CNMI, ~0730, 30 August. End of transit cruise (OES-05-10).

[1] PIFSC Cruise Report CR-06-003
Issued 27 October 2006

30 Aug.-2 Sept.

Sette departed Saipan lagoon ~0830, on 30 August, en route to Apra Harbor, Guam, to wait out typhoon Nabi that passed just north of Saipan on 1 September (lost 1.5 days of sea time due to typhoon).

3 Sept. *Sette* returned to Saipan ~0900. Embarked Robert Schroeder (Chief Scientist/fish) and Joe Laughlin (towboard/fish), Mike Trianni (fish), Mike Tenorio (fish), Peter Houk (coral), John Iguel (coral), Alex Kerr (macroinvertebrates), Kim Page (algae), Fran Castro (algae), Stephani Holzwarth (towboard/fish), Molly Timmers (towboard/habitat), Elizabeth Keenan (towboard/habitat), Jamie Gove (oceanography), Ron Hoeke (oceanography), June Firing (oceanography), Danny Merritt (BOTCAM and oceanography), Jake Asher data management/divemaster), Qamar Schuyler (education specialist), and Rodney Hiekimen (chamber operator). Departed Saipan Harbor ~1300 to begin cruise (OES-05-11). Conducted shipboard orientation, dive safety management drills, and fire and abandon ship drills. All divers received neurological examinations and conducted decompression chamber dives.

4 Sept. Began field surveys around Saipan. Conducted six towed-diver habitat/fish surveys, three benthic and three fish rapid ecological assessment (REA) surveys. Conducted 15 shallow water conductivity (salinity), temperature, and depth (CTD) casts around the NW, N, NE, E and SE of Saipan. Conducted bottomfish digital stereo-camera bait system (BOTCAM) launch and recovery operations. Completed two EK60 bioacoustic transects. Departed Saipan around 2200 en route to Guguan Island.

5 Sept. Arrived Guguan Island at 0700. Conducted two towed-diver habitat/fish surveys, along with two benthic and one fish REA surveys. Three shipboard CTDs, two water sample sites (five samples each) were collected during acoustic Doppler current profiler (ADCP) transects around the island. Replaced one subsurface temperature recorder (STR), conducted BOTCAM deployment and recovery operations, and completed one bioacoustic survey around Guguan. Departed Guguan around 2200.

6-8 Sept. Arrived Pagan Island at 0700. Conducted 20 towed-diver habitat/fish surveys around the island perimeter, along with 9 fish and benthic REA surveys. Replaced an STR and a Sea Surface Temperature (SST) buoy. Four shipboard CTDs and 4 water sample sites (20 samples total) were visited along ADCP transects around the island at five bioacoustic transects. Completed two BOTCAM deployments and five bioacoustic transects. Departed Pagan Island around 2200 en route to Asuncion Island.

9 Sept. Arrived Asuncion Island at 0700. Conducted six towed-diver habitat/fish surveys, three benthic and three fish REA surveys. Replaced an STR. Three shipboard CTDs and 3 water sample sites (15 samples total) were collected during ADCP transects around the island. Completed one BOTCAM deployment and two bioacoustic transects. Departed Ascuncion around 2200 en route to Uracas Island.

10 Sept. Arrived Uracas at 0700. Conducted six towed-diver habitat/fish surveys, three benthic and three fish REA surveys. Deployed an STR at a new location, with the old STR presumed lost from storm events. Eight shipboard CTDs and 8 water sample sites (40 samples total) were collected during ADCP transects both around the island and around a nearby submarine mount/bank. Completed one BOTCAM deployment. Departed Uracas around 2200 en route to Maug Islands.

11-13 Sept. Arrived Maug Islands at 0700. Conducted 13 towed-diver habitat/fish surveys, along with nine benthic and nine fish REA surveys. Replaced a SST, one STR, and added three new STR sites. Completed 35 shallow water CTDs and 14 shallow water sampling sites (54 samples total) along ADCP transects. Completed a 50-nmi transect intersecting the Marianas Island chain, collecting DIC samples at six shipboard CTD stations. Completed two BOTCAM deployments and 13 EK60 bioacoustic transects. Conducted two Isaacs-Kidd midwater trawl (IKMT) deployments (lost/replaced cod end after completion of first trawl). Departed at 2200 en route to Supply Reef.

14 Sept. Arrived Supply Reef at 0700. Recovered and replaced wave and tide recorder (WTR). Completed four shipboard CTDs and 4 water sample sites (20 samples total) during ADCP transects around the reef. Completed three BOTCAM deployments. No towboard or REA surveys were conducted because of hazardous diving conditions (i.e., very strong currents). Departed Supply Reef around 2200 en route to Agrihan Island.

15 Sept. Arrived Agrihan Island at 0700. Conducted five towed-diver habitat/fish surveys, along with three benthic and three fish REA surveys. Collected 14 shallow water CTDs and replaced an STR. Completed two shipboard CTDs and 2 water sample sites (10 samples total) during ADCP transects around the island. Completed one BOTCAM deployment and one EK60 bioacoustic transect. Completed one IKMT survey. Departed Agrihan Island ~2200 en route to Alamagan Island.

16 Sept. Arrived Alamagan Island at 0700. Conducted six towed-diver habitat/fish surveys, along with three benthic and three fish REA surveys. Completed 15 shallow water CTDs and replaced an STR. Completed three shipboard CTDs and 3 water sample sites (15 samples total) during ADCP transects around the island. Completed one BOTCAM deployment and two EK60 bioacoustic transects. Completed one IKMT. Departed Alamagan Island 2200 en route to Zealandia Reef.

17 Sept. Arrived Zealandia Reef at 0700. Conducted one benthic and one fish REA. Additional REA surveys were limited because of hazardous diving conditions (shark aggression). Recovered and replaced WTR (tow/oceanography teams). Completed two shipboard CTDs and 2 water sample sites (10 samples total) during ADCP transects around the reef. Completed one BOTCAM deployment and two EK60 bioacoustic transects. Departed Zealandia Reef ~2200 en route to Sarigan Island.

18 Sept. Arrived Sarigan Island at 0700. Conducted five towed-diver habitat/fish surveys, along with three benthic and three fish REA surveys. Completed nine shallow water CTDs and one shallow water sampling site (four samples total). Replaced an STR. Completed two shipboard CTDs and 2 water sample sites (15 samples total) during ADCP transects around the island. Completed one BOTCAM deployment and four EK60 bioacoustic transects. Departed Sarigan Island 2200 en route to Saipan Island.

19 Sept. Arrived Saipan Island at 0800 (ship in port). Disembarked Mike Trianni, John Iguel, Andrew Kerr, and June Firing. (End first leg of OES-05-11.)

21-22 Sept. Saipan Island. Embarked Tony Flores, Ben Richards, Edson Limes, Matt Dunlap, and Kyle Hogrefe. Conducted 11 towed-diver habitat/fish surveys, along with 8 benthic and fish REA surveys. Completed one BOTCAM deployment. Fifteen shallow water CTDs were made and one shallow water sampling site (4 samples total) was sampled. Four EK60 Bioacoustic transects were made. A check out dive was also performed to test a variety of oceanographic gear and equipment. Over the course of 2 nights, four shipboard CTD casts were performed collecting water samples at each site for a total of 20 nutrient and 20 chlorophyll samples collected. The CTD casts sites were located on the corners of the ADCP box transect conducted around the island on the first night. Departed Saipan Island 2200 en route to Anatahan Island.

23 Sept. Arrived 0700 at Anatahan Island. No dive ops were conducted other than by oceanography team, due to risk of volcanic eruption. Six shallow water CTDs were conducted and an STR was replaced. The second STR was not found (presumed buried deep under volcanic ash). Two shipboard CTD casts were performed collecting water samples at both sites for a total of 10 nutrient, 10 chlorophyll, and 4 DIC samples. The DIC samples were conducted as the easternmost sites of an extended transect running to Pathfinder Reef. A continuous ADCP transect was conducted during operations around the island. Departed Anatahan Island 2200 en route to Pathfinder Reef.

24 Sept. Arrived Pathfinder Reef at 0700. Conducted three towed-diver habitat/fish surveys, along with two benthic and two fish REA surveys. Completed five BOTCAM deployments. Forty shallow water CTDs and 5 shallow water sampling sites (21 samples total) were collected. An SST

buoy and an STR were replaced. On the transit to Pathfinder, one shipboard CTD cast was performed collecting water for five chlorophyll, five nutrient, and two DIC samples. Four shipboard CTD casts were performed collecting chlorophyll and nutrient samples at all sites and collecting DIC samples at the NE and SE sites for a total of 20 nutrient, 20 chlorophyll and 4 DIC samples. The CTD casts sites were located on the corners of the ADCP box transect conducted around the reef. The intent of the DIC sampling at Anatahan, on transit and at Pathfinder was to create an extended transect of 140 nmi within the time constraints of other cruise logistics. Two EK60 bioacoustics transects were conducted along with one IKMT. Departed Pathfinder Reef 2200 en route to Arakane Reef.

25 Sept. Arrived Arakane Reef at 0700. Conducted three towed-diver habitat/fish surveys, along with two benthic and two fish REA surveys. Completed three BOTCAM deployments. Thirteen shallow water CTDs were collected and an STR was replaced. No night operations were conducted; however, ADCP data was collected during day ops and during transits to and from the site. Departed Arakane Reef 2200 en route to Tinian Island.

26-27 Sept. Arrived Tinian Island at 0700. Conducted 12 towed-diver habitat/fish surveys, along with 6 benthic and 6 fish REA surveys. Completed three BOTCAM deployments. Twelve shallow water CTDs and 4 shallow water sampling sites (16 samples total) were collected. The STR at this location was not found; it is presumed lost in a storm. A new deployment location was found and a new STR deployed. Two shipboard CTD casts were performed at the SE and SW corners of a "U" shaped ADCP transect adjacent to the bottom of the box transect already completed around Saipan. Water samples were collected at both sites for a total of 10 nutrient and 10 chlorophyll samples. Additionally, a 56-nmi transect intersecting the Marianas Archipelago between Saipan and Tinian Islands was performed collecting samples at six shipboard CTD stations in addition to the requisite nutrient and chlorophyll samples for a total of 29 nutrient, 29 chlorophyll, and 12 DIC samples. ADCP data was collected along the entire transect. Five EK60 bioacoustic transects were conducted along with two IKMTs. Departed Tinian Island 2200 en route to Aguijan Island.

28 Sept. Arrived Aguijan Island at 0700. Conducted six towed-diver habitat/fish surveys, along with three benthic and three fish REA surveys. Completed two BOTCAM deployments. Thirty-five shallow water CTDs and 14 shallow water sampling sites (54 samples total) were collected. An SST buoy and an STR were replaced. Four shipboard CTD casts were made on the corners of an ADCP box transect around the island. Water samples were collected at each site for a total of 20 nutrient and 20 chlorophyll samples collected. Five EK60 bioacoustic transects were conducted. Departed Aguijan Island 2200 en route to Rota Island.

29 Sep-1 Oct. Arrived Rota Island at 0700. Conducted 11 towed-diver habitat/fish surveys, along with 6 benthic and 6 fish REA surveys. Completed two BOTCAM deployments. A WTR was recovered and replaced. Four shipboard CTD casts were made on the corners of an ADCP box transect around the island. Water samples were collected at each site for a total of 14 nutrient and 20 chlorophyll samples collected. Nutrient sampling was discontinued during the third cast because of an insufficient number of sample bottles. Eight EK60 bioacoustic transects were conducted along with three IKMTs. Departed Rota Island ~0200. Arrived Guam ~0700. Disembarked Flores, Tenorio, Houk, Limes, Castro, Holzwarth, Schuyler, and Hiekinen. End of Leg 2 (OES-05-11).

Table 1. Cruise summary statistics for CNMI.

Island/ Bank	Survey dates (2005)	Fish & habitat diver tows	Fish & benthic REAs	STRs	SSTs	WTR	Deep CTDs	Shallow CTDs	SCUBA dives	EK60 bioacoustic transects	BOTCAM	IKMTs
Saipan	9/4	6	3					20	40	2	1	
Guguan	9/5	2	2	1			3	6	29	1	1	
Pagan	9/6-8	20	9	1	1		10	40	113	5	2	
Asuncion	9/9	6	3	1			3	13	42	2	1	
Uracas	9/10	6	3	1			8	12	36		1	
Maug	9/11-13	13	9	4	1		10	35	89	13	2	2
Supply	9/14					1	4		8		3	
Agrihan	9/15	5	3	1			1	14	34	1	1	1
Alamagan	9/16	6	3	1			2	15	39	2	1	1
Zealandia	9/17		1			1	2		16	2	1	
Sarigan	9/18	5	3	1			2	9	34	4	1	
Saipan	9/21-22	11	5				4	15	66	4		0
Anatahan	9/23	0	0	1			2	6	4	0		0
Pathfinder	9/24	3	2	1	1		5	40	22	2	5	1
Arakane	9/25	3	2	1			0	13	22	0	3	0
Tinian	9/26-27	12	6	1			8	12	74	5	3	2
Aguijan	9/28	6	3	1			4	35	36	5	2	0
Rota	9/29-30	11	6			1	4		86	8	2	3
Totals		115	63	16	3	3	72	285	790	56	30	10

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, respectively, at habitat-representative stations to contribute to an expanded baseline assessment and implement monitoring for temporal changes.

Overall, fish assemblages around the CNMI were basically similar to that found during our first assessment cruise 2 years prior, while several differences were noteworthy. Large fish appeared less abundant around Uracas and no large grouper (*Epinephelus lanceolatus*) were seen. Otherwise, the general trend still indicated a greater abundance of larger fish in the northernmost islands compared to the great number of people in the southern islands. Medium-large fish were moderately abundant on the western banks. In general, sharks were very scarce throughout the archipelago, but slightly more common at Asuncion, Zealandia, Agrihan, and Pathfinder. The most common fish (by numbers) were damsels and small wrasses (especially in the south), many exhibiting good recruitment pulses (e.g., *Chromis acares, C. vanderbilti, Pomacentrus vaiuli*). A few Napoleon wrasses (*Cheilinus undulatus*) were seen at some islands mid-chain and south, including some large ones. No bumphead parrotfish (*Bolbometopon muricatum*) were seen in 2005, while several were seen in the archipelago in 2003. (See Appendix A for further details of fish surveys.)

B. CORALS: Conducted surveys to document the species composition, abundance, percent cover, size distribution, and general health of the shallow water corals in the CNMI.

In general, recruitment of branching corals (e.g., *Acropora, Pocillopora, Stylophora*) was found to be higher in the northern islands, while relative abundance was higher in the southern islands, implying that these corals are not reaching adult sizes in the south. Coral diversity was found to be higher in the south where reefs are older and more established. Several species of corals, that were not recorded in the south, were also found in the north. (See Appendix B. for further details of coral surveys)

C. ALGAE: Used quantitative photoquadrat sampling method to collect species composition and baseline abundance data of reef algae in the CNMI to compare with previous samples.

Algal surveys found turf algae and crustose coralline algae to generally be the most common forms at many of these islands. Blue-green algae and red cyanobacteria were found to be common at Arakane Bank in the western shoals. At the far north end of the chain (Uracas, Maug, Asuncion) encrusting forms of *Lobophora, Halimeda* and *Jania* were found to be more common. (See Appendix C for further details on algal surveys.)

D. MACROINVERTEBRATES: Surveyed non-coral, large marine invertebrate fauna to assess their relative abundance and monitor reef communities. This is

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 at the different islands and in diverse habitats. (See Appendix D for detailed description by island.)

E. TOWED-DIVER SURVEYS: Used benthic and fish towed-diver survey methods in the CNMI to provide a general description of reef habitat composition (hard coral, stressed coral, soft coral, marcroalgae, 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.

Towboard observations (for fish > 50 cm TL) similarly detected a dramatic decrease in large predators at Uracas in 2005, compared to 2003. Only one gray reef shark was seen at Uracas (compared to 67 in 2003). Bigeye jack (*Caranx sexfasciatus*) was the most abundant fish (numerically) fish around some islands. Sharks were rare overall, slightly more common on the outer banks, and many were small juveniles. Several humphead wrasse, some >100 cm TL, were also seen, but no bumphead parrotfish. An unknown pencil wrasse (*Psudojuloides* sp.) was collected, photographed, and confirmed as a new species. Benthic towboard observations found a generally higher number of crown-of-thorns starfish (COTs) than in 2003, especially at Pagan (80-fold increase). Giant clams varied in abundance by island/bank. (See Appendix E for details.)

F. OCEANOGRAPHIC/NIGHT SURVEYS: Conducted near and offshore oceanographic surveys and deployed a variety of surface and subsurface oceanographic instruments in the CNMI 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); water samples were collected for nutrient, dissolved inorganic carbon, and chlorophyll analysis. Shipboard acoustic Doppler current profiles (ADCP) also were 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, lying in the well-mixed western Pacific warm pool. In 2005, the currents in the northern end of the archipelago were exceptionally strong (up to ~1 m/s on the ADCP), and they slowly weakened toward the south along the archipelago. The STR data indicate frequent 1- to 3-week episodes of warming/cooling in the northern islands in the last 2 years, which could imply close connectivity between the Ryukyu Islands (Japan) and the northern Marianas Islands (e.g., ~1 mo transport time). Also in 2005, there was more evidence of localized upwelling at the northern islands than to the south.

The STR data indicated the drastic effect of typhoons, where local water temperatures dropped by about 1˚C at Anatahan and Sarigan during Typhoon Nabi, which remained depressed for about a week. (See Appendix F for further details.)

G. BIOACOUSTIC SURVEYS Shipboard bioacoustic (echosounder) lines were conducted at numerous sites along the Archipelago and around each of the major islands/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. (See Appendix G for details.)

H. BOTCAM: A bottomfish digital stereo-camera bait system (BOTCAM) was deployed at stations around the islands/banks to trial test its utility in assessing relative abundance of deepwater (150-350 m) commercial bottomfish. Initially, the BOTCAM instrument experienced a number of logistical and technical constraints, most of which were remedied as the cruise progressed. Video sufficient to identify and size target species (e.g, onaga, lehi, gindai, kalekale, kahala, grouper, etc.) have been obtained. Video records of associated species (e.g., sharks, damselfish, filefish, emperor, angelfish, etc.) and habitat composition were also collected. This should help us to understand shallow-deep linkages in coral reef ecosystems. The most abundant fish were recorded where BOTCAM successfully landed in areas of high habitat quality. Existing constraints and recommendations for improvements are provided. (See Appendix H for additional detail by island/bank).

I. EDUCATION AND OUTREACH: An education specialist onboard contributed to a daily website and corresponded with school children to promote improved understanding of this research and the value of coral reef ecosystems of the CNMI. Throughout the cruise, the education specialist assisted or observed the research activities of most of the field teams (fish, benthic, tow-team, BOTCAM, oceanography, night ops). Daily logs and photos were posted to the website for school classes. Questions sent by students were answered by scientists on the ship on a regular basis. (See Appendix I for more detail).

SCIENTIFIC PERSONNEL:

Robert Schroeder, Ph.D., Chief Scientist, Fish REA Team, University of Hawaii (UH)-Joint Institute for Marine and Atmospheric Research (JIMAR)/Coral Reef Ecosystems Division (CRED)
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Mike Tenorio, Fish REA Team, CNMI - DFW
Tony Flores, Fish REA Team, CNMI - DFW
Stephani Holzwarth, Towboard Team-Fish/Divemaster, UH-JIMAR/CRED
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Molly Timmers, Towboard Team-Habitat, UH-JIMAR/CRED
Elizabeth Keenan, Towboard Team-Habitat, Benthic REA MacroInverts,UH-JIMAR/CRED
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Danny Merritt, BotCam/Oceanography Team, UH-JIMAR/CRED
June Firing, Night Operations Team, UH/CRED
Matt Dunlap, BotCam, UH-JIMAR/CRED
Kyle Hogrefe, Night Operations Team, UH/CRED
Jake Asher, Data Manager/Divemaster, Towboard Team-Habitat, UH-JIMAR/CRED
Rodney Hiekinen, Chamber Operator, US Army
Qamar Schuyler, Education specialist, CNMI – DEQ/CRM/DFW

DATA COLLECTED:

Fish REA numerical and biomass densities by species
Fish specimens for description of new 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 towboard surveys of large fish species (>50 cm TL)
Digital video surveys of fish from towboard transects
Benthic composition estimations from towboard surveys
Macroinvertebrate counts from towboard surveys
Digital images of the benthic habitat from towboard surveys
Habitat lineation from towboard 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 deepwater bottomfish

(/s/Robert E. Schroeder)

Submitted by: _____
Robert E. Schroeder, Ph.D.
Chief Scientist

(/s/Samuel G. Pooley)

Approved by: _____
Samuel G. Pooley, Ph.D.
Science Director
Pacific Islands Fisheries Science Center

Attachments

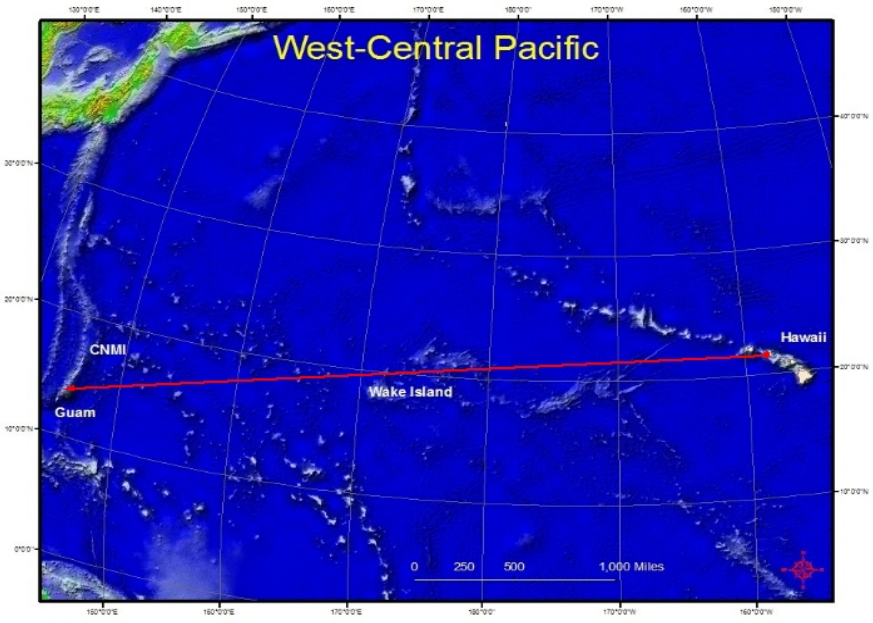

Figure 1. Map of transit path from Honolulu, Hawaii to Saipan, CNMI (OES-05-10).

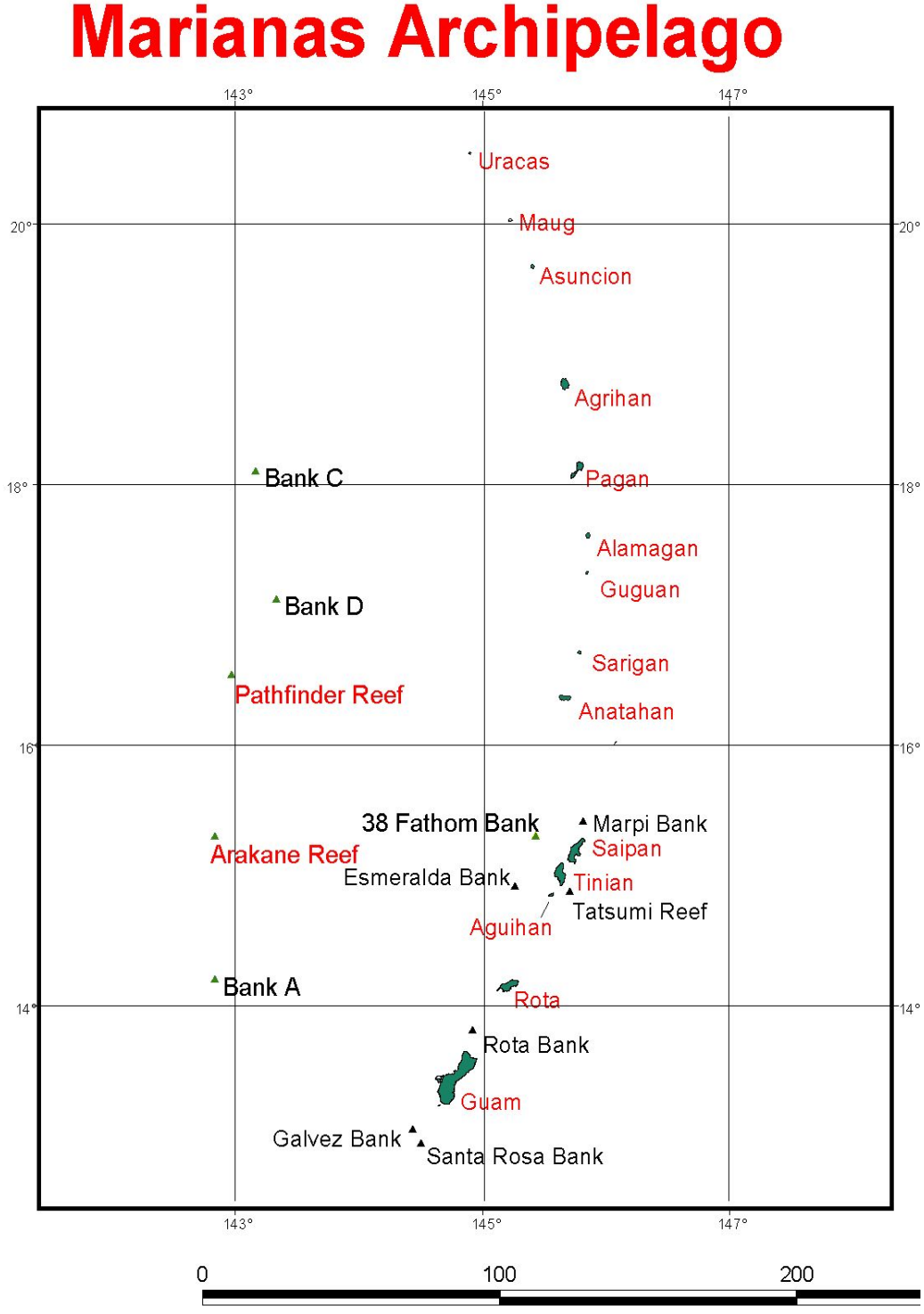

Figure 2. Map of the Marianas Archipelago (CNMI and Guam).

Appendix A: Fish Rapid Ecological Assessment (REA) Team Field Activity Summary (Robert Schroeder, Mike Trianni, Mike Tenorio, Tony Flores)

A. Methods

Quantitative belt transects (BLT), stationary point counts (SPC), and REA surveys (species presence) were conducted at station sites. Belt-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 stationary point counts 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-min 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 recorded 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 census sites (except at Guguan).

B. Results

From 3 to 10 September 2005, the fish census team (Robert Schroeder, Michael Trianni, and Michael Tenorio) surveyed 20 total stations: 3 stations along Saipan's east coast, 2 stations at Guguan, 9 stations at Pagan, 3 stations at Asuncion, and 3 stations Uracas.

From 11 to 18 September 2005, this fish census team surveyed 19 total stations: 9 stations at Maug, 3 stations at Agrihan, 3 stations at Alamagan, 1 station at Zealandia, and 3 stations at Sarigan. (REA dives were not possible at Supply Reef because of a persistent ~3-kn current from the north.)

From 21 September to 1 October 2005 (Leg 2), the fish census team (Robert Schroeder, Michael Tenorio, and Tony Flores) surveyed 24 total stations: 5 at Saipan, 0 at Anatahan, 2 at Pathfinder, 2 at Arakane, 6 at Tinian, 3 at Aguijan (Goat I.), and 6 at Rota. (REA dives were not possible at Anatahan because of a persistent risk of volcanic eruption. Reefs were also buried deep in ash.)

Saipan (E):
Three sites were surveyed along the E side of Saipan (1=Bird Is, 2=Tank Beach, 3= Laulau-Forbidden). A preliminary minimum number of 131 fish species were observed (pending full data compilation and analysis). Damselfish (especially *Pomacentrus vaiuli*

and *Stegastes fasciolatus*) were common, followed by surgeonfish, wrasses, and a few hawkfish. Sharks and apex predators were uncommon. SPC surveys found medium-sized fish, an assortment of wrasses, snapper, and parrotfish, but few large fish (with the exception of a few large emperors, barracuda, and a dog-tooth (white) tuna (*Gymnosarda unicolor*). Findings are believed to be somewhat similar to our 2003 surveys here (but S, W, and N sided of this large island will be surveyed on Leg 2 of the cruise).

Guguan:
Two sites were surveyed along the W side (sea conditions did not permit working the windward E side of the island). Overall, there appeared to be a healthy mix of fish diversity and abundance, and substrate complexity was high. A preliminary minimum of 211 species were observed. Local diversity appeared higher than that of Saipan. Medium-large fish appeared more abundant. Common taxa included grouper, snapper, parrotfish, and surgeonfish (especially *Naso* spp.).

Pagan:
Pagan is the largest of the northern islands of the CNMI. We surveyed there for 3 days to monitor the diversity of habitat types. A preliminary minimum of 182 species were observed. Fish abundance appeared to be strongly dependent on habitat quality. Damselfish were common with good recruitment pulses of *Chromis acares* and *C. vanderbilti*. *Stegastes fasciolatus*, a benthic herbivore, was also common. Most of the major common fish families were well represented at Pagan. Medium to large fishes were moderately abundant on SPC counts, including snapper (e.g., *Lutjanus bohar*, *L. gibbus*, *Macolor niger*), parrotfish, grouper, surgeonfish, fusiliers, and jacks (e.g., *Caranx melampygus*, golden trevally). Only a few sharks were seen (white-tip, nurse shark). Local diversity (i.e., from belt-transects) appeared to be lower than at Guguan, but higher than at Saipan. The mass recruitment of juvenile *Naso lituratus*, and related mortality, observed in 2003 was not seen here, nor at any other islands in 2005 (only a few new year-class individuals were seen). However, large *N. lituratus* appeared more common.

Asuncion:
Fish diversity and abundance were high around this tall, nearly conical volcanic island. A preliminary minimum of 132 species were observed. Medium-large fish were common here, including sharks. Grey reef sharks were seen on all dives. Other common target species were snapper (e.g., *L. bohar*), surgeons (mainly *Naso*), parrotfish (e.g., *Scarus oviceps*, *S. fosteni*, *S. rubroviolaceus*, *S. frontalis*), and barracuda (*Sphyraena* spp.). A few knifejaws (*Oplegnathus punctatus*) were also seen. Local diversity seemed to be as high as anywhere in the northern islands. Most common were surgeonfish (*A. nigricans*, *N. lituratus*), and damselfish (*Chromis acares*, *C. agilis*, *C. vanderbilti*, *Stegastes fasciolatus*). Species of soldierfish (Holocentridae) appeared more common here. Small surgeonfish were represented by *Ctenochaetus strigosus* and *C. hawaiiensis*, and lesser of *C. striatus*.

Uracas:
Uracas is the northern most island in the archipelago and is characterized by large rock boulder substrate and young coral colonies. Giant grouper (*Epinephelus lanceolatus*), seen here in 2003, were not seen during this visit. Overall, the abundance of large fish, including sharks, appeared to be depressed from our earlier visit. Gray reef sharks were

very rare (compared to 2003). However, a school of ~40 *Caranx sexfasciatus* was observed. Groups that were dominant on transects were snapper, grouper surgeons, and wrasses. Damselfish and parrotfish seemed to be less abundant than at islands to the S. Surgeonfish were mainly *C. hawaiiensis* and few *C. strigosus*. The batfish *Platax teira* was also seen. A preliminary minimum of 120 species were observed at Uracas.

Maug:
Maug consists of three long, tall islands that surround a deep lagoon. Of the nine sites surveyed by the REA teams, eight were reef slopes, five outside and three inside the lagoon, and one was a small pinnacle in the center of the lagoon. In general, reef structure was highly rugose at most sites, many of which were fairly steep slopes. The site on the inner east side (MAU-2) remains unique in having an extensive area of nearly 100% live coral cover adjacent to a bed of hot reddish mud flats that emit gas bubbles (presumably sulfuric acid) in many places. Overall, diversity and abundance of fish were relatively high at Maug, and most major families were represented (e.g., damselfish, grouper, hawkfish, parrotfish, surgeonfish, wrasse, etc.). A preliminary minimum of 213 species were observed. Healthy recruitment pulses were occurring for some species, particularly for some damselfish species (e.g., *Pomacentrus vaiuli, Chromis vanderbilti*). Surgeonfish were diverse and abundant. Parrotfish were most abundant on the outer reef slopes. Medium—large fish were also relatively diverse and abundant here. Common species included red and black snapper (*Lutjanus bohar* and *Macolor niger*). Only a few sharks were seen. Overall, fish fauna at Maug appeared to remain as healthy as we recalled it to be 2 years ago, while some signs of fishing were seen (e.g., lines on bottom). The outer west side has especially well developed reefs; bathymetry along the east side is not as well developed (more boulders and pavement).

Agrihan:
Three stations were surveyed around Agrihan Island. Habitat was characterized by high substrate rugosity and complexity, often interspersed with sand. Fish were observed to be relatively healthy, with medium—large fish fairly common. Dominant groups included jacks (e.g., *Caranx melampygus*), snapper (e.g., *Lutjanus bohar, Macolor macularis*), surgeonfish, and grouper. Considering all fish censused, species diversity was moderate-high, with multiple members of most major reef families present. A preliminary minimum of 128 species were observed. Belt transects revealed numerous species of wrasses, surgeonfish, butterflyfish, soildierfish, and grouper. Many of these were juveniles. Surgeonfish, damselfish, and wrasses appeared to dominate. Sharks were few, but more common than at most other northern islands.

Alamagan:
Three sites were surveyed around Alamagan Island. Medium-large reef fish were abundant and diverse, including snapper (*L. bohar, Macolor* sp.), jacks (dense schools), parrotfish, surgeonfish (*Naso* sp.), and grouper. However, fish were less abundant in areas with low relief habitat. Small fish were also abundant (e.g., *Pomachromis guamensis*), some reflecting good recruitment pulses. This was the first sighting (so far) of this cruise by the fish team of the rare, endangered humphead wrasse (*Cheilinus undulatus*)- 3 large individuals. Large *Lethrius* spp. and dog-tooth tuna were also seen. Sharks were rare, mainly white-tips and nurse sharks. A preliminary minimum of 147 species were observed. Alamagan has been designated as a remote commercial fishing

station (community development project) for fishing of shallow reef fish and deep bottomfish to ship back to Saipan markets on a regularly scheduled transit vessel.

Zealandia Bank:
Zealandia Bank is a small oceanic pinnacle reef with two areas of diveable depths, each only about a few 100 m^2, surrounded by nearly vertical drop-offs to very deep water. Only one REA dive was possible because of strong winds and large seas; current was 1-2 kn. The fish team did SPCs and REAs on the NE pinnacle, but not belt transects. Generally, the same fish species were present as commonly seen elsewhere in the northern islands. A preliminary minimum of 89 species were observed. Medium-large fish were common: school of rainbow runner, a dog-tooth tuna, surgeons (e.g., *Naso hexacanthus*), snapper (*L. bohar*, *Macolor macularis*), humphead (Napoleon) wrasse (~100 cm TL), and a few jacks and groupers. The fish team only saw a few small gray reef sharks (but see below). Species seen here, that were not common elsewhere, were the butterflyfish, *Hemipteronotus thompsoni*, and the blue tang, *Paracanthurus hepatus*. About 10 min after the fish team surfaced, the marcroinvertebrate benthic team was harassed by ~two-dozen large (6-7 ft), and aggressive gray reefs sharks. They exhibited pre-attack (jerking) behavior and repeatedly charged them with opened mouths. A wounded dog-tooth tuna was seen nearby.

Sarigan:
The fish REA team surveyed one station on the east side and two on the west. Fish density (of mainly smaller fish) was relatively low, but species diversity was good, and medium-large fish were common. A preliminary minimum of 146 species were observed. Larger fish included grouper, snapper, knifejaws, rays, jacks, rainbow runner, and Napoleon wrasse. Fish seen but not common elsewhere (so far) included humphead wrasse, rabbitfish (*Siganus aregenteus*), eagle ray, grouper (*Epinephelus microspilos*), jack (*Caranx sexfasciatus*), and surgeonfish (*Acanthurus blochii*). Substrate habitat rugosity was very high in most places. However, a relatively higher degree of corals were dead and algae covered at some sites (possibly from ash-fall from the long ~ongoing eruptions of the active Anatahan volcano, ~20 nmi to the S, or the cumulated impact of several strong typhoons since our last visit; palm trees on one side of the island also appeared brownish and stressed).

Saipan (S & W):
The south and west sides of the large island of Saipan were surveyed. In general, fish abundance was low-moderate. Large fish were uncommon, especially in areas of low habitat rugosity. Most fish were 15 cm TL or less. Recruitment pulses were observed for some species, especially damsels (e.g., *Pomacentrus vaiuli*) and parrotfish. The south side of the island (Boy Scout area) and southwest side (golf course area) were characterized by good substrate rugosity, spur and groove zones, and reef patches, interspersed with white sand. The west side (Wing Beach area) and central west (north of MMCA) had more flat habitat, gentle slopes, and low rugosity. Very few large fish were seen on SPC surveys; these were parrotfish, wrasses, surgeonfish, or groupers. The south and southwest sides had relatively more large fish (e.g., *Aphareus furca*, *Lethrinus olivaceus*), but were still not abundant. Most of the main common families were represented on the belt transects. There were few species and few numbers of angelfish; and even less butterflyfish. Damselfish species were probably the most common and

abundant, especially juveniles (e.g., *P. vaiuli*). Goatfish were few, typically only one or none on a transect. Groupers were few and small, mostly *Cephalopholis urodeta*, less than 20 cm TL. Four species of hawkfish were seen, mostly *Paracirrhites arcatus*. Very few parrotfish were censused on the belt transects, but more, mostly juveniles, were seen in the area. Soldierfish were uncommon (~3 species) and in the few places that offered dark shelter. Surgeonfish in general were not very abundant, mostly *Acanthurus nigrofuscus* and a few *A. olivaceus*. About a dozen juvenile blue tangs (*Paracanthurus hepatus*) were observed sheltering in *Acropora* coral; this species was rare at most islands. About seven to eight species of mostly small wrasses were typically seen, though not abundant (e.g., *Thalassoma quinquevittatum, T. lutescens*). Triggerfish were, for the most part, few to absent on the transects. Other families that were only rarely represented on the transects included lizardfish, gobies, blennies, and moorish idol. At some sites planktivores were common in the water column, mainly damsels and the wrasse *Cirrhilabrus katherinae*.

Pathfinder:
This bank along the western chain of shoals is characterized by low habitat relief, with branching coral heads (e.g., *Pocillopora*) common, that appear as gently sloped hills interspersed with hard pavement channels. Local fish diversity was low on the transects (although a bit higher than at Arakane Bank). Juvenile wrasses were most abundant (e.g., *Thalassoma amblycephalum*), followed by a few species of damselfish. There were also a few small grouper and hawkfish. Butterflyfish were rare. The most common medium-large (>25 cm) fish seen was the red snapper *Lutjanus bohar*, which were not shy of divers. Also seen were rainbow runner, black jack, and some parrotfish. A school of ~80 surgeonfish (*Naso caesius*) was seen. A few sharks were sighted, mostly full size (~2 m TL) gray reef sharks, which is more than seen elsewhere in the CNMI this cruise. A species of damselfish, *Plectroglyphidodon phoenixensis*, occurred here but had not been seen previously on the cruise. During our surface interval, a whale shark (*Rhyncodon typus*, ~7 m TL) swam under our small anchored boat.

Arakane:
This bank is about 60 nmi south of Pathfinder and of generally similar habitat, but with greater rugosity with lots of soft corals. Diversity and abundance of medium-large fish were low, but more were seen well off the lines along the drop-off (e.g., *L. bohar, Monotaxis grandoculis, Lutjanus gibbus, Naso* spp.). Red snapper, *L. bohar*, was the most common of the larger fish, with a few *Epinephelus fasciatus, Caranx orthogramus*, Nasos, parrotfish, and a clown triggerfish. Sharks (white-tips, grays) were fewer than at Pathfinder. Local diversity for all fish was low on the transect lines, while generally a subset of species was seen commonly in the main Marianas Archipelago. Wrasses dominated, mostly juvenile *Thalassoma amblycephalum*. *Halichoeres margaritaceus* was also common. Juvenile surgeonfish were primarily *Acanthurus nigrofuscus* and *A. olivaceus*. Damselfish and butterflyfish were few. A school of ~150 blue-lined snapper (*Lutjanus kasmira*) was seen.

Tinian:
Fish species diversity at stations surveyed was moderate to good. (Over 70 species were seen on a single dive.) Damselfishes were the most numerous, most common being *Plectroglyphidodon lacrymatus*, *Pomacentrus vaiuli*, and *Stegastes fasciolatus*, many of

which were juveniles. There were also a few species of anemone fish and *Dascyllus*. Wrasses were the next most common, with a good mix of ~8-10 species. Surgeonfish followed, dominated by *Acanthrurus nigrofuscus*, and some *Ctenochaetus striatus*. A number of other families were also represented each by a few species. Species that were rare so far on this cruise (from the more northern islands) and seen at Tinian were *Epibulus insidiator, Amphiprion frenatus, Cheilinus trilobatus, Cetoscarus bicolor*, and *Signaus argenteus*. Medium-large fish were very rare; a few were seen on SPC survey replicates. The few that were present were mostly 25-30 cm TL (e.g., mainly parrots, and a few wrasses, goatfish, snapper, or grouper).

Aguijan (Goat I.):
Fish abundance and diversity were moderate to good here. Most common were damsels (*Plectroglyphidodon lacrymatus*), surgeons (*Acanthurus nigrofuscus*), and wrasses (*Halichores margaritaceus*), most of which were small. Other families, parrotfish, soilderfish, goatfish, snapper, were represented by a few species each. Species rarely seen elsewhere included *Exallis brevis*, *Decapterus macarellus*, *Amphiprion frenatus*, *Cephalopholis sexmaculata*, and *Xyrichthys celebicus*. Medium-large fish were generally rare, but slightly more common in areas of more complex, high-relief habitat. Parrotfish, primarily *Scarus sordidus*, was the most common medium-sized fish, with lesser *Monotaxis grandoculis* and *Macolor* spp.

Rota:
The reefs around Rota appeared to be more "stressed" than that of 2 years ago; more algae and dead corals (possibly typhoon related). Fish along the east side of the island were of moderate diversity, and abundance of medium-large fish was good, including parrots (e.g, *Chlorurus microrhinus*), surgeons (e.g., *Naso tonganus*), snapper, rudderfish, and emperors (*Lethrinus* sp.). At one site, eight 40-50-cm (TL) and two 120-cm Napoleon wrasse (*Cheilinus undulatus*) were seen. Rabbitfish (*Signaus argenteus*) ~25 cm and *Plectropomus laevis* ~ 40 cm were also present. Sharks were uncommon; only back-tip and white-tip seen. Belt transects along the east side also revealed good diversity and abundance of all fish. Families with good representation included damselfish, butterflyfish, parrotfish, goatfish, wrasses, snapper, and surgeonfish. The damsels *Pomacentrus vaiuli* and *Plectroglyphidodon lacrymatus* were most common. Rare fish seen included a clown trigger (*Balistoides conspicillum*). Along the west side of Rota medium-large fish were much fewer, mostly 25-30-cm TL parrotfish and snapper, with a few jacks and emperors. Damselfish (*P. vaiuli* and *S. fasciolatus*) and wrasses (*Halichoeres margaritaceus*, *Thalassoma quinquevittatum*), many of which were juveniles, also dominated along the west side.

Benthic REA Team Field Activity Summaries:

Appendix B. Corals (Peter Houk, John Iguel [Leg 1], Edson Limes [Leg 2])

General Summary of Coral and Benthic Work Completed:

Benthic and coral community data collection for REA surveys have been consistent. At each site we have recorded benthic video transects (2 by 25 m) and several measures of the coral populations including; 1) species-population densities, 2) species-relative abundances, 3) community-size class distributions, and 4) coral recruitment levels (genus). At deep REA locations only biodiversity checklists were conducted.

Overview of Initial Findings for Coral and Benthic Communities:

Similar to 2003 we are finding a general pattern of decreased diversity and development on the coral reefs in the Northern Mariana Islands as compared with the southern. Despite this trend several surveyed reefs stand out as exceptions where extensive modern coral assemblages were found at PAG-12, ASU-3, MAU-1, MAU-4, and in small patches elsewhere. Presumably, extensive modern development is a consequence of a combination of favorable environmental variables including gentle bathymetric slopes, presence of antecedent topography (basement rock geology and historical reef development), low hydrodynamic energy, and type and percent of vegetation cover in the adjacent watershed. Recruitment surveys show that there are sufficient levels of new recruits present on all of the reefs surveyed; however, post-settlement mortality rates must be high. On all sites thus far, no visual changes from 2003 surveys were noted; however, data have not been processed and analyzed to confirm these observations.

Saipan (E):
Current, ongoing long-term monitoring efforts in the Southern Mariana Islands have already characterized the coral reef communities at all reefs studied on Saipan Island. At all three locations 'well developed' reefs existed and wave energy seems to be the largest influence to the coral communities. SAI-3 is dominated by the laminar/columnar coral (*Porites rus*), while such growth forms do not exist at the more exposed SAI-1 and SAI-2 sites.

Guguan:
Rough weather conditions limited our surveys on Guguan Islands to only one site, previously not surveyed. GUG-4 consisted of a mixture of unconsolidated volcanic boulders with most coral growth (*Pocillopora* mainly) occurring on the tops of boulders. *Pocillopora* recruits were found on all sides of volcanic boulders; however, adult colonies only existed on the tops.

Pagan:
Extensive surveys at multiple locations on Pagan Island showed that reef development followed the patterns suggested above. PAG-12 was an exceptional reef where gentle bathymetric slope and high rugosity provided ideal conditions for extensive modern communities. Diversity was higher, coral sizes were larger, and relative abundances were more evenly distributed at this site in comparison to others. The southwest coast

sites (PAG-6, PAG-5, PAG-11) had favorable settings for coral communities to develop, and an extensive Holocene framework, but the living community was unexpectedly depauperate. This may be due to the recent (1980's and 1990's) eruptions of Mount Pagan and the location of these reefs downwind from the ash outfall. The east coast was the only location in the Northern Islands thus far with a developed reef flat, which seemed to be above mean sea level, and devoid of coral. The reef slopes were dominated by domal corals (*Astreopora, Porites,* and *Favia*) situated in low relief reef settings.

Asuncion:
Asuncion Island had little reef shelf development around it. The northeast side (ASU-1) has a barren watershed adjacent to the surveyed site where ash and boulders have created a habitat unfavorable for coral communities. ASU-2 was very similar in setting to the PAG-12 site with an unexpected vibrant living community found. Large, diverse coral communities dominated by *Acropora palifera*, *Pocillopora* spp., and *Porites lobata* were found here. Along the southwest coast (ASU-2) we resurveyed a ~30-ft. reef shelf with little topographic relief and small, fragmented coral communities dominated by *Leptoria phygria*, *Favia stelligera*, and *Pavona varians*.

Uracus:
At Uracus Island unvegetated watersheds are ubiquitous and result in nearshore reefs dominated by fallen rocks and loose volcanic sediment. Coral cover and colony size were visually correlated with boulder size and topographic relief. Small encrusting *Pavona varians*, *Cyphastrea chalcidicum*, *Astreopora myriophthalma*, and *Porites lobata* colonies were most abundant at all REA sites, with large population densities and very small geometric diameters.

Maug:
Maug Island holds some of the most developed and diverse coral communities throughout the island chain. MAU-4, MAU-1, MAU-9, MAU-11 all have favorable basement rock that has led to large *Pocillopora* spp. and *Porites* massive corals and a diverse assemblage of Faviids. MAU-1 holds the greatest *Acropora* diversity, a genus that is otherwise poorly represented throughout the NMI. On the inside of the three islands exists a steeply sloping, protected coral reef environment. Coral communities in these protected waters are dominated by *Porites rus*, *Astreopora myriophthalma*, *Goniastrea retiformis*, *G. edwardsi*, and *G. pectinata*. Favorable hydrodynamic conditions have led to larger coral colony sizes when compared to the outer reefs. The diversity of habitats and geological foundations are thought to be responsible for the reef systems outlined above.

Agrihan:
Limiting weather conditions and time resulted in surveys being conducted on the west side of Agrihan at three stations. Two stations consisted of fallen volcanic boulders with substantial development on the top of boulders at AGR-4, but no coral community development at AGR-6. Our final site (AGR-2) consisted of raised spurs isolated by pockets of volcanic ash and sand. The coral community on the spurs was dominated by small encrusting and massive corals, with occasional large *Pocillopora* spp. colonies providing the only three-dimensional growth. More time should be spent surveying the nearshore coral reef ecosystem around Agrihan as the selected sites may not be

representative of all the coral communities that exist on the island according to the results gained by the towed team.

Alamagan:
Three sites were surveyed around Alamagan on the NE, NW, and SW exposures. ALA-1 (NE) had the most extensive and diverse coral communities, the greatest rugosity, and the highest recruitment levels. The other two sites were very similar in "reef setting" consisting of a flat, gentle slope populated mainly by *Astreopora myriophthalma*, *Astreopora randalli*, *Astreopora listeri,* and many small encrusting Faviids. Similar to Agrihan, more time should be spent surveying the nearshore coral reef ecosystem around Alamagan as the selected sites may not be representative of all the coral communities that exist on the island according to the results gained by the towed team.

Sarigan:
At Sarigan Island coral communities showed signs of stress potentially resultant from the eruptions of the nearby Anatahan volcano. Large *Acropora robusta* and *Porites lobata* colonies were partly bleached and partially infested with mucus and bacteria growth. Because these large coral colonies are rare at each of our monitoring sites the data may or may not confirm these observations. The community on the reef slope consists of small encrusting and massive colonies, with occasional large *Pocillopora* and Faviids being present. There are limited data to evaluate the changes that evolved over time as a result of the volcanic disturbance because only one of the sites from the 2003 cruise was resurveyed.

Banks (Pathfinder and Arakane):
Pathfinder and Arakane Banks were similar in geological nature consisting of relatively large, flat banks with atypical spur-and-groove development. Diversity was lower than all islands surveyed which is as expected given the smaller area of the banks. Coral communities were dominated by *Pocillopora, Cyphastrea, Milleopora, Heliopora,* and several other Faviids. Notably, a new record of a columnar *Cyphastrea* was found to be common on these banks, which has never been recorded elsewhere in the CNMI. Hard and soft coral coverage were high in comparison to many of the other surveyed sites.

Southern Mariana Islands (Saipan, Tinian, Aguijan, and Rota):
Coral communities of the southern islands have been sufficiently described, and continued long-term coral monitoring programs from the CNMI regulatory agencies have been documenting trends over the past 4 years at all but four sites visited. Reports, references, and summaries can be obtained by e-mail from Peter Houk, Marine Biologist, Division of Environmental Quality (deq.biologist@saipan.com). As expected, we found more substantial geological reef development in the southern islands compared with the northern. These favorable settings allow for higher diversity, cover, and evenness in species distributions when compared with the northern islands. Relative to each other, Saipan holds the largest amount of actively accreting coral reefs along the western barrier reef. These reefs, along with a few others around the southern part of the island are some of the few locations where numerous species of *Acropora* can still be found as a thriving community. Tinian has mostly unfavorable geology except for the section of reef from Taga Beach north to airport point, along the western shore. These reefs, and a few others associated with beaches on the northwest and east coasts are the only locations where

Acropora and *Pocillopora* communities thrive. Rota is unique because it was the only island in which geological uplifting occurred. As a result most of Rota's reef flats consist of uplifted Holocene reef flats, while today's reef flat does not hold a vibrant coral community. Most of the reefs surveyed in Rota were *Halimeda* dominated, consisting of mainly *Astreopora myriophthalma* and *A. randalli* colonies. Notably, Aguijan, despite its small size, has a thriving *Pocillopora* and *Acropora* dominated reef along its northwestern shoreline. At all islands, populations of Crown-of-Thorn starfish have moved through, or are continuing to pass through, and left many partially and completely dead *Acropora*, *Pocillopora*, *Favia*, and *Astreopora* corals. Unpreferred prey includes *Porites* spp. corals that were visually less affected.

Day	Island	Location	Benthic video	Coral community	Recruitment	Biodiversity
9/4/05	Saipan	SAI-1	2 x 25 m	yes	yes	yes
9/4/05	Saipan	SAI-2	2 x 25 m	yes	yes	yes
9/4/05	Saipan	SAI-3	2 x 25 m	yes	yes	yes
9/5/05	Guguan	GUG-4	2 x 25 m	yes	yes	no
9/6/05	Pagan	PAG-9	2 x 25 m	yes	yes	yes
9/6/05	Pagan	PAG-11	2 x 25 m	yes	yes	yes
9/6/05	Pagan	PAG-6	2 x 25 m	yes	yes	yes
9/7/05	Pagan	PAG-3	2 x 25 m	yes	yes	yes
9/7/05	Pagan	PAG-12	2 x 25 m	yes	yes	no
9/7/05	Pagan	PAG-5	2 x 25 m	yes	yes	yes
9/8/05	Pagan	PAG-8	2 x 25 m	yes	yes	yes
9/8/05	Pagan	PAG-13	2 x 25 m	yes	yes	no
9/8/05	Pagan	PAG-1	2 x 25 m	yes	yes	yes
9/9/05	Asuncion	ASU-1	2 x 25 m	yes	yes	yes
9/9/05	Asuncion	ASU-3	2 x 25 m	yes	yes	yes
9/9/05	Asuncion	ASU-2	2 x 25 m	yes	yes	yes
9/10/05	Uracus	FDP-2	2 x 25 m	yes	yes	yes
9/10/05	Uracus	FDP-1	2 x 25 m	yes	yes	yes
9/10/05	Uracus	FDP-4	2 x 25 m	yes	yes	no
9/11/05	Maug	MAU-4	2 x 25 m	yes	yes	yes
9/11/05	Maug	MAU-2	2 x 25 m	yes	yes	yes
9/11/05	Maug	MAU-5	2 x 25 m	yes	yes	yes
9/12/05	Maug	MAU-11	2 x 25 m	yes	yes	yes
9/12/05	Maug	MAU-10	2 x 25 m	yes	yes	yes
9/12/05	Maug	MAU-9	2 x 25 m	yes	yes	no
9/13/05	Maug	MAU-8	None	no	no	yes
9/13/05	Maug	MAU-6	2 x 25 m	yes	yes	yes
9/13/05	Maug	MAU-1	2 x 25 m	yes	yes	yes
9/15/05	Agrihan	AGR-4	2 x 25 m	yes	yes	yes
9/15/05	Agrihan	AGR-6	2 x 25 m	yes	yes	yes
9/15/05	Agrihan	AGR-2	2 x 25 m	yes	yes	yes
9/16/05	Alamagan	ALA-1	2 x 25 m	yes	yes	yes
9/16/05	Alamagan	ALA-2	2 x 25 m	yes	yes	yes
9/16/05	Alamagan	ALA-3	2 x 25 m	yes	yes	yes
9/17/05	Zelandia Bank	ZEL-2	None	no	no	yes
9/18/05	Sarigan	SAR-4	2 x 25 m	yes	yes	yes
9/18/05	Sarigan	SAR-1	2 x 25 m	yes	yes	yes
9/18/05	Sarigan	SAR-2	2 x 25 m	yes	yes	yes

Day	Island	Location	Benthic video	Coral community	Recruitment	Biodiversity
9/21/05	Saipan	SAI-7	2 x 25 m	yes	yes	yes
9/21/05	Saipan	SAI-10	2 x 25 m	yes	yes	yes
9/21/05	Saipan	SAI-8	2 x 25 m	yes	yes	yes
9/22/05	Saipan	SAI-11	2 x 25 m	yes	yes	no
9/22/05	Saipan	SAI-12	2 x 25 m	yes	yes	yes
9/22/05	Pathfinder Bank	PAT-2	2 x 25 m	yes	yes	yes
9/24/05	Pathfinder Bank	PAT-1	2 x 25 m	yes	yes	yes
9/24/05	Aracane Bank	ARA-2	2 x 25 m	yes	yes	yes
9/25/05	Aracane Bank	ARA-1	2 x 25 m	yes	yes	yes
9/25/05	Tinian	TIN-2	2 x 25 m	yes	yes	yes
9/26/05	Tinian	TIN-4	2 x 25 m	yes	yes	yes
9/26/05	Tinian	TIN-1	2 x 25 m	yes	yes	yes
9/26/05	Tinian	TIN-5	2 x 25 m	yes	yes	no
9/27/05	Tinian	TIN-3	2 x 25 m	yes	yes	yes
9/27/05	Tinian	TIN-6	2 x 25 m	yes	yes	yes
9/27/05	Aguijan	AGU-1	2 x 25 m	yes	yes	yes
9/28/05	Aguijan	AGU-2	2 x 25 m	yes	yes	yes
9/28/05	Aguijan	AGU-3	2 x 25 m	yes	yes	no
9/28/05	Rota	ROT-2	2 x 25 m	yes	yes	yes
9/29/05	Rota	ROT-1	2 x 25 m	yes	yes	yes
9/29/05	Rota	ROT-7	2 x 25 m	yes	yes	yes
9/30/05	Rota	ROT-6	2 x 25 m	yes	yes	yes
9/30/05	Rota	ROT-5	2 x 25 m	yes	yes	yes

Appendix C. Algae (Kim Page and Fran Castro)

Saipan (E):
Algal Highlights:

- Turf algae and crustose coralline algae were the main space occupiers.
- *Halimeda* spp. and *Caulerpa* spp. were found at each site and the most common of the macroalgae.

Site Descriptions:
9/4/05
SAI 1:
This site is located at Bird Island on the east side of Saipan. It is characterized by large boulders of *Porites* separated by pavement. Turf algae was very abundant as well as crustose coralline algae; there were also large clumps of *Asparagopsis taxiformis* and an articulated *Galaxaura*.

SAI 2:
This site is located at Tank Beach. This site had less visibility and a higher number of algal species. Turf algae, *Halimeda* spp., and *Amansia* sp. were the most common species. *Valonia*, *Rhipidosiphon*, *Caulerpa*, *Udotea*, *Portieria* and *Valonia* were also found.

SAI 3:
This site was in a very peaceful lagoon on the southeast side of Saipan and was characterized by high coral cover (*Porites rus*). Turf algae, cyanophytes, and branched corallines were the most common plants found. *Tydemania*, *Galaxaura*, *Caulerpa* and *Actinotrichia* were also found.

Table 1: Algae of East Saipan. 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. Standard deviation of island averages are given in parentheses. Asterisks indicate algae found during the random swim that did not occur in photoquadrats sampled.

	SAI 2	**SAI 1**	**SAI 3**	**Island average**
Caulerpa	**41.67** *4.20*	**8.33** *3.00*	*	**16.67 (22.05)** *3.60 (0.85)*
Chlorodesmis	**8.33** *4.00*			**2.78 (4.81)** *4.00*
Halimeda	**100.00** *2.58*	*	**8.33** *4.00*	**36.11 (55.49)** *3.29 (1.00)*
Neomeris	**33.33** *4.75*			**11.11 (19.25)** *4.75*
Rhipidosiphon	**8.33**			**2.78**

	SAI 2	SAI 1	SAI 3	Island average
	5.00			**(4.81)** *5.00*
Tydemania			*	
Udotea	*			
Valonia	**16.67** *6.00*		**8.33** *5.00*	**8.33** **(8.33)** *5.50* *(0.71)*
Ventricaria	**8.33** *6.00*			**2.78** **(4.81)** *6.00*
Actinotrichia			**66.67** *2.75*	**22.22** **(38.49)** *2.75*
Amansia	**75.00** *2.78*			**25.00** **(43.30)** *2.78*
Asparagopsis	**8.33** *3.00*	**8.33** *3.00*		**5.56** **(4.81)** *3.00*
Botryocladia	**8.33** *4.00*			**2.78** **(4.81)** *4.00*
Galaxaura	**8.33** *3.00*	**8.33** *2.00*	*	**5.56** **(4.81)** *2.50* *(0.71)*
Martensia	**8.33** *4.00*			**2.78** **(4.81)** *4.00*
Portieria	*			
branched upright coralline			**83.33** *2.60*	**27.78** **(48.11)** *2.60*
crustose coralline	**33.33** *3.75*	**66.67** *2.00*		**33.33** **(33.33)** *2.88* *(1.24)*
Dictyota	**8.33** *7.00*			**2.78** **(4.81)** *7.00*
Lobophora		*		
Blue-green			**58.33** *3.29*	**19.44** **(33.68)** *3.29*
Turf	**100.00** *1.00*	**100.00** *1.00*	**100.00** *1.00*	**100.00** **0.00** *1.00*

Guguan:
Algal Highlights:

- Turf algae and crustose coralline algae were the most common space occupiers.
- *Dictyosphaeria* sp. the sometimes invasive "bubble algae" was also common, but not invasive.

Site Descriptions:
GUG 4: 9/5/05
This site was located on the central west side of Guguan in a small embayment. The site had extreme relief with depths ranging from 25 to 60 feet and was comprised of boulders with moderate coral growth. There were large clouds of fish. Turf algae, crustose coralline algae, *Caulerpa serulata, C. filicoides, Dictyosphaeria cavernosa, Rhipidosiphon, Actinotrichia,* and *Dictyota* were found on the transect. *Halimeda, Tydemania* sp, *Avrainvillea,* and *Ventricaria* were found during the random swim.

Table 2: Algae of Guguan. 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. Standard deviation of island averages are given in parentheses. Asterisks indicate algae found during the random swim that did not occur in photoquadrats sampled.

	Guguan
Caulerpa	**25.00** *2.67*
Dictyosphaeria	**33.33** *3.25*
Rhipidosiphon	**25.00** *3.67*
Actinotrichia	**8.33** *4.00*
crustose coralline	**91.67** *2.18*
Dictyota	**16.67** *3.00*
Turf	**100** *1.00*

Pagan:
Algal Highlights

- Turf algae and crustose coralline algae were the most common space occupiers.
- *Halimeda* spp. was the most common of the frondose algae, while *Amphiroa* a branched coralline alga was also very common and abundant.

Site Descriptions:
9/6/05
PAG 9:
This site was on the southwest side of Pagan. It was characterized by large coral boulders and non coral boulders that created high relief. There was a high abundance of fish at this site. Turf algae, cyanobacteria, crustose and branched coralline algae, *Dictyota* sp.,

Amphiroa sp., and *Portieria hornemanni* were common along the transects. *Cheilosporum* sp., *Ventricaria ventricosa*, and *Caulerpa serrulata* were found during the random swim.

PAG 11:
This site is located to the north of PAG 9 and was similar to this site with slightly less relief and less live coral. Turf algae, crustose coralline algae, cyanobacteria, *Dictyota*, *Tydemania expeditionis* (tuft and fan-shaped form), *Ventricaria ventricosa*, *Amphiroa* sp., *Neomeris* sp., and a brown encrusting alga were seen during the transect survey. *Halimeda* sp., *Cheilosporum* sp., *Galaxuara* sp., and a *Caulerpa* that resembled *taxifolia* but more diminutive were collected during the random swim.

PAG 6:
This site was slightly north of PAG 11 and was similar to the first two sites, however, there were high numbers of larger fish and a relatively steep drop off away from the site. Turf algae, crustose coralline algae, brown encrusting alga, *Ventricaria ventricosa*, *Dictyosphaeria versluysii*, *Amphiroa* sp., *Dictyota* sp. *Neomeris*, and cyanobacteria were quantitatively observed on the transects. During the random swim, *Tydemania expeditionis* (tuft and fan-shaped), *Bornetella sphaerica*, *Cheilosporum*, and *Halimeda* sp. were found.

9/7/05
PAG 3:
This site was dominated by *Halimeda* sp. and *Asparagopsis taxiformis*. There was low to moderate relief with a relatively strong current. In addition to *Halimeda* and *A. taxiformis*, turf algae, crustose coralline algae, *Ventricaria ventricosa*, *Neomeris* sp., *Dictyosphaeria versluysii*, and *Caulerpa filicoides* were also recorded from the transect.

PAG 12:
This was a new site located on the northwest side of Pagan. There was high relief (ravine like) with high abundances of fish including a white tip reef shark. Turf algae, crustose coralline algae, blue-green algae, *Dictyosphaeria* sp, *Halimeda* spp., *Wrangelia* sp., *Dicytota* sp., *Valonia* sp., *Caulerpa* sp., as well as an orange encrusting alga were quantitatively recorded with the photoquadrats.

PAG 5:
This site was located just south of Pagan Village bay which is home to a handful of Chamorro men. This site had poor visibility and comparatively little relief. Turf algae, crustose coralline algae, *Amphiroa* sp., *Neomeris* sp, *Valonia* sp., *Halimeda* sp., *Dictyosphaeria* sp., *Jania* sp., and *Caulerpa* were seen in the photoquadrats. During the random swim, a gelid species was collected along with *Galaxaura filamentosa*, *Wrangelia* sp., and *Rhipidosiphon* sp.

9/8/05
PAG 8:
This site was located on the southeast side of Pagan. It was characterized by large boulders with channels of black sand separating them. There were very little frondose algae. Turf algae, crustose coralline algae, *Jania* sp., *Halimeda* sp., and a finely branched

Galaxaura or *Trichleocarpa* were found during the transect survey. During the random swim, *Cheilosporum* sp., *Dictyosphaeria* sp., *Gelidiopsis* sp., *Rhipidosiphon* sp., *Botrycladia* sp., and a small red blade were seen.

PAG 13:
This site was located off from a beach with cows on it on the southeast side of Pagan. This site was characterized by a large number of diminutive species of algae. Turf algae, *Halimeda* sp., crustose coralline algae, *Cheilosphorum* sp., *Tricleocarpa* sp., cyanobacteria, *Amphiroa* sp., *Ventricaria ventricosa*, *Avrainvillea* sp., *Actinotrichia* sp., *Gelidiopsis* sp., and an orange crust were identified from this site.

PAG 1:
This site was a large reef with large patches of white and black sand surrounding it. There were a few large *Porites* heads. Turf algae, blue-green algae, *Amphiroa* sp., *Dictyosphaeria cavernosa*, crustose coralline algae, *Asparagopsis taxiformis*, *Gelidiopsis* sp., and *Ventricaria ventricosa* were found within the photoquadrat area. *Turbinaria ornata* and *Caulerpa peltata* were found during the random swim.

Table 3: Algae of Pagan. 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. Standard deviation of island averages are given in parentheses. Asterisks indicate algae found during the random swim that did not occur in photoquadrats sampled.

	PAG 9	PAG 11	PAG 6	PAG 3	PAG 12	PAG 5	PAG 8	PAG 13	PAG 1	**Island average**
Avrainvillea								**8.33** *7.00*		**0.93 (2.78)** *7.00*
Bornetella			*							**0.00 (0.00)**
Caulerpa	*	*		**8.33** *3.00*	**8.33** *5.00*	**8.33** *6.00*			*	**2.78 (4.17)** *4.67 (1.53)*
Chlorodesmis								**8.33** *3.00*		**0.93 (2.78)** *3.00*
Dictyosphaeria			**8.33** *4.00*	**16.67** *4.50*	**16.67** *5.00*	**8.33** *5.00*	*	**25.00** *5.00*	**58.33** *3.00*	**14.81 (18.53)** *4.42 (0.80)*
Halimeda		*	*	**91.67** *2.00*	**33.33** *4.00*	**33.33** *3.00*	**8.33** *3.00*	**100** *2.83*		**29.63 (39.99)** *2.97 (0.71)*
Neomeris		**8.33** *6.00*	**16.67** *3.00*	**33.33** *4.50*		**58.33** *3.71*				**12.96 (20.46)** *4.30 (1.29)*

	PAG 9	PAG 11	PAG 6	PAG 3	PAG 12	PAG 5	PAG 8	PAG 13	PAG 1	**Island average**
Tydemania	**8.33** *5.00*	**8.33** *3.00*	*							**1.85 (3.67)** *4.00 (1.41)*
Valonia					**8.33** *5.00*	**8.33** *5.00*				**1.85 (3.67)** *5.00 (0.00)*
Ventricaria	**8.33** *4.00*	**8.33** *5.00*	**8.33** *4.00*	**8.33** *4.00*	**16.67** *4.00*	**8.33** *5.00*		**33.33** *5.50*	**8.33** *4.00*	**11.11 (9.32)** *4.44 (0.62)*
Actinotrichia								**33.33** *5.00*		**3.70 (11.11)** *5.00*
Amphiroa	**58.33** *3.29*	**25.00** *3.67*	**33.33** *3.25*			**58.33** *3.00*		**75.00** *4.44*	**75.00** *3.00*	**36.11 (31.73)** *3.44 (0.55)*
Asparagopsis				**83.33** *3.20*				**8.33** *5.00*	**8.33** *2.00*	**11.11 (27.32)** *3.40 (1.51)*
Cheilosporum	*	*	*				*	**8.33** *4.00*		**0.93 (2.78)** *4.00*
Dasya									**8.33** *5.00*	**0.93 (2.78)** *5.00*
gelid							*	**16.67** *4.00*	**16.67** *4.50*	**3.70 (7.35)** *4.25 (0.35)*
Jania						**8.33** *4.00*	**16.67** *2.00*			**2.78 (5.89)** *3.00 (1.41)*
Portieria	**8.33** *4.00*									**0.93 (2.78)** *4.00*
Tricleocarpa							**16.67** *3.50*	**8.33** *5.00*		**2.78 (5.89)** *4.25 (1.06)*
Wrangelia		**8.33** *4.00*			**16.67** *3.00*					**2.78 (5.89)** *3.50 (0.71)*
branched upright coralline	**8.33** *4.00*									**0.93 (2.78)** *4.00*

	PAG 9	PAG 11	PAG 6	PAG 3	PAG 12	PAG 5	PAG 8	PAG 13	PAG 1	**Island average**
crustose coralline	**75.00** *2.22*	**91.67** *2.00*	**91.67** *2.18*	**50.00** *3.50*	**91.67** *1.91*	**75.00** *2.33*	**50.00** *2.00*	**91.67** *1.91*	**58.33** *3.14*	**75.00 (18.16)** *2.36 (0.57)*
Dictyota	**33.33** *3.50*	**25.00** *3.33*	**8.33** *4.00*		**25.00** *3.67*					**10.19 (13.68)** *3.63 (0.28)*
Lobophora		**50.00** *2.17*	**25.00** *2.33*		**8.33** *3.00*			**8.33** *2.00*		**10.19 (17.07)** *2.38 (0.44)*
orange crust	**8.33** *2.00*		**16.67** *3.00*		**50.00** *3.00*			**8.33** *7.00*	**16.67** *4.50*	**11.11 (16.14)** *3.90 (1.95)*
Turbinaria									*	**0.00 0.00)**
Blue-green	**41.67** *2.80*	**41.67** *2.80*	**25.00** *2.67*		**8.33** *3.00*	**16.67** *4.00*		**33.33** *5.50*	**41.67** *3.20*	**23.15 (17.57)** *3.42 (1.02)*
turf	**100** *1.00*	**100** *1.75*	**100** *1.08*	**100** *1.17*	**100** *1.08*	**100** *1.00*	**75.00** *1.11*	**100** *1.42*	**91.67** *1.00*	**96.30 (8.45)** *1.18 (0.25)*

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Asuncion:

Algal Highlights:

- In addition to turf and crustose coralline algae, the encrusting form of *Lobophora variagata* was also a major space occupier.
- The green algae *Halimeda spp*. and *Chlorodesmis sp*. were the most common frondose algae.

Site Descriptions:

9/9/05

ASU 1:

This site was located on the northeast side of the island and was characterized by large boulders with black sand channels separating them. Visibility was initially very good (70) but dropped quickly to less than 10 feet. Turf, crustose coralline algae, encrusting *Lobophora*, *Halimeda* sp., orange crust, *Jania* sp., *Neomeris* sp., and *Padina* sp. were found within the quadrat area. Additionally, *Caulerpa filicoides* was found during the random swim.

ASU 3:
This site was located on the northwest side of the island and was characterized by higher relief with a high abundance of fire coral. Although, not recorded much in the photoquadrats, *Caulerpa filicoides* was very abundant carpeting wall areas. In addition, turf algae, *Chlorodesmis* sp., crustose coralline algae, *Halimeda* sp., *Jania* sp., *Neomeris* sp., encrusting *Lobophora*, as well as an encrusting orange were found in the photoquadrats. During the random swim, *Ventricaria ventricosa* as well as *Caulerpa serrulata* were also found.

ASU 2:
This site was located on the southwest side of the island and was a very pretty reef with a ledge around 20-35 feet with a drop-off (sheer wall) to ~80 feet. Two gray reef sharks along with other large snappers were in the deeper region. There were also a large number of planktivorous fish. Turf algae, encrusting *Lobophora*, *Chlorodesmis* sp., crustose coralline algae, *Chlorodesmis* sp., *Rhipidosiphon* sp., *Caulerpa filicoides*, *C. serrulata*, *Jania* sp., *Dictyota* sp., *Dictyosphaeria versluysii*, and *Halimeda* sp. were seen during the survey. *Caulerpa filicoides* was a dominant alga that carpeted the walls as in ASC 3; this was not adequately recorded from the photoquadrats.

Table 4: Algae of Asuncion. 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. Standard deviation of island averages are given in parentheses. Asterisks indicate algae found during the random swim that did not occur in photoquadrats sampled.

	ASU 1	ASU 3	ASU 2	**Island average**
Caulerpa	*	**25.00** *2.00*	**33.33** *3.25*	**19.44** **(17.35)** *2.63* *(0.88)*
Chlorodesmis		**33.33** *3.00*	**58.33** *4.00*	**30.56** **(29.27)** *3.50* *(0.71)*
Dictyosphaeria			**33.33** *5.50*	**11.11** **(19.25)** *5.50*
Halimeda	**33.33** *3.50*	**16.67** *4.00*	**33.33** *5.25*	**27.78** **(9.62)** *4.25* *(0.90)*
Neomeris	**8.33** *4.00*	**8.33** *5.00*		**5.56** **(4.81)** *4.50* *(0.71)*
Rhipidosiphon			**50.00** *4.33*	**16.67** **(28.87)** *4.33*
Ventricaria		*		**0.00** **(0.00)**
Jania		**16.67** *3.50*	**16.67** *6.50*	**11.11** **(9.62)** *5.00*

	ASU 1	ASU 3	ASU 2	**Island average**
				(2.12)
crustose coralline	**41.67** *3.20*	**91.67** *3.00*	**100** *3.08*	**77.78** **(31.55)** *3.09* *(0.10)*
Dictyota			**16.67** *7.00*	**5.56** **(9.62)** *7.00*
Lobophora	**100** *1.42*	**58.33** *2.00*	**75.00** *1.78*	**77.78** **(20.97)** *1.73* *(0.29)*
orange crust	**16.67** *3.50*	**41.67** *3.40*		**19.44** **(20.97)** *3.45* *(0.07)*
Padina	**16.67** *3.50*			**5.56** **(9.62)** *3.50*
Blue-green		**8.33** *5.00*		**2.78** **(4.81)** *5.00*
Turf	**100** *1.92*	**91.67** *1.27*	**100** *1.25*	**97.22** **(4.81)** *1.48* *(0.38)*

Uracus (Farallon de Pajaros):
Algal Highlights:

- Turf algae and the encrusting form of *Lobophora variagata* were the main space occupiers along with a species of *Jania*.

FDP 2, 1, 4
Site 2 was located on the southeast side of the island, Site 1 on the southwest side of the island, and Site 4 on the northwest side of the island. All sites were very similar. They were characterized by large boulders separated by black sand channels. FDP 2 had an older reef adjacent and was just to the north of the site that had more developed reef. FDP 4 had interesting topography with a wall dropping from 40 feet to ~80 feet. The boulders were colonized by turf algae, encrusting *Lobophora variagata*, as well as *Jania* sp. Under the sand and silt at FDP 4 crustose coralline algae was present, but not recorded very frequently. *Rhipidosiphon* sp., *Dictyosphaeria versluysii*, and *D. cavernosa* were also recorded within the photoquadrat area. *Caulerpa mexicana*, *Caulerpa facilicoides*, *Neomeris* sp., *Ventricaria ventricosa*, *Padina* sp., and *Halimeda* sp., were found during the random swims.

Table 5: Algae of Uracus. 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. Standard deviation of island averages are given in parentheses. Asterisks indicate algae found during the random swim that did not occur in photoquadrats sampled.

	FDP 2	FDP 1	FDP 4	**Island average**
Caulerpa	*		*	**0.00 (0.00)**
Dictyosphaeria	**16.67** *2.50*		**16.67** *3.00*	**11.11 (9.62)** *2.75 (0.35)*
Halimeda	*		*	**0.00**
Neomeris	*			**0.00**
Rhipidosiphon	*	**16.67** *3.50*	* **8.33** *4.00*	**8.33 (8.33)** *3.75 (0.35)*
Ventricaria	*	*		**0.00**
Jania	**66.67** *2.50*	**33.33** *3.00*	**33.33** *3.00*	**44.44 (19.25)** *2.83 (0.29)*
Dictyota		**16.67** *3.00*		**5.56 (9.62)** *3.00*
Lobophora	**83.33** *2.50*	**75.00** *1.78*	**75.00** *1.56*	**77.78 (4.81)** *1.94 (0.49)*
Padina			*	**0.00**
Turf	**100** *1.00*	**91.67** *1.18*	**75.00** *1.44*	**88.89 (12.73)** *1.21 (0.22)*

Maug:

Algal Highlights:

- Turf algae, crustose coralline algae, encrusting *Lobophora* sp. as well as *Halimeda* spp. were the most ubiquitous algae at Maug.
- The green alga *Caulerpa filicoides* as well as the red algae *Jania* sp. were locally abundant.

Site Descriptions:

MAU 4:

This site was located on the southeast of the island. It was characterized by high abundance of coral rocks with ledges of more cemented reef. Turf algae, crustose

coralline algae, encrusting *Lobophora, Jania* sp., *Ventricaria ventricosa,* and *Halimeda* were found sparsely covering areas within the photoquadrats. *Dictyosphaeria, Caulerpa filicoides, Rhipidosiphon* sp., and a red blade were found on the ledges.

MAU 2:
This site was on the inside of the lagoon on East Island. There was spectacular coral cover with near 100% cover on the 2nd transect of *Porites rus*. On transect one there was more diverse assemblages of benthic cover (algae and coral) and swimming into shore from the site there were bubbles from the volcanic gases being released as well as a drop in coral cover. Turf algae, *Dictyosphaeria* sp., crustose coralline algae, *Ventricaria ventricosa, Jania* sp., *Amphiroa* sp., and *Dictyota* were found in the survey area. During the random swim, *Caulerpa filicoides, Asparagopsis taxiformis, Halimeda* sp., and blue green algae were found.

MAU 5:
This site was located on the outside of North Island and was characterized by "healthy" coral reef separated by sand channels. There were a few very large *Porites* sp. coral heads. Multiple species of *Halimeda*, turf algae, *Caulerpa filicoides, C. mexicana,* crustose coralline, blue-green algae, *Ventricaria ventricosa, Rhipidosiphon* sp., *Turbinaria ornata*, *Neomeris* sp., *Lobophora* sp., and *Valonia* sp., were recorded in the photoquadrat area. *Asparagopsis taxiformis* was found during the random swim.

9/12/05
MAU 11:
This site was located on the southwest side of West Island. It was characterized by boulder-like reef formation separated by sand channels. Turf algae, crustose coralline algae, *Chlorodesmis* sp., *Halimeda* sp., *Dictyosphaeria* sp., *Ventricaria ventricosa*, Lobophora *variegata, Turbinaria ornata, Galaxaura filamentosa, Dictyota* sp., and *Jania* sp. were found during the survey.

MAU 10:
This site was located on the southeast side of West Island. It was characterized by large *Porites lobata* heads and also by a high abundance of giant clams. Turf algae, crustose coralline algae, *Amphiroa* sp., *Chlorodesmis* sp., blue green algae, and gelids were found during the photoquadrat survey. During the random swim a pretty red branched algal (*Dasya* sp.?) was found along with *Boodlea* sp., *Caulerpa serrulata, Rhipidosiphon*, *Valonia* sp., *Dictyosphaeria* sp., and *Ventricaria ventricosa*.

MAU 9:
This site was located on the northwest side of West Island. It was similar to MAU 11 with less sand channels and more reef area. *Halimeda* was also more abundant at this site. In addition to *Halimeda* spp., turf algae, branched and crustose coralline algae, *Caulerpa filicoides, C. serrulata*, *Jania* sp., *Lobophora* sp., *Turbinaria* sp., and *Dictyosphaeria* sp. were found in the photoquadrat area. Additionally, *Neomeris* sp. was found during the random swim.

9/13/05
MAU 8:
This site was located in the center of Maug's lagoon/crater. It is a deep reef with the shallowest portion at 67 feet extending to over 200 feet. There was high coral cover, lots of the bubble coral, and some wire coral as well. No quantitative survey was completed, however turf algae, crustose coralline algae, blue-green algae, *Tydemania expeditionis*, and *Ventricaria ventricosa* were observed and collected.

MAU 6:
This site was located on the east side of North Island on the inside of the lagoon. It was characterized by large reef communities (lots of giant clams) separated by small sand channels. During the photoquadrat analysis, turf algae, crustose coralline algae, *Jania* sp., *Dictyosphaeria* sp., *Amphiroa* sp., *Neomeris* sp., gelids, Halimeda sp., and *Ventricaria ventricosa* were collected.

MAU 1:
This site was located on the outside of West Island. It was a beautiful reef, comprised of large reef mounds separated by sand channels. The transect fell along the edge of the reef mound in ~45 feet. There seemed to be a high diversity of species present. Turf algae, crustose coralline algae, *Lobophora* sp., *Halimeda* sp., *Jania* sp., *Dictyosphaeria* sp., *Acanthophora pacifica*, branched coralline algae, *Galaxaura filamentosa*, and *Ventricaria ventricosa* were common and seen within the photoquadrat area. *Caulerpa serrulata* was additionally found during the random swim. In addition, Coralline Lethal Orange disease (CLOD) was seen along the transect.

Table 1: Algae of Maug. 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.

	MAU 4	MAU 2	MAU 5	MAU 11	MAU 10	MAU 9	MAU 8	MAU 6	MAU 1	Island average
Boodlea					*					
Caulerpa	*	*	**75.00** *3.00*		*	**16.67** *4.50*			*	**10.19 (24.92)** *3.75 (1.06)*
Chlorodesmis				**25.00** *3.33*	**8.33** *2.00*					**3.70 (8.45)** *2.67 (0.94)*
Dictyosphaeria	*	**16.67** *4.00*		**25.00** *4.33*	*	**8.33** *5.00*		**41.67** *3.60*		**10.19 (14.89)**

	MAU 4	MAU 2	MAU 5	MAU 11	MAU 10	MAU 9	MAU 8	MAU 6	MAU 1	Island average
										4.23 *(0.59)*
Halimeda	* **8.33** *5.00*	*	**100** *2.92*	**25.00** *3.67*	**8.33** *4.00*	**75.00** *3.33*		**8.33** *3.00*	**58.33** *3.71*	**31.48** **(36.98)** *3.66* *(0.71)*
Neomeris	**8.33** *4.00*		**16.67** *5.00*			*		**8.33** *5.00*		**3.70** **(6.05)** *4.67* *(0.58)*
Rhipidosiphon	*	**16.67** *5.00*			*					**(1.85)** **5.56** *5.00*
Tydemania							*			
Valonia		**8.33** *3.00*			*					**0.93** **(2.78)** *3.00*
Ventricaria	**8.33** *4.00*	**25.00** *4.00*		**16.67** *5.50*	*	*	*	**25.00** *4.67*	**16.67** *5.50*	**10.19** **(10.85)** *4.73* *(0.75)*
Acanthophora									**8.33** *5.00*	**0.93** **(2.78)** 5.00
Amphiroa		**25.00** *2.67*			**83.33** *2.60*			66.**67** *2.50*		**19.44** **(32.81)** *2.59* *(0.08)*
Asparagopsis		*	*							
Galaxaura				**8.33** *4.00*					**8.33** *3.00*	**1.85** **(3.67)** *3.50* *(0.71)*
gelid					**8.33** *2.00*			**8.33** *5.00*		**1.85** **(3.67)** *3.50* *(2.12)*
Jania	**16.67** *3.00*	**8.33** *3.00*		**16.67** *4.50*		**8.33** *6.00*		**41.67** *3.80*	**16.67** *4.50*	**12.04** **(13.25)** *4.13* *(1.13)*
branched upright coralline						**8.33** *4.00*			**16.67** *5.50*	**2.78** **(5.89)** *4.75* *(1.06)*
crustose coralline	**16.67** *3.00*	**83.33** *1.90*	**41.67** *4.00*		**41.67** *2.60*	**66.67** *2.88*	*	**33.33** *2.00*	**100** *1.92*	**42.59** **(35.22)** *2.61* *(0.77)*

	MAU 4	MAU 2	MAU 5	MAU 11	MAU 10	MAU 9	MAU 8	MAU 6	MAU 1	Island average
Dictyota		**8.33** *3.00*		**8.33** *4.00*						**1.85** **(3.67)** *3.50* *(0.71)*
Lobophora	**75.00** *2.00*	**8.33** *3.00*	**50.00** *2.67*	**50.00** *2.50*		**66.67** *2.38*			**75.00** *1.89*	**36.11** **(33.59)** *2.41* *(0.42)*
Turbinaria			**33.33** *4.25*	**8.33** *4.00*		**16.67** *4.00*				**6.48** **(11.62)** *4.08* *(0.14)*
Blue-green		**25.00** *3.67*	**8.33** *1.00*		**16.67** *2.00*		*	**16.67** *2.50*	**8.33** *6.00*	**8.33** **(9.32)** *3.03* *(1.92)*
turf	**100** *1.00*	**83.33** *1.10*	**100** *1.17*	**66.67** *1.50*	**100** *1.00*	**83.33** *1.30*	*	**100** *1.00*	**91.67** *2.27*	**80.56** **(32.27)** *1.29* *(0.43)*

Agrihan Island:

Algal Highlights:

- The calcified red algae *Jania* sp. as well as turf algae, crustose coralline algae, and the brown algae *Dictyota* and *Lobophora* were recorded quantitatively from each site sampled.
- *Padina* sp. was recorded for the first time during the cruise and was seen at each site although the specimens were much smaller than typical.
- Bryopsis sp. was recorded for the first time during the cruise.

Site Descriptions:

9/15/05

AGR 4:

This site was on the northwest side of the island and was a reef area with a high abundance of fish. The reef also appeared to have had a recent disturbance that caused to have less live coral there. Turf algae, crustose coralline algae, branched coralline algae, *Lobophora variegata*, *Ventricaria ventricosa*, *Dictyosphaeria* spp., *Jania* sp., and orange encrusting alga, *Chlorodesmis* sp., and *Martensia* sp. were found within the photoquadrat area. During the random swim *Padina* sp., *Bryopsis* sp., *Rhipidosiphon*, *Galaxaura filamentosa*, *Halimeda* and an unknown red blade were collected.

AGR 6:

This site was on the central west side of Agrihan and was a large boulder area with very little live coral. Turf algae, *Jania* sp., *Lobophora variegata*, *Dictyota* sp., a diminutive *Padina* sp., and crustose coralline algae were found on the boulders within the

photoquadrat area. In addition, during the random swim, *Ventricaria ventricosa*, blue-green algae, and *Rhipidosiphon* were collected.

AGR 2:
This site was on the southwest side of Agrihan and was a lovely reef characterized by patches of reef with multiple coral species separated by sand channels. Turf algae, *Lobophora variegata*, *Jania* sp., Dictyota sp., *Padina* sp., and an orange encrusting alga were found within the photoquadrat area. *Rhipidosiphon* sp. was additionally found during the random swim.

Table 2: Algae of Agrihan. 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.

	AGR 6	AGR 4	AGR 2	Island average
Bryopsis	*			
Chlorodesmis	**16.67** *4.50*			**5.56** **(9.62)** *4.50*
Dictyosphaeria	**41.67** *5.00*	*		**13.89** **(24.06)** *5.00*
Halimeda	*			
Neomeris		**8.33** *5.00*		**2.78** **(4.81)** *5.00*
Rhipidosiphon	*	*	*	
Ventricaria	**16.67** *5.50*	*		**5.56** **(9.62)** *5.50*
Galaxaura	*			
Jania	**75.00** *4.33*	**100** *1.67*	**16.67** *4.00*	**63.89** **(42.76)** *3.33* *(1.45)*
Martensia	**8.33** *4.00*			**2.78** **(4.81)** *4.00*
branched upright coralline	**8.33** *3.00*			**2.78** **(4.81)** *3.00*
crustose coralline	**100** *2.33*	**33.33** *3.50*	**33.33** *1.75*	**55.56** **(38.49)** *2.53* *(0.89)*
Dictyota	**8.33**	**16.67**	**25.00**	**16.67**

	AGR 6	AGR 4	AGR 2	Island average
	5.00	*4.50*	*3.67*	**(8.33)** *4.39* *(0.67)*
Lobophora	**100** *2.17*	**100** *2.83*	**41.67** *2.00*	**80.56** **(33.68)** *2.33* *(0.44)*
orange crust	**8.33** *6.00*		**16.67** *3.50*	**8.33** **(8.33)** *4.75* *(1.77)*
Padina	*	**8.33** *4.00*	**8.33** *2.00*	**5.56** **(4.81)** *3.00* *(1.41)*
Blue-green	**25.00** *5.00*	**8.33** *4.00*		**11.11** **(12.73)** *4.50* *(0.71)*
Turf	**100** *1.67*	**100** *1.67*	**75.00** *1.44*	**91.67** **(14.43)** *1.59* *(0.13)*

Alamagan:

Algal Highlights:

- Turf algae, blue-green algae, and crustose coralline algae as well as the green macrophytes *Caulerpa* spp. and *Neomeris* sp., the calcified red algae *Jania* sp., and the brown algae *Dictyota* sp. were quantitatively recorded at each site sampled at Alamagan.
- The frondose red alga *Asparagopsis taxiformis* was found in abundance at two of the three sites sampled.
- *Halimeda* sp. was only common at one site but was a dominant benthic cover at that site.

Site Descriptions:

9/16/05

ALA 1:

This site was on the northeast side of Alamagan. The lines were laid in relatively shallow water and there was a high surge. The reef was characterized by large shelf limestone boulders at odd angles. *Asparagopsis* taxiformis was the most dominant frondose alga. In addition, turf algae, crustose coralline algae, *Lobophora variegata*, blue-green algae, *Dictyota* sp., *Neomeris* sp., and *Caulerpa serrulata* were seen in the photoquadrat area. *Halimeda* spp., *Caulerpa webbiana*, *C. filicoides* as well as an unknown branched red resembling a *Dasya* were found during the random swim.

ALA 2:

This site was located on the northwest side of the island. There was comparatively less relief at this site. A high occurrence of *Asparagopsis taxiformis* was observed although it wasn't recorded frequently in the photoquadrat area. Turf algae, crustose coralline algae,

Halimeda sp., *Chlorodesmis* sp., and *Amphiroa* sp. were also recorded in the photoquadrat area.

ALA 3:
This site was located on the southwest side of Alamagan. It was a nice reef that gently sloped to deep water the small boat was anchored over a very large *Porites lobata* head. Turf algae, crustose coralline algae, *Halimeda* spp., *Jania* sp., *Galaxaura filamentosa*, *Dictyota* sp., *Neomeris* sp., and *Caulerpa serrulata* were recorded within the photoquadrat area. In addition, *Ventricaria ventricosa* was found during the random swim.

Table 3: Algae of Alamagan. 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.

	ALA 1	ALA 2	ALA 3	Island average
Caulerpa	**8.33** *2.00*	**8.33** *2.00*	**8.33** *3.00*	**8.33** **(0.00)**
Chlorodesmis				**19.44** **(33.68)**
Halimeda	*	*	**91.67** *2.55*	**58.33** **(50.69)**
Neomeris	**16.67** *3.00*	**16.67** *3.00*	**16.67** *5.50*	**16.67** **(0.00)** *4.17*
Ventricaria			*	**0.00** **(0.00)**
Amphiroa				**16.67** **(28.87)**
Asparagopsis	**58.33** *2.00*	**58.33** *2.00*		**25.00** **(30.05)**
Dasya	*	*		**0.00** **(0.00)**
Galaxaura			**16.67** *4.00*	**5.56** **(9.62)**
Jania	**33.33** *3.75*	**33.33** *3.75*	**10** *4.08*	**44.44** **(50.92)**
crustose coralline	**75.00** *2.78*	**75.00** *2.78*	**91.67** *2.55*	**83.33** **(8.33)** *2.77* *(0.23)*
Dictyota	**41.67** *4.00*	**41.67** *4.00*	**16.67** *5.00*	**25.00** **(14.43)** *4.17* *(0.76)*
Lobophora	**8.33** *4.00*	**8.33** *4.00*		**2.78** **(4.81)**
orange crust		**8.33**		**2.78**

	ALA 1	ALA 2	ALA 3	Island average
		3.00		**(4.81)**
Blue-green	**16.67** *4.00*	**16.67** *4.00*	**16.67** *4.50*	**16.67** **(0.00)** *4.67* *(0.76)*
Turf	**100** *1.00*	**100** *1.00*	**100** *1.00*	**100.00** **(0.00)** *1.00* *(0.00)*

Zealandia:
Site Description:
ZEA 2:
This was one of two pinnacles (the fish team and invertebrate team dove ZEA 1). There was a vertical wall that we dropped down on. There was high current along the wall; once we were on the back side of the wall, the current noticeably weakened. No quantitative survey was conducted, but a couple of different species of *Halimeda* were seen and collected. Crustose coralline algae as well as turf algae were also observed.

Sarigan:
Algal Highlights:

- Crustose coralline algae and turf algae as well as the calcified red *Jania* sp. and the brown algae *Dictyota* sp. were quantitatively recorded from each site sampled.
- The red algae *Halymenia* sp. and *Haloplegma duperreyi* were recorded for the first time during this cruise.

Site Descriptions:
SAR 4:
This site was located on the southeast side of Sarigan. It was characterized by large boulders with newer coral recruits and a high abundance of a green alga that I have tentatively identified as *Trichosolen* sp. that covered many of the boulders. In addition, turf algae, *Lobophora variegata, Jania* sp., crustose coralline algae, and *Dictyota* sp. were found within the photoquadrat area. In addition, *Halymenia* sp., *Gelidiopsis* sp., *Chlorodesmis* sp., Amansia sp. as well as an unknown red blade were collected during the random swim.

SAR 1: This site was located on the SW side of Sarigan. This site was characterized by a more developed reef that appeared to have recently been disturbed. There seemed to be relatively recent coral death with turf algae, crustose coralline algae, and *Lobophora* sp. covering the skeletons. In addition, *Chlorodesmis* sp., *Rhipidosiphon* sp., *Jania* sp., *Amphiroa* sp., *Halimeda* sp., and an orange encrusting alga were recorded within the photoquadrat. During the random swim, *Caulerpa serrulata, C. racemosa,* and *Ventricaria ventricosa* were collected.

SAR 2:
This site was located on the northwest side of Sarigan right outside from a shore landing spot. It had relatively low relief with the 1st and 2nd transects separated by sand channels.

The photoquadrats fell mostly on areas with high turf algal abundance. Crustose coralline algae, *Chlorodesmis* sp., *Amphiroa* sp., *Dictyota* sp., *Halimeda* sp., *Jania* sp., were also recorded from the photoquadrat area. During the random swim, *Avrainvillea* sp., *Portieria hornemannii*, *Martensia* sp., *Caulerpa filicoides*, *Rhipidosiphon* sp., *Haloplegma duperreyi*, *Peyssonnelia*, additional *Halimeda* spp., and *Ventricaria ventricosa* were found.

Table 4: Algae of Sarigan. 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.

	SAR 4	SAR 1	SAR 2	Island average
Avrainvillea			*	**0.00 (0.00)**
Caulerpa		*	*	**0.00 (0.00)**
Chlorodesmis	*	**25.00** *4.00*	**25.00** *2.67*	**16.67 (14.43)** *3.33 (0.94)*
Halimeda		**8.33** *4.00*	**25.00** *3.00*	**11.11 (12.73)** *3.50 (0.71)*
Rhipidosiphon		**8.33** *5.00*	*	**2.78 (4.81)** *5.00*
Trichosolen	**66.67** *2.38*			**22.22 38.49** *2.38*
Valonia		*		**0.00 (0.00)**
Ventricaria			**8.33** *4.00*	**2.78 (4.81)** *4.00*
Amansia	**8.33** *2.00*			**2.78 (4.81)** *2.00*
Amphiroa		**8.33** *3.00*	**25.00** *3.00*	**11.11 (12.73)** *3.00 (0.00)*
Galaxaura		**8.33** *5.00*		**2.78 (4.81)** *5.00*
gelid	*			**0.00 (0.00)**
Haloplegma			*	**0.00 (0.00)**

	SAR 4	SAR 1	SAR 2	Island average
Halymenia	*			**0.00 (0.00)**
Jania	**75.00** *2.89*	**58.33** *2.71*	**25.00** *3.67*	**52.78 (25.46)** *3.09 (0.51)*
Martensia			*	**0.00 (0.00)**
Peyssonnelia			*	**0.00 (0.00)**
Portieria			*	**0.00 (0.00)**
crustose coralline	**25.00** *3.00*	**91.67** *3.45*	**50.00** *2.17*	**55.56 (33.68)** *2.87 (0.65)*
Dictyota	**8.33** *4.00*	**33.33** *4.00*	**16.67** *3.50*	**19.44 (12.73)** *3.83 (0.29)*
Hydroclathrus				**0.00 (0.00)**
Lobophora	**16.67** *2.50*	**75.00** *1.67*		**30.56 (39.38)** *2.08 (0.59)*
orange crust		**16.67** *4.50*	**8.33** *3.00*	**8.33 (8.33)** *3.75 (1.06)*
Turf	**100** *1.25*	**100** *1.42*	**75.00** *1.00*	**91.67 (14.43)** *1.22 (0.21)*

Saipan (W):

Algal Highlights:

- *Microdictyon* sp., a very common green alga in Hawaii, was seen for the first time during this cruise on the northwest side of Saipan.
- Turf algae, crustose coralline algae, *Jania* sp., *Dictyota* sp., and *Halimeda* spp. were ubiquitous and quantitatively recorded at each site sampled.
- The calcified green alga *Udotea* as well as the gooey red alga *Predaea* were collected during the random swim and seem to be rare finds.

Site Descriptions:

9/21/05

SAI 5:

This site was on the south side of Saipan; it is just south of Obyan beach at a dive site referred to as Boy Scout. It was a mature reef, with both live and dead coral (moderate relief) separated by sand channels. Turf algae, crustose and branched coralline algae, blue-green algae, *Bryopsis* sp., *Jania* sp., *Amphiroa* sp., *Dictyota* sp., *Actinotrichia* sp.,

Halimeda sp., and an encrusting orange alga were found within the photoquadrated area. In addition, *Chlorodesmis* sp., *Caulerpa serrulata*, and a large *C. racemosa* var. *lamourouxii* were found during the random swim.

SAI 7:
This site was located to the north of SAI 5 at the base of a golf course. It was characterized by patches of reef separated by pavement and sand channels. Turf algae, crustose and branched coralline algae, *Halimeda* sp., *Jania* sp., *Amphiroa* sp., *Neomeris* sp., *Galaxaura filamentosa*, *Caulerpa racemosa*, and *Padina* were found during the photoquadrat survey. During the randoms swim, *Galaxaura marginata, Ventricaria ventricosa, Predaea laciniosa,* and *Udotea* sp. were also found.

9/22/05
SAI 6:
This site was located on the southwest side of Saipan off from the main town of Garapan. The site had moderate relief with lower visibility and had what seemed to be zooplankton in the water column. It was dominated by *Pocillopora* heads with many of the dead. Turf algae, crustose coralline algae, *Neomeris* sp., *Jania* sp., *Galaxaura* sp., *Dictyota* sp., *Halimeda* sp., *Amphiroa* sp., blue-green algae, *Actinotrichia* sp., and *Padina* sp. were found during the photoquadrat survey. During the random swim, *Halymenia* sp. and *Ventricaria ventricosa* were collected.

SAI 4:
This site was located on the west side of Saipan on the outer reef. It had a ~15 degree slope and seemed to be a wave-swept area with a high occurrence of *Pocillopora meandrina*. In addition to turf algae and crustose coralline algae, *Halimeda* spp. was very abundant. *Cyanobacteria*, *Dictyosphaeria* sp., *Jania* sp., *Rhipidosiphon* sp., *Amphiroa* sp., and *Dictyota* were additionally found during the photoquadrat survey. *Galaxaura marginata* and *Padina* sp. were additionally found during the random swim.

SAI 8:
This site was on the northwest side of Saipan off from Wing Beach. It had a 25 degree slope and moderate current. Small *Acropora* and *Pocillopora* heads were the dominant corals, and crinoids were common. The site had high *Halimeda* sp. and *Microdictyon* sp. cover. In addition, turf algae, crustose coralline algae, branched coralline algae, blue-green algae, *Jania* sp., *Dictyota* sp., *Amphiroa* sp., *Padina* sp., *Actinotrichia* sp., *Galaxaura* sp., and *Amansia* sp. were found within the photoquadrat area. *Predaea* sp. was additionally collected during the random swim.

Table 1: Algae of Saipan West. 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.

	SAI 5	SAI 7	SAI 6	SAI 4	SAI 8	Island average
Bryopsis	**8.33** *4.00*					**1.67** **(3.73)** *4.00*
Caulerpa	*	**8.33** *6.00*				**1.67** **(3.73)** *6.00*
Chlorodesmis	*					**0.00** **(0.00)**
Dictyosphaeria				**8.33** *4.00*		**1.67** **(3.73)** *4.00*
Halimeda	**16.67** *4.50*	**41.67** *3.80*	**50.00** *2.83*	**100** *2.33*	**91.67** *2.36*	**60.00** **(35.06)** *3.17* *(0.95)*
Microdictyon					**66.67** *3.38*	**13.33** **(29.81)** *3.38*
Neomeris		**8.33** *4.00*	**41.67** *4.40*		**8.33** *8.00*	**11.67** **(17.28)** *5.47* *(2.20)*
Rhipidosiphon				**8.33** *5.00*		**1.67** **(3.73)** *5.00*
Udotea		*				**0.00** **(0.00)**
Ventricaria		*	*			**0.00** **(0.00)**
Actinotrichia	**8.33** *6.00*		**8.33** *5.00*		**8.33** *7.00*	**5.00** **(4.56)** *6.00* *(1.00)*
Amansia					**8.33** *5.00*	**1.67** **(3.73)** *5.00*
Amphiroa	**16.67** *3.50*	**8.33** *4.00*	**41.67** *4.40*	**8.33** *7.00*		**15.00** **(16.03)** *4.73* *(1.56)*
Crouania					**16.67** *6.00*	**3.33** **(7.45)** *6.00*
Galaxaura		**8.33** *5.00*	**25.00** *5.33*	*	**8.33** *9.00*	**8.33** **(10.21)**

	SAI 5	SAI 7	SAI 6	SAI 4	SAI 8	Island average
						6.44 *(2.22)*
Halymenia			*			**0.00** **(0.00)**
Jania	**50.00** *5.33*	**25.00** *6.00*	**58.33** *3.71*	**58.33** *4.00*	**33.33** *6.25*	**45.00** **(15.14)** *5.06* *(1.15)*
Predaea		*			*	**0.00** **(0.00)**
branched upright coralline	**16.67** *5.00*	**8.33** *5.00*			**33.33** *3.50*	**11.67** **(13.94)** *4.50* *(0.87)*
crustose coralline	**83.33** *2.10*	**75.00** *2.56*	**66.67** *2.38*	**66.67** *2.88*	**75.00** *3.33*	**73.33** **(6.97)** *2.65* *(0.48)*
Dictyota	**25.00** *4.67*	**8.33** *3.00*	**33.33** *6.50*	**16.67** *5.50*	**58.33** *5.57*	**28.33** **(19.18)** *5.05* *(1.32)*
Lobophora	**16.67** *4.00*					**3.33** **(7.45)** *4.00*
orange crust	**16.67** *6.00*	**25.00** *6.00*	**33.33** *4.25*		**8.33** *5.00*	**16.67** **(13.18)** *5.31* *(0.85)*
Padina		**8.33** *6.00*	**16.67** *4.50*	*	**8.33** *6.00*	**6.67** **(6.97)** *5.50* *(0.87)*
Turbinaria		**8.33** *4.00*				**1.67** **(3.73)** *4.00*
Blue-green	**66.67** *2.88*		**50.00** *3.67*	**83.33** *3.80*	**50.00** *3.83*	**50.00** **(31.18)** *3.54* *(0.45)*
Turf	**83.33** *1.00*	**91.67** *1.00*	**100** *1.08*	**100** *1.00*	**100** *1.08*	**95.00** **(7.45)** *1.03* *(0.05)*

Pathfinder Bank:

Algal Highlights:

- Coralline algae lethal disease (CLOD) was recorded at PAT 1.
- Turf algae, and the green algae *Halimeda* spp. and *Chlorodesmis* sp. were recorded in more than 70% of the quadrats.
-

9/24/05
PAT 1 (NE) and 2 (SW):
Both sites at Pathfinder Bank were pretty similar. PAT 1 was on the northeast side of the banks and was shallower with more sand channels than PAT 2 which was on the southwest side of the bank. Both sites were relatively flat with little relief and had high surge. There seemed to be a high occurrence of *Pocillopora* as well as the Bohar snapper. Turf algae, *Halimeda* spp., crustose coralline algae, *Dictyota* sp., *Rhipidosiphon* sp., *Chlorodesmis* sp., blue-green algae, *Jania* sp., *Actinotrichia* sp., *Ventricaria ventricosa*, a small *Laurencia* sp., *Dictyosphaeria versluysii*, *Caulerpa racemosa* var. *peltata*, *C. webbiana*, and an orange encrusting alga were recorded at the two sites. In addition, coralline algae leathal disease (CLOD) was recorded at PAT 1.

Table 2: Algae of Pathfinder Bank. 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.

	PAT 2	PAT 1	Island average
Caulerpa	*	**16.67** *5.00*	**8.33** **(11.79)** *5.00*
Chlorodesmis	**58.33** *2.57*	**83.33** *2.20*	**70.83** **(17.68)** *2.39* *(0.26)*
Dictyosphaeria		**16.67** *4.00*	**8.33** **(11.79)** *4.00*
Halimeda	**100** *2.83*	**75.00** *2.67*	**87.50** **(17.68)** *2.75* *(0.12)*
Neomeris		**8.33** *4.00*	**4.17** **(5.89)** *4.00*
Rhipidosiphon	**8.33** *5.00*		**4.17** **(5.89)** *5.00*
Ventricaria	**16.67** *3.50*	**8.33** *4.00*	**12.50** **(5.89)** *3.75* *(0.35)*
Actinotrichia	**8.33** *7.00*		**4.17** **(5.89)** *7.00*
Jania	**16.67** *5.00*	**8.33** *4.00*	**12.50** **(5.89)** *4.50* *(0.71)*
Laurencia/Chondrophycus		**8.33** *7.00*	**4.17** **(5.89)**

	PAT 2	PAT 1	Island average
			7.00
crustose coralline	**75.00** *2.78*	**50.00** *3.17*	**62.50** **(17.68)** *2.97* *(0.27)*
Dictyota	**8.33** *4.00*		**4.17** **(5.89)** *4.00*
orange crust	**8.33** *6.00*	**8.33** *3.00*	**8.33** **()** *4.50* *(2.12)*
Blue-green	**33.33** *5.00*	**8.33** *6.00*	**20.83** **(17.68)** *5.50* *(0.71)*
Turf	**91.67** *1.00*	**100** *1.17*	**95.83** **(5.89)** *1.08* *(0.12)*

Arakane Bank:
Algal Highlights:

- *Microdictyon* sp. was very common at this site although none was seen at Pathfinder.
- At ARA 1, a red cyanobacteria, possibly *Hydrocoleum* sp. was covering the majority of the substrate.
- Turf algae, *Halimeda* sp., *Microdictyon* sp., and blue-green algae were recorded in greater than 75% of the photoquadrats.

9/25/05
ARA 2:
This site was the deeper of the two sites at Arakane and was characterized by a high abundance of soft coral *Lobophytum* sp. as well as the blue coral and *Pocillopora* sp. Strong current and surge were present at both sites. Turf algae, blue-green algae, *Halimeda* sp., *Microdictyon* sp., crustose coralline algae, *Jania* sp., *Dictyota* sp., and *Valonia* sp. were collected during the quantitative survey. *Dictyosphaeria cavernosa* was collected additionally during the random swim. Because of depth and current, random swim was less thorough at both ARA 2 and 1 than typical.

ARA 1:
This site was shallower of the two sites at Arakane and was characterized by the high occurrence of a red cyanobacteria as well as the fire coral. In addition to the blue-green algae, turf algae, *Halimeda* sp., *Microdictyon* sp., *Jania* sp., *Neomeris* sp., *Boodlea* sp., *Rhipidosiphon* sp. and *Liagora* sp. were recorded within the quadrat area. *Chlorodesmis* and *Caulerpa webbiana* were additionally seen during the random swim.

Table 3: Algae of Arakane Bank. 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.

	ARA 2	ARA 1	Island average
Boodlea		**8.33** *5.00*	**4.17** **(5.89)** *5.00*
Caulerpa		*	**0.00**
Chlorodesmis		*	**0.00**
Dictyosphaeria	*		**0.00**
Halimeda	**91.67** *2.91*	**66.67** *3.25*	**79.17** **(17.68)** *3.08* *(0.24)*
Microdictyon	**83.33** *3.20*	**100** *3.17*	**91.67** **(11.79)** *3.18* *(0.02)*
Neomeris		**16.67** *7.00*	**8.33** **(11.79)** *7.00*
Rhipidosiphon		**8.33** *6.00*	**4.17** **(5.89)** *6.00*
Valonia	**8.33** *5.00*		**4.17** **(5.89)** *5.00*
Jania	**8.33** *5.00*	**25.00** *5.33*	**16.67** **(11.79)** *5.17* *(0.24)*
Liagora		**8.33** *9.00*	**4.17** **(5.89)** *9.00*
crustose coralline	**16.67** *4.00*		**8.33** **(11.79)** *4.00*
Dictyota	**8.33** *5.00*		**4.17** **(5.89)** *5.00*
Blue-green	**91.67** *2.73*	**100** *1.50*	**95.83** **(5.89)** *2.11* *(0.87)*
turf	**100** *1.00*	**100** *1.92*	**100.00** **(0.00)** *1.46* *(0.65)*

Tinian:
Algal Highlights:

- Turf algae and cyanobacteria were the most common and relatively abundant algae.
- *Halimeda* spp. was the most common and relatively abundant macroalga recorded.

Site Descriptions:
TIN 2:
This site was located on the southwest side of Tinian. It was a sloping, largely cement reef with moderate relief and sand channels. Turf algae, crustose coralline algae, *Halimeda* spp., blue-green algae, *Lobophora* sp., *Amphiroa* sp., *Dictyota* sp., *Jania* sp., and *Padina* sp., were collected during the photoquadrat surveys. Additionally, a green blade tentatively identified as *Anadyomene* sp., as well as *Ventricaria ventricosa*, *Caulerpa racemosa* and *C. serrulata* were collected during the random swim.

TIN 4:
This site was located on the southeast side of the island just south of the suicide cliffs. It was characterized by a number of large boulders covered in turf algae and with a diversity of algae. Turf algae, blue-green algae, crustose coralline algae, *Halimeda* sp., *Neomeris* sp., *Ventricaria ventricosa*, *Jania* sp., *Galaxaura* sp., *Dictyota* sp., *Bornetella* sp., *Dictyosphaeria* sp., and *Caulerpa* sp. were recorded from the photoquadrats. *Chlorodesmis* sp., *Halymenia* sp., *Tydemania* sp., *Avrainvillea* sp., *Caulerpa filicoides, C. serrulata*, *Rhipidosiphon* sp., and a branched red that is possibly *Bostrychia* sp. were collected during the random swim.

TIN 1:
This site was on the east side of Tinian directly off from the long beach. It was gently sloping with a relatively high occurrence of *Acropora* sp. *Asparagopsis taxiformis* was very common. In addition, turf algae, *Halimeda* spp., *Padina* sp., *Neomeris* sp., blue-green algae, branched coralline algae, *Turbinaria ornata*, *Dictyota* sp., *Jania* sp., *Galaxaura* sp., *Boodlea* sp., *Caulerpa* sp., *Amansia* sp., *Portieria* sp., and an orange encrusting alga were recorded along within the photoquadrat areas. In addition, *Halychrysis* sp., *Portieria*, *Boodlea* sp., *Haloplegma* sp., *Ventricaria ventricosa*, *Peyssonnelia* sp., *Caulerpa serrulata*, *Chlorodesmis* sp., and an unidentified rubbery calcified red with an amorphous shape were collected during the random swim.

TIN 5:
This site was located directly from the casino inside the lagoon on the soutwest side of Tinian. The reef was characterized by a high occurrence of *Porites rus* with an average depth of 25 feet. Turf algae, *Peyssonnelia* sp., crustose coralline algae, blue-green algae, *Udotea* sp., *Halimeda* spp., *Jania* sp., branched coralline algae, *Dictyota* sp., *Amphiroa* sp., *Rhipidosiphon* sp., *Boodlea* sp., *Padina* sp., and a strap like red alga were recorded within the photoquadrat area. In addition, *Galaxaura* sp., *G. marginata*, and *Caulerpa serrulata* were recorded during the random swim.

TIN 3:
This site was located on the west side in a nice cove area. There was a high occurrence of Porites rus with large sand patches. Turf algae, *Amphiroa* sp., *Galaxaura* sp., *Caulerpa* spp., *Neomeris* sp., crustose coralline algae, *Peyssonnelia* sp., *Halimeda* sp., blue-green algae, *Dictyota* sp., *Actinotrichia* sp., *Chlorodesmis* sp., branched coralline algae, *Jania* sp., *Ventricaria ventricosa*, *Dictyota* sp., and *Rhipidosiphon* sp. were recorded within the photoquadrat survey area. In addition, *Udotea* sp., and *Portieria* sp. were collected.

TIN 6:
This site was on the northwestern tip of Tinian. It was a largely cement reef with little live coral and a high abundance and diversity of algae. In addition to those recorded at earlier sites from Tinian, the following algae were collected: *Bryopsis* sp., *Amansia* sp., *Caulerpa mexicana*, *Valonia* sp., *Boodlea* sp., the same unidentified rubbery calcified red that was found at TIN 1, as well as a red tentatively identified as *Rhodogorgon ramosissima*, and one red algae that is pinnately branched tentatively identified as *Bostrychia* sp. which was also collected at TIN 4. Refer to table for complete genera list.

Table 4: Algae of Tinian. 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.

	TIN 2	**TIN 4**	**TIN 1**	**TIN 5**	**TIN 3**	**TIN 6**	**Island average**
Anadyomene	*						**0.00 (0.00)**
Avrainvillea		*					**0.00 (0.00)**
Boodlea			**8.33** *7.00*	**25.00** *4.00*			**5.56 (10.09)** *5.50 (2.12)*
Bornetella		**25.00** *6.67*					**4.17 (10.21)** *6.67*
Caulerpa	*	**8.33** *6.00*	**16.67** *6.50*	*	**16.67** *6.00*	**8.33** *5.00*	**8.33 (7.45)** *5.88 (0.63)*
Chlorodesmis		*	*		**16.67** *5.00*	*	**2.78 (6.80)** *5.00*
Dictyosphaeria		**33.33** *6.50*				**25.00** *6.67*	**9.72 (15.29)** *6.58 (0.12)*
Halimeda	**66.67** *3.38*	**41.67** *4.80*	**10** *2.50*	**41.67** *4.20*	**41.67** *5.40*	**66.67** *2.63*	**59.72 (23.22)** *3.82 (1.18)*

	TIN 2	TIN 4	TIN 1	TIN 5	TIN 3	TIN 6	Island average
Neomeris	**16.67** *7.50*	**75.00** *5.11*	**66.67** *6.13*		**8.33** *5.00*	**16.67** *4.00*	**30.56** **(31.91)** *5.55* *(1.33)*
Rhipidosiphon		*		**8.33** *5.00*	**8.33** *5.00*		**2.78** **(4.30)** *5.00* *(0.00)*
Tydemania		*					**0.00** **(0.00)**
Udotea				**8.33** *5.00*	*		**1.39** **(3.40)** *5.00*
Valonia						*	**0.00** **(0.00)**
Ventricaria	*	**25.00** *6.00*	*		**8.33** *3.00*	*	**5.56** **(10.09)** *4.50* *(2.12)*
Actinotrichia					**16.67** *6.50*		**2.78** **(6.80)** *6.50*
Amansia			**8.33** *7.00*			*	**1.39** **(3.40)** *7.00*
Amphiroa	**66.67** *5.38*			**75.00** *3.33*	**75.00** *3.44*	**33.33** *4.50*	**41.67** **(35.75)** *4.16* *(0.96)*
Asparagopsis			**33.33** *2.00*			*	**5.56** **(13.61)** *2.00*
Galaxaura		**66.67** *5.13*	**8.33** *7.00*	*	**25.00** *6.67*	**41.67** *3.00*	**23.61** **(26.57)** *5.45* *(1.82)*
Gelid						**16.67** *6.00*	**2.78** **(6.80)** *6.00*
Haloplegma			*				**0.00** **(0.00)**
Halychrysis			*				**0.00** **(0.00)**
Halymenia		*					**0.00** **(0.00)**
Jania	**16.67** *7.00*	**75.00** *5.33*	**33.33** *5.75*	**8.33** *7.00*	**33.33** *7.00*		**27.78** **(26.70)** *6.42* *(0.81)*
Martensia				*			**0.00** **(0.00)**
Peyssonnelia			*	**50.00** *2.67*	**83.33** *3.50*	**66.67** *3.50*	**33.33** **(38.01)** *3.22*

	TIN 2	TIN 4	TIN 1	TIN 5	TIN 3	TIN 6	Island average
							(0.48)
Portieria			**8.33** *7.00*		*	*	**1.39** **(3.40)** *7.00*
branched upright coralline			**8.33** *6.00*	**8.33** *8.00*	**16.67** *4.00*	**8.33** *5.00*	**6.94** **(6.27)** *5.75* *(1.71)*
crustose coralline	**83.33** *3.00*	**66.67** *2.75*		**33.33** *2.75*	**66.67** *2.38*	**25.00** *2.33*	**45.83** **(31.51)** *2.64* *(0.28)*
Dictyota	**50.00** *6.00*	**66.67** *6.38*	**16.67** *6.50*	**8.33** *9.00*	**25.00** *6.00*	**8.33** *7.00*	**29.17** **(24.01)** *6.81* *(1.13)*
Lobophora	**83.33** *3.30*						**13.89** **(34.02)** *3.30*
orange crust			**8.33** *6.00*				**1.39** **(3.40)** *6.00*
Padina	**8.33** *6.00*	**25.00** *4.67*	**58.33** *4.00*	**8.33** *6.00*			**16.67** **(22.36)** *5.17* *(1.00)*
Turbinaria			**8.33** *7.00*			**8.33** *6.00*	**2.78** **(4.30)** *6.50* *(0.71)*
Blue-green	**91.67** *3.18*	**100** *3.00*	**75.00** *3.11*	**75.00** *2.78*	**41.67** *6.00*		**63.89** **(37.14)** *3.61* *(1.34)*
Turf	**100** *1.00*	**100** *1.00*	**100** *1.00*	**100** *1.00*	**100** *1.17*	**83.33** *1.00*	**97.22** **(6.80)** *1.03* *(0.07)*

Aguijan (Goat I.):

Algal Highlights:

- Turf algae, crustose coralline algae, and cyanobacteria were the most common and relatively abundant forms of algae recorded.
- *Dictyosphaeria* sp. were the most common and relatively abundant macroalgae recorded.

Site Descriptions:

AGU 1:

This site was located on the southeast side of Aguijan. It was a pavement reef with a few large boulders and very little coral. Turf algae, Microdictyon sp., and crustose coralline

algae were the most common species in the photoquadrat area. During the random swim, *Liagora* sp., *Caulerpa webbiana*, *C. filicoides*, *Bornetella* sp., *Avrainvillea* sp., *Ventricaria ventricosa*, and *Amphiroa* sp. were recorded.

AGU 2:
This site was located on the west side of Aguijan. It was a nice reef surrounded by white sand. There were large *Pocillopora eydouxi* colonies; it also seemed to have had recent crown-of-thorns predation. Turf algae, crustose coralline algae, blue-green algae, *Caulerpa* spp., and *Halimeda* spp. were the most common species seen during the photoquadrat survey. *Udotea* sp., *Padina* sp., and *Lobophora* sp. were some of the species recorded during the random swim.

AGU 3:
This site was located on the north side of Aguijan. It was composed of coralline algae and turf algae reef with little live coral. Additionally, blue-green algae, Branched corallines, *Dictyosphaeria versluysii*, and *Halimeda* sp. were commonly seen within the photoquadrat area. Notably, *Halychrysis* sp. was found within in one of the quadrats. Coralline Lethal Orange Disease (CLOD) was seen in a number of different places and photo documented.

Table 5: Algae of Aguijan. 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.

	AGU 1	**AGU 2**	**AGU 3**	**Island average**
Avrainvillea	*			**0.00 (0.00)**
Boodlea			**8.33** *4.00*	**2.78 (4.81)** *4.00*
Bornetella	*			**0.00 (0.00)**
Bryopsis				**0.00 (0.00)**
Caulerpa	**16.67** *5.50*	**25.00** *3.67*	**16.67** *5.00*	**19.44 (4.81)** *4.72 (0.95)*
Caulerpella				**0.00 (0.00)**
Chlorodesmis			**8.33** *6.00*	**2.78 (4.81)** *6.00*
Cladophora				**0.00 (0.00)**
Codium				**0.00 (0.00)**

	AGU 1	AGU 2	AGU 3	Island average
Dictyosphaeria	**33.33** *3.25*	**25.00** *5.00*	**58.33** *3.71*	**38.89** **(17.35)** *3.99* *(0.91)*
Halimeda	**8.33** *5.00*	**41.67** *4.20*	**41.67** *2.80*	**30.56** **(19.25)** *4.00* *(1.11)*
Microdictyon	**5** *2.50*			**16.67** **(28.87)** *2.50*
Neomeris		*		**0.00** **(0.00)**
Udotea		*		**0.00** **(0.00)**
Ventricaria	*	*		**0.00** **(0.00)**
Amphiroa	*			**0.00** **(0.00)**
Halychrysis			**8.33** *7.00*	**2.78** **(4.81)** *7.00*
Jania	**8.33** *6.00*	**33.33** *4.75*	**50.00** *5.33*	**30.56** **(20.97)** *5.36* *(0.63)*
Liagora	*			**0.00** **(0.00)**
Peyssonnelia			**8.33** *3.00*	**2.78** **(4.81)**
Portieria			*	**0.00** **(0.00)**
branched upright coralline			**25.00** *3.00*	**8.33** **(14.43)** *3.00*
crustose coralline	**66.67** *2.63*	**100** *2.58*	**91.67** *1.55*	**86.11** **(17.35)** *2.25* *(0.61)*
Brown crust			**16.67** *2.50*	**5.56** **(9.62)** *2.50*
Dictyota	**8.33** *5.00*	**58.33** *4.57*	**8.33** *5.00*	**25.00** **(28.87)** *4.86* *(0.25)*
Lobophora		*		**0.00** **(0.00)**
orange crust	**8.33** *4.00*		**16.67** *5.00*	**8.33** **(8.33)** *4.50* *(0.71)*
Padina		*		**0.00** **(0.00)**

	AGU 1	AGU 2	AGU 3	Island average
Stypopodium				**0.00 (0.00)**
Turbinaria	*		**8.33** *5.00*	**2.78 (4.81)** *5.00*
Blue-green	**50.00** *2.67*	**100** *2.33*	**33.33** *3.50*	**61.11 (34.69)** *2.83 (0.60)*
turf	**100** *1.00*	**100** *1.33*	**100** *1.92*	**100.00 (0.00)** *1.42 (0.46)*

Rota:

Algal Highlights:

- Turf algae and cyanobacteria were the most common and relatively abundant algal forms recorded.
- Halimeda spp. followed by *Dictyota* spp. were the most common and relatively abundant macroalgae recorded. They were found in 66.67 and 38.89 percent of the photoquadrats, respectively.
- While rarely encountered (1.39 percent of the quadrats), *Asparagopsis taxiformis* was locally abundant with an average rank of 2.

Site Descriptions:

ROT 3:

This site was on the south side of Sasanhaya Bay which is located on the west side of Rota. The site was a large reef with high relief and very little live coral. After the 2nd transect there was an area of high *Porites rus* cover. Turf algae, crustose coralline algae, *Amphiroa* sp., *Dictyota* sp., blue-green, *Jania* sp., orange-crust, and *Peyssonnelia* sp. were commonly seen along the transect. In addition, *Turbinaria ornata* along with *Tydemania expeditionis*, *Caulerpa serrulata* and *C. filicoides* were also recorded.

ROT 2:

This site was on the south side of Rota. This site was flat with very little relief and very little live coral; it was dominated by a sponge (*Dysidea herbacea*). This reef looked like a desert with the sponges as cactuses. Under the silt there was a rather diverse assemblage of macroalgae. *Halimeda* sp., *Dictyosphaeria* sp., *Chondria* sp., *Microdictyon* sp., *Neomeris* sp., *Caulerpa* sp., *Udotea* sp., and *Bornetella* sp. were recorded from within the photoquadrat area. Portieria hornemannii, *Actinotrichia* sp., *Valonia* sp., *Avrainvillea* sp., and *Chlorodesmis* sp. were additionally collected during the random swim.

ROT 1:

This site was on the southeast side of Rota. The survey area was on a nice reef that was surrounded by pavement reef and boulders. There was a high abundance of *Avrainvillea* spp. One in particular had very thick (~1 cm) blades and was relatively free of epiphytes. In addition to the *Avrainvillea*, *Halimeda* sp., *Chlorodesmis* sp., *Jania* sp., *Caulerpa* sp.,

Dictyosphaeria sp., *Portieria* sp., *Boodlea* sp., *Microdictyon* sp., *Galaxaura* sp. and *Padina* sp. were collected within the quadrat area. An epiphytic slippery red alga tentatively identified as *Crouania* sp. was found during the random swim along with *Valonia* sp. and *Caulerpa taxifolia*.

ROT 7:
This site was on the north end of Sasanhaya Bay right off from the town which is located on the west side of Rota. This site was relatively shallow, 23-27 ft . There was very little live coral but relatively high relief. Turf algae and blue-green algae were the most abundant. *Caulerpa* spp., *Jania* sp., crustose coralline algae, *Neomeris* sp., *Amphiroa* sp., *Dictyota* sp., *Avrainvillea* sp., and *Peyssonnelia* sp. were additionally recorded from the photoquadrat area. *Valonia* sp., *Ventricaria ventricosa, Tydemania expeditionis, Portieria hornemannii, Crouania* sp., and *Galaxaura* were collected during the random swim.

ROT 6:
This site was on the northwest side of Rota just north of the town. The site was a sloping pavement reef with a large boulder/ wall just north of the 2nd transect. This wall had a diverse assemblage of algae. Within the quadrat area, turf algae, *Halimeda* sp., *Dictyota* sp., and blue-green algae were the dominant species. Additionally, *Dictyosphaeria* sp., *Caulerpa* sp., Padina sp., *Neomeris* sp., *Jania* sp., *Chlorodesmis* sp., *Portieria hornemannii*, and *Galaxaura* sp., were recorded from the photoquadrat area. *Anadyomene* sp., *Halychrysis* sp., the pinnately branched red previously identified as *Bostrychia* sp., *Turbinaria ornata*, *Valonia* sp., and *Ventricaria ventricosa* were found during the random swim (primarily along the wall.)

ROT 5:
This site was on the north side of Rota. It was a gently sloping spur and groove reef with ~12 % - 20% live coral cover. Turf algae, blue-green algae, *Galaxaura* sp., *Portieria hornemannii*, *Dictyota* sp., and *Halimeda* spp. were the most commonly seen within the quadrat area. Additionally, *Chlorodesmis* sp., *Padina* sp., *Udotea* sp., *Neomeris* sp., and patches of *Asparagopsis taxiformis* were also seen within the photoquadrat area. *Halymenia* sp., *Caulerpa* spp., were also collected during the random swim.

Table 6: Algae of Rota. 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.

	ROT 3	**ROT 2**	**ROT 1**	**ROT 7**	**ROT 6**	**ROT 5**	**Island average**
Anadyomene					*		**0.00** **(0.00)**
Avrainvillea		*	**33.33** *3.25*	**8.33** *5.00*			**6.94** **(13.35)** *4.13* *(1.24)*

	ROT 3	ROT 2	ROT 1	ROT 7	ROT 6	ROT 5	Island average
Boergesenia							**0.00** **(0.00)**
Boodlea			**8.33** *4.00*				**1.39** **(3.40)** *4.00*
Bornetella		**16.67** *6.50*					**2.78** **(6.80)** *6.50*
Bryopsis	**16.67** *7.00*						**2.78** **(6.80)** *7.00*
Caulerpa	*	**16.67** *6.50*	**25.00** *7.00*	**25.00** *4.00*	**8.33** *7.00*	*	**12.50** **(11.49)** *6.13* *(1.44)*
Caulerpella							**0.00** **(0.00)**
Chlorodesmis		*	**25.00** *5.33*		**16.67** *3.00*	**25.00** *4.67*	**11.11** **(12.55)** *4.33* *(1.20)*
Cladophora							**0.00** **(0.00)**
Codium							**0.00** **(0.00)**
Dictyosphaeria	**16.67** *5.00*	**75.00** *3.89*	**50.00** *5.33*		**50.00** *5.50*		**31.94** **(30.92)** *4.93* *(0.72)*
Halimeda	**33.33** *5.00*	**91.67** *3.36*	**91.67** *3.00*		**91.67** *2.45*	**91.67** *2.36*	**66.67** **(40.14)** *3.24* *(1.07)*
Microdictyon		**75.00** *3.44*	**33.33** *5.50*				**18.06** **(30.92)** *4.47* *(1.45)*
Neomeris	*	**25.00** *5.67*	**41.67** *5.40*	**41.67** *5.20*	**25.00** *6.33*	**25.00** *7.67*	**26.39** **(15.29)** *6.05* *(1.00)*
Rhipidosiphon							**0.00** **(0.00)**
Trichosolen							**0.00** **(0.00)**
Tydemania	**8.33** *4.00*			*			**1.39** **(3.40)** *4.00*
Udotea		**16.67** *7.00*				**8.33** *7.00*	**4.17** **(6.97)** *7.00* *(0.00)*
Valonia		*	*	*	*		**0.00** **(0.00)**
Ventricaria		*		*	*		**0.00**

	ROT 3	ROT 2	ROT 1	ROT 7	ROT 6	ROT 5	Island average
							(0.00)
Acanthophora							**0.00** **(0.00)**
Actinotrichia		*					**0.00** **(0.00)**
Amansia							**0.00** **(0.0)**
Amphiroa	**83.33** *3.70*			**41.67** *4.80*	**16.67** *6.50*	**33.33** *5.00*	**29.17** **(31.51)** *5.00* *(1.15)*
Asparagopsis					*	**8.33** *2.00*	**1.39** **(3.40)** *2.00*
Botryocladia							**0.00** **(0.00)**
Callophycus							**0.00** **(0.00)**
Carpopeltis							**0.00** **(0.00)**
Cheilosporum							**0.00** **(0.00)**
Chondria		**66.67** *4.25*					**11.11** **(27.22)** *4.25*
Chrysymenia							**0.00** **(0.00)**
Coelarthrum							**0.00** **(0.00)**
Corynocystis							**0.00** **(0.00)**
Crouania			*	*			**0.00** **(0.00)**
Dasya							**0.00** **(0.00)**
Dudresnaya							**0.00** **(0.00)**
Galaxaura			**8.33** *8.00*	*	**8.33** *7.00*	**100.00** *4.42*	**19.44** **(39.67)** *6.47* *(1.85)*
gelid							**0.00** **(0.00)**
Gelidiopsis							**0.00** **(0.00)**
Gibsmithia							**0.00** **(0.00)**
Haloplegma							**0.00** **(0.00)**
Halychrysis					*		**0.00** **(0.00)**
Halymenia						*	**0.00** **(0.00)**
Hypnea							**0.00** **(0.00)**

	ROT 3	ROT 2	ROT 1	ROT 7	ROT 6	ROT 5	Island average
Hypoglossum							**0.00 (0.00)**
Jania	**66.67** *4.88*		**8.33** *7.00*	**66.67** *3.75*	**16.67** *6.00*	**8.33** *3.00*	**27.78 (30.58)** *4.93 (1.62)*
Kallymenia							**0.00 (0.00)**
Laurencia/ Chondrophycus							**0.00 (0.00)**
Liagora							**0.00 (0.00)**
Martensia							**0.00 (0.00)**
Mastophora							**0.00 (0.00)**
Myriogramme							**0.00 (0.00)**
Peyssonnelia	**25.00** *4.00*			**8.33** *5.00*			**5.56 (10.09)** *4.50 (0.71)*
Portieria		*	**16.67** *3.00*	*	**8.33** *4.00*	**83.33** *5.50*	**18.06 (32.67)** *4.17 (1.26)*
Predaea							**0.00 (0.00)**
Titanophora							**0.00 (0.00)**
Trichogloea							**0.00 (0.00)**
Tricleocarpa							**0.00 (0.00)**
Vanvoorstia							**0.00 (0.00)**
Wrangelia							**0.00 (0.00)**
Yamadaella							**0.00 (0.00)**
branched upright coralline							**0.00 (0.00)**
crustose coralline	**66.67** *2.63*	**8.33** *5.00*	**66.67** *2.88*	**100.00** *3.00*	**41.67** *4.80*		**47.22 (38.25)** *3.66 (1.14)*
Brown crust							**0.00 (0.00)**
Dictyota	**66.67** *4.88*			**25.00** *5.33*	**83.33** *4.60*	**58.33** *5.43*	**38.89 (35.62)** *5.06 (0.39)*
Hydroclathrus							**0.00**

	ROT 3	ROT 2	ROT 1	ROT 7	ROT 6	ROT 5	Island average
							(0.00)
Lobophora	**25.00** *5.00*						**4.17** **(10.21)** *5.00*
orange crust	**8.33** *5.00*						**1.39** **(3.40)** *5.00*
Padina			**8.33** *3.00*		**33.33** *6.75*	**16.67** *6.50*	**9.72** **(13.35)** *5.42* *(2.10)*
Sargassum							**0.00** **(0.00)**
Stypopodium							**0.00** **(0.00)**
Turbinaria	**8.33** *5.00*				*		**1.39** **(3.40)** *5.00*
Blue-green	**100.00** *3.58*	**83.33** *3.10*	**66.67** *3.63*	**91.67** *2.55*	**100.00** *2.92*	**91.67** *3.45*	**88.89** **(2.55)** *3.20* *(.43)*
turf	**100.00** *1.08*	**100.00** *1.00*	**83.33** *1.10*	**100.00** *1.00*	**100.00** *1.00*	**100.00** *1.00*	**97.22** **(.80)** *1.03* *(.05)*

Appendix D. Macroinvertebrates (Alexander M. Kerr [Leg 1])

Saipan (Bird Island, Tank Beach, Laolao Beach):
The holothuroid *Stichopus chloronotus* was the dominant benthic macroinvertebrate at all sites. Holothuroids of several species were common. This site had numerous echinoids, *Echinostrephus aciculatus*. Several of the gastropods *Corallophyllia* spp. were also present at Laolao. The trochid gastropod *Trochus niloticus* was also seen occasionally.

Guguan:
The echinoid *Echinostrephus aciculatus* was moderately abundant. Othe r echinoderms present included the asteroid *Linckia multifora* and a juvenile *Acanthaster planci*. Moderately abundant gastropods included *Trochus niloticus*, *Conus* spp and *Tridacna maxima*.

Pagan:
This island had a more diverse fauna of macroinvertebrates than did Guguan. Large and conspicuous species were the holothuroid *Bohadschia argus*, the echinoids *Echinostrephus aciculatus* and *Echinothrix diadema*. *Acanthaster planci* was also observed. One palinurid crustacean *Palunirus* sp. was seen. A fairly diverse gastropod fauna was also seen, which included the colorful nudibranchs *Phyllidia* spp., as well as the gastropods *Conus* spp, *Nassarius* and the cephalopod *Octopus* sp.

Asuncion:
The macroinvertebrate fauna of Asuncion was similar to that of Pagan, though somewhat less diverse. The coral-associated polycheate *Spirobranchus* sp(p) was moderately common in areas with colonies of the massive scleractinian corals *Porites* spp. and *Astreopora*. Clonal, sessile species were widespread at the sites, though invariably formed a low (< 5%) portion of the total cover. These included hydroids, the zoanthid (= zoantharian) *Palythoa* sp, sponges and alcyonacean soft corals, mostly *Lobophyton* sp.

Uracas:
This island was noticeably less diverse in macroinvertebrates than the islands previously surveyed. The small asteroid *Linckia multifora* was rather abundant. The ostreid bivalve *Alectryonella plicata* was abundant in areas dominated by volcanic boulders. Another attached bivalve, *Chama* sp., also occurred, but much less frequently. Also attached to bare rock was the polycheate *Spirorbis* sp. A single specimen of the undescribed *Echinometra* sp. A (formerly *E. mathaei*) was also seen.

Table 1. List of benthic macroinvertebrates of the northern Mariana Islands.

	Guguan	Pagan	Asuncion	Maug	Uracas
PORIFERA					
Porifera spp	+	+	+	+	+
CNIDARIA					
Palythoa		+	+	+	+
Actiniarians		+			
Discosoma sp.		+		+	
Plumarid hydrozoans		+	+	+	
Lobophytum sp.	+	+	+	+	

	Guguan	Pagan	Asuncion	Maug	Uracas
Sarcophyton sp.			+	+	
Sinularia and Cladiella spp.		+	+		
Distichopora spp		+		+	+
Stylaster sp.		+	+	+	
Heteractis spp.		+		+	
Stichodactyla sp.					
Pachyclavularia sp.		+		+	
POLYCHAETA					
Spirobranchus spp.	+		+	+	
Terebella sp.					
Serpulidae					+
MOLLUSKS					
Spiky turbo			+	+	
Alectronella plicata		+			+
Trochus niloticus	+				
Tectus pyramis			+	+	
Charonia tritonis				+	
Coralliophila violacea					
Drupa spp	+		+	+	+
Conus spp	+	+	+	+	+
Chama sp		+		+	+
Cypraea moneta					
Cypraea caputserpentsis					+
Cypraea spp					
Lambis spp		+		+	
Nassarius sp		+			+
Pedum spondyloideum				+	
Strombus gibberulus					
Tridacna spp	+	+	+	+	
Turridae		+		+	
Phyllidia spp		+		+	+
Pectinidae		+			
Nudibranchia				+	
Vasum spp	+	+	+		
Vermetidae	+	+	+	+	
Cerithiidae					
Octopus sp		+			
Other gastropods		+		+	
CRUSTACEA					
Paguritta spp		+	+	+	
Dardanus spp				+	
Calcinus spp		+	+	+	
Striped conus hermit		+			
Stenopus sp				+	
Odontodactylus scyllarus		+			
Trapezia sp.				+	+
Ciliopagurus strigatus					
Panulirus sp		+			
Percnon planissimum			+		+
Other hermit crabs		+			

	Guguan	Pagan	Asuncion	Maug	Uracas
Attiine shrimp			+		
Cirrhipedia		+			
ECHINOIDEA					
Colobocentrotus atratus					
Diadema savignyi					
Echinostrephus aciculatus	+	+	+	+	+
Echinothrix calamaris		+		+	
Echinothrix diadema	+	+		+	+
Echinometra sp. A					+
Heterocentrotus sp		+			
Eucidaris metularia				+	
OPHIUROIDEA					
Ophiocoma echinata					
Ophiuroid spp		+		+	+
CRINOIDEA					
Crinoid sp aff Oxycomanthus					
Crinoid spp aff Comaster		+		+	
ASTEROIDEA					
Acanthaster planci	+	+		+	
Linckia guildingii		+	+		
Linckia multifora	+	+	+	+	+
Mithrodia clavigera					
HOLOTHUROIDEA					
Actinopyga echinata		+			
Actinopyga mauritiana	+	+			
Actinopyga palauensis				+	
Bohadschia argus		+			
Holothuria atra		+			
Holothuria whitmaei		+			
Holothuria edulis				+	
Pearsonothuria graeffei				+	
Stichopus chloronotus		+		+	
Stichopus horrens		+			
Thelenota ananas					
Synapta maculate					
ASCIDIACEA					
Polycarpa cryptocarpa			+	+	
Didemnum spp		+		+	+
Other ascidian spp					

Maug:

Depite its relatively small size, the diversity of this island was comparable to that of more southern islands, such as Pagan. This was due to the presence of well-developed reefs at many locations, including the sheltered “lagoon” formed by the large, drowned caldera. For example, the echinoderm fauna rivaled that sampled on Saipan, with 10 species of holothuroids seen, nearly the full complement of exposed, diurnal holothuroids reported from the Marianas Archipelago. Undoubtedly, further investigation, particularly with nocturnal surveys would easily double this number. Observation of faeces of several unidentified large invertebrates, including holothuroids, supports this prediction. Unlike

at most of the other islands surveyed so far, *Acanthaster planci* were only rarely observed. Individuals seen were widely scattered, fully exposed, and quite large, always about 50 cm in diameter.

Agrihan:
The asteroid *Linckia multifora* was the dominant benthic macroinvertebrate at two sites. Holothuroids of several species were present, though not common. This site also had few tridacnid clams, e.g., *Tridacna maxima*. Of all the islands sampled, only Agrihan had a few Cheilostome bryozoans. The brightly coloured grapsid crab *Percon planissimus* was also present in small numbers at site AGR-6.

Alamagan:
The most common invertebrates seen were those associated with corals, mostly poritid species. These included vermetid gastropods, *Spirobranchus* spp. Worms and pagurittid crabs *Pagurrita* spp. The echinoid *Echinostrephus aciculatus* was moderately abundant. Other invertebrates were mostly sessile taxa, including the alcyonarians *Lobophytum, Sinularia,* as well as the zoantharian *Zoanthus* sp.

Sarigan:
The macroinvertebrate fauna of Sarigan was most similar to that of Guguan, and about as diverse. The coral-associated polycheate *Spirobranchus* sp.(p) was moderately common in areas with colonies of the massive scleractinian corals *Porites* spp. and *Astreopora*. Clonal, sessile species were widespread at the sites, though invariably formed a low (< 5%) portion of the total cover. These included hydroids, the zoanthid (= zoantharian) *Palythoa* sp., sponges and alcyonacean soft corals, mostly Lobophyton sp.

Zealandia Bank:

This pinnacle was noticeably less diverse in macroinvertebrates than the islands previously surveyed, undoubtedly due to its small area. The small asteroid Linckia multifora was somewhat abundant. I also recorded the echinoderms *Echinostrephus aciculatus* and *Echinothrix diadema*. Aggressive sharks unfortunately prevented a more thorough tally of the invertebrate fauna.

Table 1. List of benthic macroinvertebrates of the northern Mariana Islands.

	Maug	Agrihan	Alamagan	Sarigan	Zealandia I
FORAMINIFERIDA					
Marginopora sp.		+		+	
PORIFERA			+		
Porifera spp	+		+	+	
CNIDARIA					
Palythoa spp.		+	+	+	
Actiniarians		+	+	+	
Discosoma sp.	+			+	
Plumarid hydrozoans		+	+	+	
Other hydrozoans		+			
Lobophytum sp.	+	+	+		
Sarcophyton sp.		+			
Sinularia and Cladiella spp.	+	+	+	+	

	Maug	Agrihan	Alamagan	Sarigan	Zealandia I
Distichopora spp					
Stylaster sp.		+			
Heteractis spp.					
Stichodactyla sp.		+			
Pachyclavularia sp.					
POLYCHAETA					
Sabellidae				+	
Spirobranchus spp.		+	+	+	
Serpulidae					
Terebella sp.					
MOLLUSKS					
Spiky turbo like		+			
Alectronella plicata		+	+		
Trochus niloticus	+				
Tectus pyramis	+				
Charonia tritonis				+	
Coralliophila violacea					
Drupa spp					
Conus spp	+	+	+		
Chama sp					
Cypraea moneta					
Cypraea caputserpentsis					
Cypraea spp	+				
Lambis spp	+			+	
Nassarius sp					
Patelloida sp			+		
Pedum spondyloideum			+		
Strombus gibberulus	+				
Tridacna spp	+	+	+	+	
Turridae	+				
Phyllidia spp					
Pectinidae					
Nudibranchia	+		+	+	
Phyllidia spp		+		+	
Vasum spp			+		
Vermetidae	+	+	+	+	
Cerithiidae	+				
Octopus sp					
Other gastropods			+		
CRUSTACEA					
Paguritta spp	+		+	+	
Dardanus spp	+	+		+	
Calcinus spp	+	+	+	+	
Striped conus hermit		+	+		
Stenopus sp					
Odontodactylus scyllarus					
Trapezia sp.			+		
Ciliopagurus strigatus					
Panulirus sp					
Percnon planissimum		+			

	Maug	Agrihan	Alamagan	Sarigan	Zealandia I
Other hermit crabs					
Attiine shrimp					
Cirrhipedia				+	
Xanthidae			+		
ECHINOIDEA					
Colobocentrotus atratus				+	
Diadema savignyi					
Echinostrephus aciculatus	+	+	+	+	+
Echinothrix calamaris					
Echinothrix diadema	+	+	+	+	+
Echinometra sp. A			+	+	
Heterocentrotus sp					
Eucidaris metularia					
OPHIUROIDEA					
Ophiocoma echinata	+				
Ophiuroid spp			+		
CRINOIDEA					
Crinoid sp aff Oxycomanthus					
Crinoid spp aff Comaster					
ASTEROIDEA					
Acanthaster planci	+				
Linckia guildingii					
Linckia multifora	+	+	+	+	+
Mithrodia clavigera	+				
HOLOTHUROIDEA					
Actinopyga echinata					
Actinopyga mauritiana	+	+		+	
Actinopyga palauensis					
Bohadschia argus					
Holothuria atra	+	+			
Holothuria whitmaei				+	
Holothuria edulis	+				
Pearsonothuria graeffei					
Stichopus chloronotus	+			+	
Stichopus horrens					
Thelenota ananas					
Synapta maculata					
ASCIDIACEA					
Polycarpa cryptocarpa		+			
Didemnum spp		+		+	
Other ascidian spp	+				

Leg 2- Macroinvertebrates (Elizabeth Keenan)

Saipan (5 sites):
The diversity at Saipan was high relative to other islands sampled during this leg of the cruise. Hermit crabs, including *Dardanus sp., Calcinus sp.* and the tiny *Paguritta sp.,* were present at all sites and fairly common at a subset of these. Specimens of *Culcita novaeguineae* were present at a number of the sites, as were *Linkia sp. Tridacna sp.* were

found dispersed over the areas surveyed at a density of about one per transect. At one site three specimens of *Acanthaster planci* were sited and at another there was apparent *A. planci* predation in the area. Holothurians were found at all but one site and included *Bohadschia argus, Holothuria nobilis*, and *Stichopus chloronotus*. Additional sightings included *Lambis chiragra, Spirobranchus gigantus*, and several sightings from the family Comasteridae.

Pathfinder Reef (2 sites):
The dominant macroinvertebrate at this reef was the bivalve *Spondylus* sp., which was present in over half of the quadrats sampled. At the second site the echinoids were common including *Echinostrephus* sp. and *Echinothrix* sp. Also present at this bank were a number of Trapezia crabs.

Arakane (2 sites):
The most abundant invertebrate on this bank was by far the ascidian *Didemnum molle*. At one site there were generally fifty to three hundred per quadrat. The urchin *Echinostrephus sp* . was also abundant. Several *Spondylus sp.* were found on one of the transects. Two specimens of the crab, *Percnon planissum*, were found along one of the transects.

Tinian (6 sites):
A large diversity of sea cumbers was seen at this island including *Thelona ananas, Holothuria atra, Actinopyga obesa, Holothuria fuscopunctata, Actinopyga mauritianna, Holothuria nobilis, Holothuria edulis,* and *Bohadschia graeffai*. *Spirobranchus giganteus* was present at nearly all sites and abundant near a few. The small nudibranch, *Thurdilla sp*., was present at several sites. Several species of urchins were present, but not at high densities at any of the sites. Four specimens of *Acanthaster planci* were found on one of the 2x25 transects with others seen nearby. *A. planci* did not appear on any of the other transects but was noted near one of the other sites.

Goat (3 sites):
Echinostrephus sp. was fairly abundant at one of the sites, while *Echinometra* appeared at the other two in low numbers. Diversity and abundance was low overall compared to the larger islands. Of note was the presence of a Vermetid snail at two of the sites. Three *Acanthaster planci* were encountered along one 2x25 transect, and two were seen on the random swim of a second transect. One of the sites had a high percent cover of the soft coral, *Sinularia sp.*

Rota (6 sites):
Notable observations at this island include the fairly abundant presence of *Linkia multiflora* on four of the transects. At one of the sites the dominant habitat feature was a sponge which had the growth form of a fan as well as erect columns. This site also had relatively high abundance of *Echinostrephus sp.,* reaching approximately fifty per transect. Another site had almost as many large urchins including both *Echinothrix sp.* and *Diadema sp*. Half of the sites had *Thurdilla sp*. present. The only zoanthid seen during this leg, *Palythoa sp*., was found here.

Appendix E. Towed-Diver Fish / Habitat Activity Summary (Leg 1-- Stephani Holzwarth, Elizabeth Keenan, Joe Laughlin, and Molly Timmers)

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 s. The diver on the benthic towboard observed and recorded habitat composition (hard coral, stressed hard, soft coral, macro algae, 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 the first survey period, a total of 36 towed-diver surveys were conducted around Saipan, Guguan, Asuncion, Pagan, and Uracus covering a total of 66.3 km of habitat. (See Table 1)

Island	**Surveyed Km**	**# of Tows**
Asuncion	9.3	5
Guguan	3.9	3
Pagan	33.8	18
Saipan	11.2	6
Uracus	8.1	4
Total	**66.3**	**36**

Benthic Observations: (Elizabeth Keenan and Molly Timmers)

The most noteworthy observation was the increased number of crown-of-thorns starfish observed during towed-diver surveys when compared to MARAMP 2003. The most significant increase was at Pagan where sightings increased 80 fold from 2003 surveys.

Saipan:
Live coral cover in the survey areas located along the east coast of Saipan was consistently low. Levels generally ranged from 1-20% over the entire area. The percentage of this coral which was stressed was less then 5% in the surveyed areas. Although only eight crown-of-thorns (COTS) were observed along 2.1 km of habitat in Puntan LauLau, the diver noted that the stress on the corals along this tow appeared to be caused by predation. In 2003, the number of COTS observed along relatively the same

tow in Puntan Laulau was 38. Twenty-four COTS were observed along 3.1 km of habitat surveyed in Puntan Hagman, and 12 COTS were observed along 1.8 km of habitat between Blue Grotto and Bird Island. Giant clams were at low levels along the east coast with the highest number being six found between Blue Grotto and Bird island.

Guguan:
Because of high winds and surf, all of the tows were located on the west side of the island and had similar hard coral cover which generally ranged from 5 to 20%. Levels of stressed corals were low (<5%) in all areas. Along most of the coast levels of giant clams they were consistently low at one per 10 min of survey time. In 2003, divers observed only one COTS along 10.5 km of surveyed habitat. This year, 17 COTS were observed along 3.9 km, 13 of which were along a 1.5 km northwest tow.

Asuncion:
Hard coral cover at this island was relatively consistent, with areas of up to 30% coral cover during all tows except the southeast corner, which had its highest level at 10%. There was little stressed coral reported. The highest concentration of giant clams found on the island is located along the west coast at approximately one reported per 5 minutes of survey time. No COTS were observed during the 2003 surveys. This year, 25 were tallied, 24 of which were located along 2.1 km of habitat along the northwest side of the island.

Uracas:
The highest levels of live coral were found on the west and north coasts at up to 20%. Stressed coral was reportedly very low at this island although possible predation was noted along the northern coast. No COTS were observed during the 8.1 km of surveyed habitat. Four cases of fouled fishing line were noted along the west side. High numbers of bivalves covered the boulders along the southern end. A large number of small linkia sp. was noted along the northern end of the island.

Pagan:
Live coral cover on this island generally ranged from 5 to 20%, with areas of highest cover occurring along the west and east coasts which had up to 50% cover. Stressed coral was low throughout the island with the exception of some areas along the southeast side which had generally 5-20% stressed and one area in the northeast with up to 60% stressed. Some of the stresses were noted as probable crown-of-thorns predation while other areas looked more like disease or bleaching related stress. Giant clams were found in relatively low numbers ranging from 0 to 27 per tow. There was a significant increase in COTS sightings. In 2003, towed divers observed only eight COTS along 40.1 km of surveyed habitat. This year, towed divers observed 674 COTS along 33.8 km of surveyed habitat. The highest concentrations were located along the northeast and southeast. Divers observed 234 COTS during 3.7 km of surveyed habitat along the southeast coast and 176 COTS during 3.2 km of surveyed habitat along the northeast coast. The 8.6 km of habitat surveyed along the north and northwest coasts contained 179 COTS.

Fish Observations: (Joe Laughlin and Stephani Holzwarth)

In 7 days of field work, a total of 36 towed-diver surveys were conducted at Saipan, Guguan, Pagan, Asuncion, and Uracas. The most notable observation during the

fish towed-diver surveys was the dramatic decrease in the presence of large predators at Uracas compared to survey results in 2003. In 2003, 67 gray reef sharks (*Carcharhinus amblyrhynchos*) were recorded compared to 1 during surveys this year. Twinspot snapper (*Lutjanus bojar*) showed a similar decrease with 239 sited in 2003 versus 13 sited this year, and no giant grouper (*Epinephelus lanceolatus*) were seen this year at Uracas, compared to three sightings of large (120+ cm) giant grouper in 2003. Overall (considering these first five islands visited) the most abundant schooling fishes over 50 cm total length (TL) were bigeye jacks (*Caranx sexfasciatus*), Heller's barracuda (*Sphyraena helleri*), and rainbow runner (*Elagatis bipinnulata*).The most commonly encountered large fishes were gray reef sharks, twinspot snapper, and snapper in the genus *Macolor* (*M. macularis* and *M. niger*) which occurred singly and in small groups. A dominant feature of the observed population of gray reef shark was that most of the sharks were of immature length (less than 100 cm TL). The average size at birth for this species of shark is 60 cm TL and the average size at maturation is 140 cm TL. The size distribution of the nurse shark (*Nebrius feruguineus*) was generally larger with most around 200 cm TL. Humphead Wrasse (*Cheilinus undulatus*) were observed only at one island, Saipan, with observations of four individuals, two of which were over 100 cm TL.

During the second survey period (or Leg 1), a total of 29 towed-diver surveys were conducted around Maug, Agrihan, Alamagan, and Sarigan covering a total of 57.8 km of habitat.

Island	Surveyed Km	# of Tows
Maug	26	13
Agrihan	10.5	5
Alamagan	10.7	6
Sarigan	10.6	5
Total	**57.8**	**29**

Benthic Observations: (Elizabeth Keenan and Molly Timmers)

Maug:
This island had consistently high hard coral cover, with the percentages reaching between 50-75% on all tows except the southernmost part of west island where it was only between 1-10%. The area of highest coral cover was along the northwest side of west island. Incidences of stressed coral were low at all sites with less than 1% except the southeast lagoon area of the west island which had some areas up to 5% stressed. It was noted in this area that the majority of the Acropora corals were dead, some only recently killed and still white. Nineteen COTS were observed in this same area by the diver thereby indicating the probable cause for the decline in the Acorporas. During the 2003 surveys, only four COTS were observed from 30 km of surveyed habitat. This year, towed divers recorded a total of 31 COTS from 26 km of surveyed habitat. Coralline algae disease was seen in the southwest corner of west island. Maug had high levels of giant clams compared to the other surveyed islands, especially along the protected sides of the islands facing the inner lagoonal area. Levels in this area were reported as high as 50 clams per 5-min segment during each tow along the lagoon and up to 100 per 5-min segment on the southeast coast of the north island and the southeast segment of west island. Around the outside of the islands the levels of clams were found to range between

0 and 50 per segment, with most tows having a total of approximately 20 to 40 clams. Two incidents of fishing line were reported in the lagoon.

Alamagan:
Hard coral cover was variable on most tows, usually ranging between 1-40%. One area of high coral cover was reported off of the northwest shore of the island, which was recorded to be 50-62% on certain segments. The southwest corner had the lowest reported cover. Signs of stressed coral were low throughout the island, with no tows showing incidences of stress higher then 1%. Giant clams were reported on all areas towed, with the highest total being 36 on a tow covering the reef on the west side. All other tows reported between 3 and 12. Like the 2003 surveys, no COTS were observed by towed divers.

Agrihan:
The highest coral cover found on this island was reported along the southern tip of the island and the southwest corner. Live hard coral cover on these tows reached levels of 50-62%. The tow which covered the southwest corner also documented areas where the reef was soft coral dominated. The other tows reported moderate levels of hard coral cover. No tows were conducted on the east and southeast facing reefs because of weather conditions. Signs of stressed coral were low on all tows on the west side. Reports of coral stress appearing in the form of white dots and lines were observed long the southern point of the island. Along this same tow, two net fragments were observed. During 2003 surveys, divers only saw one COTS at Agrihan along a 2.3-km tow located on the northeast side. The resurvey of this tow in 2005 had 64 COTS. The percentage of the coral stressed as a result of COTS predation along this tow reached up to 90%.

Sarigan:
The highest coral cover found on this island was reported along the northeast and northwest with recorded levels up to 62%. Stressed coral was low throughout the island, not exceeding 5%. Areas along the southern shore appeared to contain coralline algae disease. Much of the halimeda along the northwest and western shores were white, indicating the recent release of spores. Beds of wire coral were observed along the northeastern shore. There was a high abundance of Pocillopora stems appearing to be bitten off along the southern and southeastern shores. Only one crown-of-thorns starfish was recorded.

Fish Observations: (Joe Laughlin and Stephani Holzwarth)
In 6 days of field work, a total of twenty-nine towed-diver surveys were conducted at Maug, Alamagan, Agrihan, and Sarigan. The most notable observation during the fish towed-diver surveys was the identification of a probable new species of pencil wrasse in the genus *Psuedojuloides*. Towed divers returned to the site and were able to capture and preserve nine specimens. These specimens will be formally described in collaboration with experts in fish taxonomy at the Bishop Museum in Honolulu. The most numerically abundant fish was the bigeye jack (*Caranx sexfasciatus*), observed in schools of up to 250 individuals. Otherwise, the most commonly encountered fish over 50 cm TL was the gray reef shark (*Carcharhinus amblyrhynchos*). A planktivore, the black-tongue unicorn fish (*Naso hexacanthus*) was the second most commonly encountered large fish, followed by the twin-spot snapper (*Lutjanus bohar*). Five sightings of Napoleon wrasses (*Chelinus*

undulatus) were recorded at Alamagan, four of which were over 100 cm TL. No bumphead parrotfish (*Bolbometopon muricatum*) nor any large grouper (*Ephinephelus* sp.) were seen by towed divers, including the giant grouper *E. lanceolatus*, that were seen at a number of northern islands in 2003.

Leg 2-- Towed-Diver Fish/Habitat Activity Summary (Stephani Holzwarth, Jake Asher, Joe Laughlin, and Molly Timmers)

During this survey period (Leg 2), a total of 46 towed-diver surveys were conducted around Saipan, Tinian, Pathfinder Bank, Arakane Bank, Aguijan (Goat Island) and Rota covering a total of 99.53 km of habitat. (See Table 1)

Island	**Surveyed Km**	**# of Tows**
Saipan	22.76	11
Tinian	26.72	12
Goat	13.57	6
Pathfinder	6.67	3
Arakane	6.86	3
Rota	22.93	11
Total	**99.53**	**46**

Benthic Observations: (Jake Asher and Molly Timmers)

Saipan:

The highest hard coral cover was reported along the western shore of the island with levels ranging from 20 to 65%. Soft coral cover around Saipan remained relatively low, ranging from 1 to 5%. Several surveys also noted low incidence of diseased *Pocillopora meandrina*. Additional observations included long scars or channels north of the main harbor and channel, with large (usually singular) clump(s) of substrate located on the downhill side, suggesting previous anchorage damage.

Along the southeastern, southern, and southwestern portions of the island, COT predation was noted with incidences of stressed corals ranging from 1 to 40%. Between Puntan Naftan and Puntan Agingan much of the habitat was composed of dead *pocillopora* species on pavement, which indicated recent COT predation. COT numbers had remained relatively low until the survey of the southern segment and southwestern corner of the island, which logged 53 COTS and 99 COTS, respectively during two subsequent surveys (70 COTS were noted in one time segment near Puntan Obyan). Numbers of COTS dropped off significantly as surveys progressed farther north along the western shoreline.

Pathfinder:

Hard coral cover at Pathfinder Bank remained relatively constant through all surveys, ranging from 20 to 40%. The frequency of soft coral ranged from 5 to 40%, with the northern part of the bank being dominated by soft coral cover. Incidences of stressed coral were low. No crown-of-thorns starfish were observed. Giant clams were reported in all surveys, with 13, 11, and 7 reported for each respective survey.

Arakane:
This bank had relatively high coral cover, with the percentages reaching between 25-65% on all tows. Octocorals from the genus *Sinularia* were the predominate coral throughout the bank. Incidences of stressed coral were low. A layer of red cyanobacteria covered the benthos. No crown-of-thorns were observed.

Tinian:
Surveys along the eastern shore of Tinian recorded the highest incidence of hard coral cover (5-40%) along the southeastern corner of the island between Carolinas and Marpo Point. Surveys along the western shore of Tinian found the highest recorded levels of hard coral coverage along the northwestern shore near Puntan Lanan and after Faibus Point. The incidence of stressed coral remained relatively low along all the coastlines (1-5%), but increased slightly along surveys in the northeast between Massalog Point and Ushi Point (1-10%). Overall soft coral cover remained low (1-5%) around the island**.** A total of 53 COTS were observed, 48 of which were recorded along the eastern shore. Out of these 48 observed COTS, 44 were recorded between Massalog Point and Puntan Asigo. In 2003 only 10 COTS were observed between Massalog Point and Puntan. Giant clams were recorded during 8 out of the 12 surveys conducted, with a maximum of 26 recorded during the southeastern survey of the island.

Rota:
Surveys along the southern shore of Rota found low hard coral cover (1-10%). The highest recorded hard coral coverage (50%) occurred within the Sasanhaya Bay Fish Sanctuary, heading towards Puntan Pona. Surveys along the northern coast found the highest recorded hard coral cover on a survey heading to Tataacho Point from Rota town, with an average of 20.5% coverage. Coral stress was relatively low, although one area along the middle of the northern coast past Tataacho Point had approximately 20% of corals exhibiting stress signs. Soft coral coverage ranged from 1-40%, with the highest average percentage of soft coral cover occurring along Funiya Point on the southeastern shore. A total of 60 COTS were observed, 223 less than 2003 surveys. Forty-two of the 60 were recorded along the southwestern isthmus from Sasanhaya Bay to Anjota.

Aguijan:
The highest hard coral and soft coral covers were recorded along the western shore of the island with percentages ranging from 10 to 65%. Stressed coral was relatively low averaging 5% for all tows. A total of 83 COTS were recorded, 27 more than 2003 surveys. Seventy-three of these COTS were recorded along the western shore whereas in 2003 only 21 were observed. In 2003, 35 COTS were observed along the southern shore. This year only 10 were recorded there. Along the western shore, much of the *Acropora* and *Pocillopora* appeared dead. COTS were observed to be feeding on *Porites* sp. A total of 58 giant clams were observed.

Fish Observations: (Stephani Holzwarth, Joe Laughlin, Ben Richards)
In 9 days of field work, a total of 46 towed-diver surveys were conducted on the west side of Saipan and at Pathfinder Bank, Arakane Bank, Tinian, Aguijan (Goat Island), and Rota. The most notable observation during the fish towed-diver surveys were the 19 sightings of Napoleon Wrasse (*Chelinus undulatus*), which were more numerous than expected for this populated part of the island chain. The most numerically abundant fish

were the blackfin baracuda (*Sphyraena qenie*) and snubnose pompano (*Trachinotus blochii*), each observed in schools of up to 200 individuals. Otherwise, the most commonly encountered fish over 50 cm TL was a planktivore, the black-tongue unicorn fish (*Naso hexacanthus*), followed by the twin-spot snapper (*Lutjanus bohar*). No gray reef sharks (*Carcharhinus amblyrhynchos*) were seen at the island reefs, but a few whitetips (*Triaenodon obesus*) and blacktips (*C. melanopterus*) were recorded. A total of 23 gray reef sharks were seen on the banks, as well as 21 whitetips, two nurse sharks, and one silver tip (*C. albimargninatus*). In addition to large fishes, turtle sightings were also recorded by towed divers. While hawksbills were seen further north in the chain, during this leg only green turtles were recorded, with a total of 64 sightings.

Appendix F. Oceanography / Night Ops Team Activity Summary

The volcanic island arc/subduction zone topography and associated steep slopes of the Marianas Archipelago greatly modify the near-shore oceanographic conditions of the islands. Localized upwelling and associated nutrient enhancement of surface waters, nutrient enrichment and seawater chemistry changes due to volcanic seeps and vents, freshwater inputs, and anthropogenic impacts all have poorly understood effects on these near-shore ecosystems. The effects of seasonal and climatic change on the islands' marine ecosystems as well as changes due to episodic events such as typhoons and volcanic eruptions are also poorly understood. In order to better understand the linkages between oceanography and ecology, scientists on board are taking a two pronged approach: 1) intensive assessment of oceanographic conditions and water quality parameters at each island, simultaneous with ecological assessments, and 2) maintenance of existing long-term monitoring stations established during MARAMP 2003 as well as deployment of selected new stations.

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

1. Shallow water (~30m 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.

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 bioacoustic data collection, which is addressed in another section.

Site Summary (Leg 1): (June Firing, Jamison Gove, Ron Hoeke, Danny Merritt, and Phil White)

A brief log of data collection follows. Overview is also given by tables following this section. For brevity, temperature data collected during towboard operations has been omitted:

Saipan:
Fifteen shallow water CTDs and one shallow water sampling site (four samples total) were collected at Saipan on September 4, 2005. A check out dive was also performed to test a variety of oceanographic gear and equipment. Additional shallow CTDs and water samples will be collected and a CREWS Buoy serviced during Leg 2.

Guguan:
Six shallow water CTDs were collected and an STR was replaced. Three shipboard CTDs, two water sample sites (five samples each) were collected during ADCP transects around the island.

Pagan:
Forty shallow water CTDs and 5 shallow water sampling sites (21 samples total) were collected. An SST buoy and an STR were replaced. Four shipboard CTDs and 4 water sample sites (20 samples total) were visited along ADCP transects around the island. Additionally, a 50-nmi transect intersecting the Mariannas island chain was performed collecting DIC samples at six shipboard CTD stations in addition to the requisite nutrient and chlorophyll samples (42 samples total) and ADCP data. Transect of this type will also be performed at Maug, Saipan, and Guam to develop an archipelago-scale picture of DIC, nutrient, and chlorophyll variations.

Asuncion:
Thirteen shallow water CTDs were collected and an STR was replaced. Three shipboard CTDs and 3 water sample sites (15 samples total) were collected during ADCP transects around the island.

Uracas:
Twelve shallow water CTDs and 4 shallow water sampling sites (16 samples total) were collected. The STR at this location was not found; it is presumed lost in a storm. A new deployment location was found and a new STR deployed. Eight shipboard CTDs and 8 water sample sites (40 samples total) were collected during ADCP transects both around the island and around a nearby submarine mount or bank.

Maug:
Thirty-five shallow water CTDs and 14 shallow water sampling sites (54 samples total) were collected. An SST buoy and an STR were replaced. Four shipboard CTDs and 4 water sample sites (20 samples total) were visited along ADCP transects around the island. Additionally, a 50-nmi transect intersecting the Marianas island chain was performed collecting DIC samples at 6 Shipboard CTD stations in addition to the requisite nutrient and chlorophyll samples (42 samples total) and ADCP data; this is the same transect that was performed at Pagan.

Supply Reef:
A WTR was recovered and replaced. Four shipboard CTDs and 4 water sample sites (20 samples total) were collected during ADCP transects around the reef.

Agrihan:
Fourteen shallow water CTDs were collected and an STR was replaced. Two shipboard CTDs and 2 water sample sites (10 samples total) were collected during ADCP transects around the island.

Almagan:
Fifteen shallow water CTDs were collected and an STR was replaced. Three shipboard CTDs and 3 water sample sites (15 samples total) were collected during ADCP transects around the island.

Zealandia Reef:
A WTR was recovered and replaced. Two shipboard CTDs and 2 water sample sites (10 samples total) were collected during ADCP transects around the reef.

Sarigan:
Nine shallow water CTDs and one shallow water sampling site (4 samples total) were collected and an STR was replaced. Two shipboard CTDs and 2 water sample sites (15 samples total) were collected during ADCP transects around the island.

Table 1: Instrumentation Summary

Site	CREWS	SST	WTR	STR	Comments
Saipan	1				This instrument to be serviced during the first two days of Leg 2.
Guguan				1	
Pagan		1		1	
Asuncion				1	
Uracas				1	Old instrument lost; new deployment location
Maug		1		4	3 new STR sites added
Supply			1		
Agrihan				1	
Alamagan				1	
Zealandia			1		
Sarigan				1	Old instrument location deemed unsound; new deployment location

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

Acronyms: CREWS = Coral Reef Early Warning System (buoy), SST = Sea Surface Temperature (buoy), WTR = Wave and Tide Recorder, STR = Subsurface Temperature Recorder

Table 2: Shallow Water Oceanographic Sampling Summary

Site	CTD sites	Water sample sites	Chlorophyll samples collected	Nutrient samples collected	Comments
Saipan	15	1	4	4	This is a water sampling area of focus; more samples will be collected during Leg 2.
Guguan	6				Insufficient time for water samples
Pagan	40	5	21	21	This is a water sampling area of focus; DIC sampling attempted but deemed unsafe and of questionable consistency.
Asuncion	13				Insufficient time for water samples
Uracas	12	4	16	16	Time allowed for water samples to be collected.
Maug	35	14	54	54	This is a water sampling area of focus.
Supply Reef					No shallow CTDs; area well covered by Shipboard CTDs/ADCP
Agrihan	14				Insufficient time for water samples
Alamagan	15				Insufficient time for water samples
Zealandia					No shallow CTDs; area well covered by Shipboard CTDs/ADCP
Sarigan	9	1	4	4	

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	Comments
Saipan					
Guguan	3	2	10	10	Time limitations restricted the number of CTD and water samples obtained around the island.
Pagan	10	10	50	50	CTD profiles and concurrent water samples were obtained in a box pattern around the island. An additional six CTD/water sample locations which included 2 DIC samples per location were obtained along a 60 mile east-west transect performed to the north of the island.
Asuncion	3	3	15	15	Due to time restrictions, CTD profiles and concurrent water samples were obtained at three of four planned locations.
Uracas/Uracas Bank	8	8	40	40	CTD profiles and concurrent water samples were obtained in a box pattern around both Uracas Island and Uracas Bank
Maug	10	10	50	50	CTD profiles and concurrent water samples were obtained in a box pattern around the island. An additional six CTD/water sample locations which included 2 DIC samples per location were obtained along a 60 mile east-west transect performed to the north of the island.
Supply Reef	4	4	20	20	CTD profiles and concurrent water samples were obtained in a box pattern around the reef.
Agrihan	2	2	10	10	CTD profiles and concurrent water samples were obtained in a box pattern around the island.
Alamagan	3	3	15	15	CTD profiles and concurrent water samples were obtained in a box pattern around the island.
Zealandia Reef	2	2	10	10	CTD profiles and concurrent water samples were obtained in a box pattern around the reef.
Sarigan	4	4	20	20	CTD profiles and concurrent water samples were obtained in a box pattern around the island.

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

Site Summary (Leg 2) (Jamison Gove, Ron Hoeke, Danny Merritt, Kyle Hogrefe, and Phil White)**:**

Saipan:

The CREWS Enhanced buoy in Saipan Harbor was serviced (replaced) and an STR deployed on the anchor on September 21-22. Sixteen shallow water CTDs cast and 6 shallow water sampling sites (18 samples total) were collected at Saipan on September 22. This brings up the total shallow water CTDs and water samples sites at Saipan to 31 and 7, respectively collected on both Leg 1 and Leg 2. Unfortunately, manufacturing errors in the (new) CREWs buoy required unforeseen repairs, and time was not available

to collect CTDs and water samples around the perimeter of the entire island; the northern half of the island was well covered, the southern half was not. Over the course of 2 nights (September 21-22), 4 shipboard CTD casts were performed collecting water samples at each site for a total of 20 nutrient and 20 chlorophyll samples collected. The CTD casts sites were located on the corners of the ADCP box transect conducted around the island on the first night.

Anatahan:
Active volcanism limited operations here limited small boat operations to ~2.5 working hours. Three shallow water CTDs and 3 water sample sites (10 samples total) were collected. Of the two STRs that were deployed in 2003, one was not located, and is assumed buried under volcanic ash; the other was replaced. The extremely poor visibility (<1-m) at the STR deployment sites made recovery/replacement operations extremely difficult. Two shipboard CTD casts were performed collecting water samples at both sites for a total of 10 nutrient, 10 chlorophyll and 4 DIC samples. The DIC samples were conducted at the easternmost sites of an extended transect running to Pathfinder Reef. A continuous ADCP transect was conducted during operations around the island.

Pathfinder Reef:
Small boat oceanographic operations were not conducted. On the transit to Pathfinder, one shipboard CTD cast was performed collecting water for five chlorophyll, five nutrient and two DIC samples. At Pathfinder Reef, four shipboard CTD casts were performed collecting chlorophyll and nutrient samples at all sites and DIC samples at the northeast and southeast sites for a total of 20 nutrient, 20 chlorophyll, and 4 DIC samples. The CTD cast sites were located on the corners of the ADCP box transect conducted around the reef. The intent of the DIC sampling at Anatahan, on transit and at Pathfinder was to create an extended transect of 140 nmi within the time constraints of other cruise logistics.

Arakane Reef:
Small boat oceanographic operations were not conducted. No night operations were conducted; however, ADCP data was collected during day ops and during transits to and from the site.

Tinian:
During 2 days of operation (September 26-27), 31 shallow water CTDs and 4 shallow water sampling sites (16 samples total) were collected. A new STR site, colocated with an REA site was surveyed and new instrument deployed. Two shipboard CTD casts were performed at the southeast and southwest corners of a “U” shaped ADCP transect adjacent to the bottom of the box transect already completed around Saipan. Water samples were collected at both sites for a total of 10 nutrient and 10 chlorophyll samples. Additionally, a 56-nmi transect intersecting the Marianas Archipelago between Saipan and Tinian Islands was performed collecting samples at six shipboard CTD stations in addition to the requisite nutrient and chlorophyll samples for a total of 29 nutrient, 29 chlorophyll, and 12 DIC samples. ADCP data were collected along the entire transect.

Aguijan:
Twenty-two shallow water CTDs and 4 shallow water sampling sites (16 samples total) were collected. The STR at the 2003 deployment location was not found; it is presumed lost in a storm. A new STR site, colocated with an REA site was surveyed and new instrument deployed. Four shipboard CTD casts were made on the corners of an ADCP box transect around the island. Water samples were collected at each site for a total of 20 nutrient and 20 chlorophyll samples collected.

Rota:
Neither the SST buoy deployed in 2003 nor its anchor were located. It stopped transmitting in late 2004; it is assumed that an unknown party took the mooring. A new SST buoy site, near the old one, was surveyed and a new buoy deployed in the Sasanhaga Bay Fish Sanctuary. An STR was deployed near the new SST anchor. Twenty-nine shallow water CTDs and 4 shallow water sampling sites (16 samples total) were collected. Four shipboard CTD casts were made on the corners of an ADCP box transect around the island. Water samples were collected at each site for a total of 14 nutrient and 20 chlorophyll samples collected. Nutrient sampling was discontinued during the third cast because of an insufficient number of sample bottles.

Table 1: Instrumentation Summary

Site	CREWS	SST	WTR	STR	Comments
Saipan	1	-	-	1	Old buoy successfully recovered; manufacturing errors in new buoy mitigated, but may need servicing before 2007.
Anatahan	-	-	-	2	Only one of the previous (2003) STRs replaced; the other deployment location appears to be buried in ash.
Pathfinder R.	-	-	-	-	No small boat oceanography operations
Arakane R.		-	-	-	No small boat oceanography operations
Tinian	-	-	-	1	New STR site.
Aguijan	-	-	-	2	STR from 2003 deployment not located, it is assumed lost in a storm. A new STR was deployed at a new site.
Rota	-	1	-	2	SST buoy site relocated; two new STR sites.

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

Acronyms: CREWS = Coral Reef Early Warning System (buoy), SST = Sea Surface Temperature (buoy), WTR = Wave and Tide Recorder, STR = Subsurface Temperature Recorder

Table 2: Shallow Water Oceanographic Sampling Summary

Site	CTD sites	Water sample sites	Chlorophyll samples collected	Nutrient samples collected	Comments
Saipan	13	6	15	15	This is a water sampling area of focus; more samples were collected during Leg 1.
Anatahan	3	3	10	10	Recently volcanic activity; extremely poor water visibility volcano.
Pathfinder R.	-	-	-	-	Area well covered by Shipboard CTDs/ADCP
Arakane R.	-	-	-	-	Area well covered by Shipboard CTDs/ADCP
Tinian	31	6	22	22	
Aguijan	22	3	12	12	
Rota	29	4	16	15	

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
Saipan	4	4	20	20	0	CTD profiles and concurrent water samples were obtained on the corners of a ADCP box transect around the island. The ADCP transect and two CTDs were completed on the first night. Due to CTD malfunction, the second two were completed on the second night.
Anatahan	2	2	10	10	4	These CTD casts were conducted during the day. Time limitations restricted the number of CTD and water samples obtained around the island. DIC samples collected as the beginning of an extended transect.
Pathfinder R. (including transit)	5	5	25	25	6	One CTD and concurrent water samples collected ~ ½ way between Anatahan and Pathfinder. CTD profiles and concurrent water samples were obtained on the corners of an ADCP box transect around the reef. DIC samples were collected at the ½ way site and two of the Pathfinder sites to complete the extended transect started at Anatahan. ADCP data was collected during transit.
Arakane R.	-	-	-	-	-	No CTD casts or water sampling allowed for by time restrictions. ADCP data was collected during transit.
Tinian	8	8	40	40	12	CTD profiles and concurrent water samples were obtained at the SE and SW corners of a "U" shaped transect adjacent to the Saipan Box transect. An additional six CTD/water sample locations which included 2 DIC samples per location were obtained along a 60 mile east-west transect running between Tinian and Saipan.
Aguijan	4	4	20	20	0	CTD profiles and concurrent water samples were obtained on the corners of an ADCP box transect around the reef.
Rota	4	4	30	20	0	CTD profiles and concurrent water samples were obtained on the corners of an ADCP box transect around the reef. Triplicate samples for chlorophyll were conducted during the last cast.

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 during 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 deepwater 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 of the organisms of the MBC in shallow water conditions, where a trawl is not feasible, with a cabled video camera to depths of up to 75 meters.

Leg 1-- Site Summary: (June Firign and Phil White; **d**ata collected for Marc Lammers)

Note: Great effort was made to collect physical specimens, bioacoustics data, and oceanographic data that may affect the MBC during night operations, but the collection of ADCP/CTD/water sampling data in accordance with established CRED protocols has

been prioritized over the bioacoustics effort. 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 took precedence over any night operations.

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

Saipan:
Two EK60 transects were conducted, one during the day and one at night.

Anatahan:
No bioacoustics surveys were conducted.

Guguan:
One EK60 transect was conducted at night.

Pagan:
Five EK60 transects were conducted, two during the day and three at night.

Asuncion:
One EK60 transect was conducted one during the day.

Uracas:
No bioacoustics surveys were conducted.

Maug:
Fifteen EK60 transects were conducted, four during the day, nine at night and two during trawls. The codend was lost during the first trawl, so no sample was collected.

Supply Reef:
No bioacoustics surveys were conducted.

Agrihan:
Two EK60 transects were conducted, one at night and one during a trawl.

Alamagan:
Three EK60 transects were conducted, two at night and one during a trawl.

Zealandia Bank:
Two EK60 transects were conducted, one during the day and one at night.

Sarigan:
Four EK60 transects were conducted at night.

Table 1: Bioacoustics Sampling Summary

Site	EK60 Day transects	EK60 Night transects	EK60 Trawl transects	IKMT Trawl samples	CTD/ADCP/ Water samples	Comments
OES0511 – Leg 1a						
Saipan	1	1			none	
Anatahan					n/a	
Guguan		1			nearby	
Pagan	2	3			nearby	
Asuncion	1				nearby	
Uracas					n/a	

Table 2: Bioacoustics Sampling Summary

Site	EK60 Day transects	EK60 Night transects	EK60 Trawl transects	IKMT Trawl samples	CTD/ADCP/ Water samples	Comments
OES0511 – Leg 1b						
Maug	4	9	2	1	nearby	Codend lost first trawl – no sample collected.
Supply Reef					n/a	
Agrihan		1	1	1	nearby	
Alamagan		2	1	1	nearby	
Zealandia Bank	1	1			nearby	
Sarigan		4			nearby	

Leg 2-- 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.

Saipan:

Six EK60 transects were conducted, two during the day and six at night. Considered conducting an IKMT trawl along Saipan Transect B, but the density of the MBC was marginally suitable for a trawl and was from 150 M to 200 M which is outside of the scientific design for sample collection. The completion of a second EK60 transect and a CTD/water sample cast at a site that had not been covered was prioritized over the trawl.

Anatahan:
The vessel arrived at 0700, just in time for daytime operations, and left at ~1630 on transit to Pathfinder Reef. There was no time available for bioacoustics operations.

Pathfinder Reef (and transit):
Two EK60 transects were conducted, one at night and one during a trawl (also at night) from which MBL samples were collected.

Arakane Reef:
The vessel arrived at 0700, just in time for daytime operations, and left at ~1630 on transit to Tinian. There was no time available for bioacoustics operations.

Tinian:
Five EK60 transects were conducted, three at night and two during trawls (also at night) from which MBL samples were collected.

Aguijan:
Five EK60 transects were conducted, two during the day and three at night. Best MBC sign yet to this point of the cruise on transect C to the northeast of the island, but the operational window closed requiring departure to Rota in order to make it in time for day ops - priorities are priorities.

Rota:
Five EK60 transects were conducted, six at night and three during trawls (also at night) from which MBL samples were collected. Was not woken up for potential daytime transects.

Table 1: Bioacoustics Sampling Summary

Site	EK60 Day transects	EK60 Night transects	EK60 Trawl transects	IKMT Trawl samples	CTD/ADCP/ Water samples	Comments
Saipan	2	4	0	0	nearby	
Anatahan	0	0	0	0	n/a	No night operations activity.
Pathfinder Reef	0	1	1	1	nearby	
Arakane Reef	0	0	0	0	n/a	No night operations activity.
Tinian	0	3	2	2	nearby	
Aguijan	2	3	0	0	nearby	
Rota	0	6	3	3	nearby	

Appendix H. Bottomfish Baited Camera (BotCam) Trials

Leg 1-- Activity Summary (Danny Merritt, Jake Asher)

From September 3 through September 18, 2005, a bottom camera bait station (Botcam) was deployed 15 times: 1 drop at Saipan, 1 drop at Guguan, 2 drops at Pagan, 1 drop at Asuncion, 1 drop at Uracus, 2 drops at Maug, 3 drops at Supply Reef, 1 drop at Agrihan, 1 drop at Alamagan, 1 drop at Zealandia and 1 drop at Sarigan. The purpose of the Botcam on this cruise is to trial test this instrument for the assessment and monitoring of commercial bottomfish and their habitat, from 150--350 m deep, on future cruises.

This is the first shipboard operation of the Botcam and several logistical and technical problems have been encountered that have limited its use and caused loss of data. Of the 15 drops, 11 returned with recorded video images and 8 recorded various fish species. Further, the automated bait release system only worked correctly on 4 drops with early releases recorded on 4 drops.

Several target species have been captured including Onaga, Opakapaka, Gindai, Kalekale, Kahala and several grouper species. Additionally, several non-target species have been identified including, Jacks and Sharks, and of particular note, Dog Tooth Tuna on three occasions at 328 meters, 263 meters and again at 238 meters.

Drop depths taken from a Seabird 39 pressure and temperature recorder range from 101 dbar to 456 dbar, with temperatures ranging from 27.7 to 12.7 degrees Celsius. Table 1 below is the field data sheet, and table 2 is a preliminary data analysis sheet.

TABLE 1. BOTCAM FIELD LOG - MARAMP 2005 OES0511

							Time, Date and Location - In Water				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	RF 700C6 Frequency	Battery Sheet Checked (Y or N)	Latitude	Longitude	Date (UTC)	Time (UTC)	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
9/3/2005	Saipan	SAI 01	198	160.725			N 12 06.991	E 143 29.721	9/4/2005	0015	N 12 06.625	E 143 18.680	9/4/2005		55	5	9/4/2005	0100	9/4/2005	0200					Bait Release Failure due to BWR problems. Removed BWR and replaced with old proven unit.
9/4/2005	Guguan	Gug 01	198	160.725			N 17 17.462	E 145 49.155	9/5/2005	0049	N 17 17.462	E 145 49.155	9/5/2005		104	12	9/5/2005	0230	9/5/2005	0330					First drop didn't hit bottom so anchors were released and unit recovered. On reprogramming of the unit, the timer was left in program mode rather than run mode so the unit did not turn on.
9/5/2005	Pagan	Pag 01	198	160.725			N 18 07.835	E 145 44.700	9/5/2005	1144	N 18 27.857	E 145 44.650	9/5/2005	1152	135	12	9/6/2005	0030	9/6/2005	0130					Bait release failed and no video seen. Seems to be a low power issue.
9/7/2005	Pagan	Pag02	198	160.725			N 18 05.493	E 145 47.562	9/8/2005	0011	N 18 05.493	E 145 47.562	9/8/2005		114	12	9/8/2005	0105	9/8/2005	0210	N 18 05.405	E 145 47.799	9/8/2005	0342	First drop surface line was dropped in the water. Surface line should not be left either cleated off or attached to a float. First good video with bait release.
9/8/2005	Asuncion	Asu01	198	160.725			N 19 39.749	E 145 24.567	9/9/2005	1111	N 19 39.749	E 145 24.567	9/8/2005	1118	164	12	9/9/2005	0030	9/9/2005	0130					Current was ripping. Botcam unit dragged to 456 m depth. Video is completely black with nothing visible except the SVS flashing.
9/9/2005	Uracus	Uru01	198	160.725			N 20 32.371	E 144 53.051	9/9/2005	1111	N 20 32.371	E 144 53.051	9/9/2005	1120	84	12	9/10/2005	0030	9/10/2005	0130	N 20 33.103	E 144 52.961	9/10/2005	0317	Botcam appears to have booted. Burn wire corroded and bait released, but the video could not be found on the hard drive anywhere. Troubleshooting started but no conclusive answers as to why?
9/11/2005	Maug	Mau01	198	160.725			N 20 00.382	E 145 12.389	9/11/2005	1050	N 20 00.382	E 145 12.389	9/11/2005	1100	165	12	9/12/2005	0030	9/12/2005	0100					
9/12/2005	Maug	Mau02	198	160.725			N 20 00.798	E 145 12.105	9/12/2005	1110	N 20 00.798	E 145 12.105	9/12/2005	1115	146	12	9/13/2005	0001	9/13/2005	0031					Bait released prior to recording stop but appears to have corroded. Anchor lines too shart fo r steep slops we are encountering. We need to lengthen them for future drops. The bait arm was hitting the bottom.
9/13/2005	Supply Reef	Sup01	198	160.725			N 20 08.513	E 145 06.173	9/13/2005	1029	N 20 08.513	E 145 06.173	9/13/2005	1036	105	12	9/13/2005	2230	9/14/2005	2300					Good Drop. Good location.
9/14/2004	Supply Reef	Sup02	198	160.725					9/14/2005																Miscommunication. Unit was not progreammed to turn on. The bait still burned though. It seems that the BWR is trickling a current.
9/14/2005	Supply Reef	Sup03	198	160.725			N 20 08.331	E 145 06.153	9/14/2005	0541	N 20 08.331	E145 06.153	9/14/2005	0548	97	12	9/14/2005	0600	9/14/2005	0635					Good drop but early bait release. Good Location.
9/15/2005	Agrihan	Agr01	198	160.725			N 18 44.289	E 145 38.116	9/15/2005	0110	N 18 44.289	E 145 38.116	9/15/2005	0118	105	12	9/15/2005	0145	9/15/2005	0220	N 18 42.957	E 145 43.284	9/15/2005	0406	Good drop and bait release on very steep slope. No fish, majority of video looking away from slope into blue water.
9/16/2005	Alamagan	Ala01	198	160.725			N 17 37.527	E 145 48.266	9/16/2005	0110	N 17 37.527	E 145 48.266	9/16/2005	0118	99	12	9/16/2005	0145	9/16/2005	0220	N17 36.274	E145 48.039	9/16/2005	0534	No bait release. Unit does not appear to have turned on? The previous evening the unit was hit with several waves during the download process which shroted the tv monitor and may have had an effect on the unit.
9/17/2005	Zealandia	Zea01	198	160.725							N 16 52.397	E145 50.600	9/17/2005	0113	90	12	9/17/2005	0145	9/17/2005	0220	N 16 52.467	E145 50.817	9/17/2005	0420	Unit performed well. The Deep unit was removed from the frame and brought inside for troubleshooting. The Deep unit appears to be working fine and the download went OK. Many of th eperipheral connectors are having troubles though.
9/18/2005	Sarigan	Sar01	198	154.585			N16 42.812	E145 45.938	9/18/2005	0101	N 16 42.852	E 145 45.938	9/18/2005	0109	95	12	9/18/2005	0200	9/18/2005	0235	N 16 43.214	E145 45.764	9/18/2005	0708	Early Bait Release

TABLE 2. PRELIMINARY BOTCAM DATA ANALYSIS - MARAMP 2005 OES0511

								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
1	9/3/2005	Saipan	SAI01	101	27.7	Soft Sediment, Small Rocks, Algae/Soft Coral	5 to 10											Various Reef Fish, Jacks, Grey Reef Shark	No bait release. ~ 4 degree temperature variation over 5 hours of bottom time (27 to 24 degrees C).
2	9/4/2005	Guguan	GUG01	309	15.5														Unit not programmed correctly, no video.
3	9/5/2005	Pagan	PAG01	328	15.3	Wire Coral, Soft Coral/Algae	45 +	x	x		x	x						Papio, Dog Tooth Tuna	No bait release.
4	9/7/2005	Pagan	PAG02	263	19.6	Fine Sediments, Small Rocks	45 +	x	x		x	x		x				Papio, Dog Tooth Tuna	First fully functional deployment. Bottom fishing caught Papio and Gindai.
5	9/8/2005	Asuncion	ASU01	456	12.7														Very strong current. Botcam dragged off drop location to deep water. Video too dark to see anything.
6	9/9/2005	Uracus	URA01	220	20.0														No video found on system.
7	9/11/2005	Maug	MAU01	298	16.7	Hard Bottom, Small Rocks, Ledge Feature in Background	20 to 30												Early bait release. Dark images. No fish.
8	9/12/2005	Maug	MAU02	303	16.8	Large Rock Outcrops, Little to no growth	20 to 30	x			x			x					Early bait release. Bait arm hitting large rock outcrop (anchor lines too short).
9	9/13/2005	Supply Reef	SUP01	233	17.8	Unconsolidated Boulder Field	20 to 30				x	x		x				Papio	Good drop.
10	9/14/2005	Supply Reef	SUP02	186	18.3														Not programmed to turn on.
11	9/14/2005	Supply Reef	SUP03	224	17.7	Hard Bottom, Small Features	45 +				x	x				x			Early bait release
12	9/15/2005	Agrihan	AGR01	267	17.4	Hard Wall	70 +												Good drop but no fish. SVS not turned on.
13	9/16/2005	Alamagan	ALA01	268	18.2														Unit did not turn on and bait did not release.
14	9/17/2005	Zealandia	ZEA01	176	25.5	Soft bottom, Limited Features, Wire Coral	20 to 30	x								x		Papio, Numerous Unidentified	Good drop.
15	9/18/2005	Sarigan	SAR01	238	20.3	Large Outcrop Boulder		x				x		x		x		Papio, Dog Tooth Tuna, Unidentified	Early Bait Release

Leg 2-- Botcam Activity Summary (Danny Merritt, Matt Dunlap)

From September 23 to September 30, 2005, the Botcam was deployed 16 times – 1 drop at Saipan (the second drop there, another was made on Leg 1 of this cruise), 5 drops at Pathfinder, 3 drops at Arakane, 3 drops at Tinian, 2 drops at Aguijan, and 2 drops at Rota.

Much of the video from this leg consists of schools of the commercially important bottomfish – kalekale, opakapaka, gindai, and onaga. Many of the specimens appear to be fairly small, roughly 9-15 inches long. Also present occasionally are Galapagos sharks, a couple of unidentified sharks, dogtooth tuna, kahala, and ulua. There are single sightings of an unidentified skate, a needlefish, and a couple of species of unidentified sharks. On the shallower sets at Tinian, although still 170-190 m deep, there are many individuals of an unidentified damselfish species, an unidentified filefish species, and a red-gilled emperor. At 226 meters deep at Arakane Bank, an unidentified angelfish is briefly sighted. Only three of the drops returned no sightings of target bottomfish.

Smoothing out some of the technical and manpower issues of the first leg, all but 1.5 of the drops resulted in successful video. That video was lost on the day with 5 drops, when the camera system battery failed at the end of the 4th drop. An adjustment was made with the timer to insure the cameras only turn on for the 35-minute segment on the bottom. This should allow enough battery power for 5 deployments without opening the container, if that opportunity should arise later in the cruise.

Early release of the bait was still an issue on three of the drops from this leg. This is most likely a result of a trickling of electrical current from the BWR that is prematurely breaking the burn wire before it is triggered by the Viperfish Deep unit.

Because of a reduced number of small boats in the water at Pathfinder and Arakane Banks, the ship was able to devote more time and manpower to Botcam deployment and retrieval on those two days. Five drops appears to be the maximum number of drops per day for this operational setting, i.e. using the RV Oscar Elton Sette while it is providing support to 3 small boats on a very small bank. When there are more boats in the water, or the ship has to cover much more territory, as it does around other islands of the CNMI, the capacity for more than 1 or 2 drops is greatly diminished.

TABLE 1. BOTCAM FIELD LOG - MARAMP 2005 OES0511 Leg II

					Time, Date and Location - In Water				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)	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
9/22/2005	Saipan	Sai02	198	154.585	N 15 14.403	E 145 40.627	9/21/2005	2325	N 15 14.430	E 145 40.650	9/21/2005	2328	105	12	9/22/2005	0001	9/22/2005	0036	N 15 14.628	E 145 40.870	9/22/2005	0435	Deployment and recovery smooth. Downloading video took several hours. Unit will not stay on for more than a minute without tweaking connector prongs with a screwdriver. Matt Dunlap's first BotCam deployment. Sand plain, only 2 eels (hagfish?).
9/23/2005	Pathfinder	Pat01	198	154.585	N 16 29.950	E 143 09.032	9/23/2005	2145	N 16 29.940	E 143 09.044	9/23/2005	2149	110	12	9/23/2005	2200	9/23/2005	2230					
9/24/2005	Pathfinder	Pat02	198	154.585	N 16 29.930	E 143 08.979	9/24/2005	0015	N 16 29.920	E 143 08.995	9/24/2005	0022	108	12	9/24/2005	0035	9/24/2005	0105	N 16 29.715	E 143 09.203	9/24/2005	0219	
9/24/2005	Pathfinder	Pat03	198	154.585	N 16 29.894	E 143 08.856	9/24/2005	0242	N 16 29.882	E 143 08.866	9/24/2005	0244	95	12	9/24/2005	0250	9/24/2005	0320	N 16 29.635	E 143 08.821	9/24/2005	0406	
9/24/2005	Pathfinder	Pat04	198	154.585	N 16 29.879	E 143 08.748	9/24/2005	0422	N 16 29.865	E 143 08.767	9/24/2005	0426	110	12	9/24/2005	0440	9/24/2005	0510	N 16 29.785	E 143 08.443	9/24/2005	0553	
9/24/2005	Pathfinder	Pat05	198	154.585			9/24/2005		N 16 30.193	E 143 08.547	9/24/2005	0613	76	12	9/24/2005	0625	9/24/2005	0655	N 16 30.337	E 143 08.543	9/24/2005	0804	
9/25/2005	Arakane	ARA01	198	154.585					N 15 37.788	E 142 45.306	9/24/2005	2144	215 M	12	9/25/2005	2230	9/24/2005	2305					
9/25/2005	Arakane	ARA02	198	154.585					N 15 37.740	E 142 45.370	9/25/2005	0008	190 M	12	9/25/2005	0020	9/25/2005	0055	N 15 37.427	E 142 45.580	9/25/2005	0208	One side of bait container already open when filming begins. Other side fires within 1st minute.
9/25/2005	Arakane	ARA03	198	154.585					N 15 37.565	E 142 45.566	9/25/2005	0224	215 M	12	9/25/2005	0235	9/25/2005	0310	N 15 37.141	E 142 45.538	9/25/2005	0415	
9/26/2005	Tinian	TIN01	198	154.585	N 14 54.750	E 145 36.441	9/25/2005	1113	N 14 54.476	E 145 36.418	9/25/2005	1116	94	12	9/25/2005	1135	9/26/2005	0010	N 14 56.273	E 145 35.132	9/26/2005	0418	After filming, unit dragged off edge into blue water and was found ~1.5 miles from original drop location
9/27/2005	Tinian	TIN02	198	154.585	N 15 02.672	E 145 35.116	9/26/2005	2331	N 15 02.654	E 145 35.113	9/26/2005	2334	82	12	9/26/2005	2345	9/27/2005	0020	N 15 02.501	E 145 34.992	9/27/2005	0105	
9/27/2005	Tinian	TIN03	198	154.585	N 15 03.050	E 145 35.204	9/27/2005	0302	N 15 03.074	E 145 35.208	9/27/2005	0305	91	12	9/27/2005	0320	9/27/2005	0355	N 15 03.809	E 145 35.580	9/27/2005	0445	Arm installed upside down by accident
9/27/2005	Aguijan	AGU01	198	154.585					N 14 52.786	E 145 34.449	9/27/2005	2317	80	12	9/27/2005	2330	9/28/2005	0005	N 14 52.881	E 145 34.119	9/28/2005	0035	
9/28/2005	Aguijan	AGU02	198	154.585					N 14 52.544	E 145 33.987	9/28/2005	0209	136	12	9/28/2005	0200	9/28/2005	0230	N 14 52.217	E 145 33.468	9/28/2005	0331	Camera started on deck due to fire alarm, new personnel didn't know to reset time.
9/30/2005	Rota	ROT01	198	154.585	N 14 11.317	E 145 10.756	9/30/2005	0018	N 14 11.310	E 145 10.762	9/30/2005	0022	75	12	9/30/2005	0025	9/30/2005	0100					
9/30/2005	Rota	ROT02	198	154.585					N 14 11.066	E 145 10.686	9/30/2005	0550	200m	12	9/30/2005	0555	9/30/2005	0630					

TABLE 2. PRELIMINARY BOTCAM DATA ANALYSIS - MARAMP 2005 OES0511 Leg II

								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
16	9/22/2005	Saipan	SAI02	216	16.4	Flat - sand and small rubble	flat											2 eels (hagfish?)	Good drop, bad downloading. Power issues.
17	9/24/2005	Pathfinder	PAT01	274	15.4	Hard bottom, small features and puka's	45			x		x						1 each of needlefish, gindai, kalekale, ehu, and skate	
18	9/24/2005	Pathfinder	PAT02	277	16.2	Hard Bottom with thin sediment layer patches , small features,	45			x	x	x						2 Different Unidentified Shark, Dog Tooth Tuna	
19	9/24/2005	Pathfinder	PAT03	261	17.5	Hard pavement with light sediment covering and small rock features	30 to 40				x	x				x		Dog Tooth Tuna	Bait released immediately upon recording start
20	9/24/2005	Pathfinder	PAT04	264	16.5	Large Flat Rock, low rugosity but rough bottom mixed with sediment, small rocks	30 to 40		x	x		x						Unidentified Shark	Quick Bait Release
21	9/24/2005	Pathfinder	PAT05	201	21.1														Battery ran during PAT04 so nothing recorded. No bait release either.
22	9/25/2005	Arakane	ARA01	245	17.7	Small Rock Outcrops, Hard Bottom with Sand/Mud Patches	40 to 50		x	x		x				x			
23	9/25/2005	Arakane	ARA02	226	18.7	Small Rock Outcrops, Hard Bottom with Sand/Mud Patches	45 to 55		x		x	x				x		Unidentified Shark, Unidendified Angel Fish, Papio (Black Jack)	One side of bait container already open when filming begins. Other side fires within 1st minute.
24	9/25/2005	Arakane	ARA03	241	17.4	Hard Bottom,	20 to 30		x	x	x	x				x			
25	9/26/2005	Tinian	TIN01	255	16.4	Lagre outcrops, Some soft biology, Hard Bottom primarily	40 to 50	x	x		x	x	x					Papio (Black Jack), Unidentified Dark Snapper/Grouper, Dog Tooth Tuna,	Strange Bottom Features, look unnatural, cave structure visible early, early bait release
26	9/27/2005	Tinian	TIN02	173	20.5	On small bump, lot of algae, possible gorgonians, large rock outcrops, large soft sediment flat plane	20 to 30					x						Small Unidentified Fish,	
27	9/27/2005	Tinian	TIN03	185	20.2	On top of pinnacle, large structure, hard bottom with lots of biology	na				x	x						Unidentified Damsal Fish, Unidentified File Fish or Wrasse, Numerous Unidentified Small Fish	
28	9/27/2005	Aguijan	AGU01	173	22.6	Soft Sediment Slope with small rocks and biological growth	35 to 45	x	x		x					x		Emporer (Red Gill),	Early Bait Release.
29	9/28/2005	Aguijan	AGU02	253 to 313	17.1 to 11.4	Hard, rough texture bottom, parallel running ridges?, near cliff with large outcroppings: After sliding - Rocky Outcrops	35 to 45	x					x						Botcam turned on before hitting bottom, most of the bait released on way down, botcam slid after being stable for some time.
30	9/30/2005	Rota	ROT01	175	20.9	Gentle slope, soft bottom, possible light biological covering	20 to 30											Ray	
31	9/30/2005	Rota	ROT02	214	18.5	Gentle slope, soft bottom, possible light biological covering	20 to 30											Unidentified	

Appendix I. **Education/Outreach** (Qamar Schuyler)

Education Specialist Report for Part I of Leg I: Saipan, Guguan, Pagan, Asuncion, Uracas

Before departing for the MARAMP cruise, a website was created which would enable students and teachers to follow along in their classrooms with the activities on board the ship. One of the static pages is called "Resources for Teachers." The page includes links to websites about the northern islands and to various agencies such as CRED, CNMI DEQ, etc. There are also links to lesson plans which are relevant to the activities we are doing on board and a list of potential classroom speakers.

In addition, we created several sections that can be updated by my colleague on shore. I e-mail him articles and photos, and he uploads them onto the site. The Daily Log is a report of the activities I participate in each day. It is updated every day and also includes a photo. The Features section is for articles on a specific topic, such as the BOTCAM or particular creatures of interest. This is updated as new articles are written. There is a Photo Gallery, with various photos of ships activities, and a section entitled "Meet the Crew," which lists the names and positions of all crew members and scientists.

There is also a section entitled "Ask a Scientist," where students can enter questions onto an online form. The questions are forwarded to me on the ship, and I answer them, or ask other scientists to write an answer.

So far, the activities for the first five islands are as follows: I have written 8 daily logs, 2 feature articles, and answered 11 "Ask a Scientist" questions.

Saipan:
On the first day at sea, I wrote a daily log about the safety drills and the chamber dive. On the second day, I watched the BOTCAM deployment in the morning and went out with the mooring team in the afternoon. I wrote about the BOTCAM and the CTD transects and included a classroom exercise for students.

Guguan:
I had wanted to go to land to document the large colonies of nesting seabirds, but the weather did not permit a shore landing. Instead, I joined the benthic REA team in the boat and dived with the fish REA team on their second dive of the day. My article primarily focused on Guguan Island and on the population of megapodes on the island. It also included a classroom exercise for students.

Pagan:
On the first day, I was asked to be a safety diver for the mooring team as they replaced an SST buoy. After the dive was finished, I went ashore to document the village on land. My daily log described both activities. On the second day, I dived with the REA teams. My article focused on a description of Pagan Island, of the marine life that I saw, and on the methods used by the REA team. On the third day, I was back with the mooring team, and my daily log described replacing an STR, exploring Apansanmeena Beach, and CTDs and water sampling. I answered a total of eight "Ask a Scientist" questions about a variety of topics during our time in Pagan.

Asuncion:
I dived with the REA teams in Asuncion and wrote about the marine life at Asuncion as well as a detailed description of the towboard team activities. I also wrote a feature article about ship and science lingo, a glossary.

Uracas:
I was asked to go with the REA team, to replace John Iguel. My daily log was primarily about the daily activities on board the *Oscar Sette*. I answered three "Ask a Scientist" questions and also completed a feature article about the BOTCAM.

Education Specialist Report for Part II of Leg I: Maug, Supply Reef Agrihan, Alamagan, Zealandia Bank, Sarigan During Part II of Leg I, I wrote 8 daily logs, 1 feature article, and answered 43 "Ask a Scientist" questions.

Maug:
On the first day, I joined the oceanographers as they replaced an STR and installed two new STRs. In the daily log, I wrote about the formation of the Marianas Archipelago. On the second day, I helped out with night operations in the early morning, dived with the shipboard crew, and rode with the towboard team in the afternoon. The daily log primarily described the shipboard oceanography. On the third day, I was back with the mooring team while they installed another STR. The daily log was about marine debris, the curse of Maug, and the new fish species. I also answered four "Ask a Scientist" questions during our stay in Maug.

Supply Reef:
I was asked to assist with the mooring team's deployment of their WTR and described the procedure in detail in the daily log. I also answered 28 "Ask a Scientist" questions.

Agrihan:
I visited the island to report on the community living there. I took a tour of the island and wrote about it in my daily log. I also helped with night ops.

Alamagan:
I joined the Benthic REA team. My daily article talked about endemic species, in particular the Nightingale Reed Warbler, as well as described the settlement on Alamagan.

Zealandia Bank:
I joined the Benthic REA team. My daily log described the shark incident with the invertebrate team. I also answered eight "Ask a Scientist" questions.

Sarigan:
I went ashore to write about Sarigan and how it has been proposed as a relocation site for birds from the southern islands. I also completed a feature article and answered three "Ask a Scientist" questions.

During Part II of Leg I, I wrote 10 daily logs and answered 15 "Ask a Scientist" questions. I also coordinated tours for approximately 40 middle and high school students during the in-port in Saipan and had a teleconference with a high school class in Saipan.

Saipan:
On the first day, I went out with the mooring team to be a safety diver for the CREWS buoy replacement. My daily log discussed the CREWS buoy and also the role of algae in the ecosystem. On the second day in Saipan I stayed on the ship and wrote about the crew and officers, and what they do while the scientists are off the ship. I answered eight "Ask a Scientist" questions.

Anatahan:
I went with the mooring team and reported on the volcano and replacing the STRs there.

Pathfinder:
I accompanied the benthic REA team and wrote about diving and the whale shark that we saw.

Arakane Reef:
I joined the benthic team again and wrote about BOTCAM, bottom fishing, and the RAIOMA project.

Tinian:
On the first day, I spent the early morning on the ship catching up on "Ask a Scientist" questions and writing. I answered seven questions on-line. I then joined the mooring team to help collect water samples and CTDs. We replaced an STR, and I wrote about Tinian's cliffs and the blackblotched stingray. On the second day, I joined the benthic teams in the morning and wrote about the scientific reasons for collecting samples. In the afternoon, I had a teleconference with a class from Saipan Southern High.

Aguiguan:
I joined the mooring team, helped them replace an STR, and helped to collect nutrient samples and CTDs. I wrote about the island, its history, and the difficult conditions the team faced in finding the second STR.

Rota:
On the first day, I was planning to join the benthic teams but due to the incident with the *Avon*, I spent the morning on the *Sette*. In the afternoon, I accompanied the mooring team to shore to discuss the missing SST with the Dive Rota employees and helped to take nutrient samples and CTDs while Ron worked on the new SST buoy on the ship. My daily log reflected these activities. On the second day, our last day at sea, I joined the mooring team, helped to install an STR, and collected water samples and CTDs. My daily log was a summary of peoples' experiences during the entire cruise.

Overall, for both legs of the MARAMP cruise, I received much positive feedback from students, teachers, and friends and family members of cruise participants.