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CRUISE REPORT¹

VESSEL: *Oscar Elton Sette*, Cruise 05-02 (Fig. 1)

CRUISE PERIOD: 24 February–6 March 2005

AREA OF OPERATION: Main Hawaiian Islands

TYPE OF OPERATION: Personnel from the Coral Reef Ecosystem Division, Pacific Islands Fisheries Science Center, National Marine Fisheries Service (NMFS), NOAA, and the Division of Aquatic Resources, Department of Land and Natural Resources, State of Hawaii, conducted reef assessment/monitoring and mapping studies in waters surrounding the Main Hawaiian Islands of Maui and Hawaii.

ITINERARY:
24 February Start of cruise. Embarked Rusty Brainard (towboard/habitat), Molly Timmers (towboard/habitat), Dwayne Meadows (towboard/habitat), Casey Wilkinson (towboard/habitat), Brian Zgliczynski (towboard/fish), Joe Laughlin (towboard/fish), Stephani Holzwarth (towboard/fish), Ben Richards (towboard/fish), Steve Cotton (fish), Paul Murakawa (fish), Darla White (fish), Greta Aeby (coral), Dave Gulko (coral), Ranya Henson (algae), Ryan Okano (algae), Scott Godwin (invertebrates), Kyle Hogrefe (oceanography), Oliver Dameron (data manager), Marc Lammers (bioacoustics), and Jake Asher (Divemaster). Conducted dive accident management drill and safety meeting. Departed Snug Harbor at 1030 to commence cruise. Conducted scientific indoctrination meeting, fire and abandon ship drills, and small boat/dive safety meeting. Arrived off Barber's Point channel at 1400 to commence launching small boats. Conducted one fish and benthic Rapid Ecological Assessment (REA) survey and four fish and benthic towed-diver surveys of impact region of the grounding of the M/V *Cape Flattery*. Departed Barber's Point survey area at 1730 en route to Maui.



¹ PIFSC Cruise Report CR-06-007
Issued 31 May 2006

- 25 February Arrived off Hana, Maui at 0700. Conducted small boat/dive safety meeting at 0730. Conducted two fish and benthic REA surveys in north Hana Bay and west of Keanae Point in Nuaaihua Bay, respectively. Conducted five fish and five benthic towed-diver surveys and intercomparisons along the forereef habitats of the northeast coast of Maui from Hana Bay to Makaiwa Bay. Conducted 10 shallow water conductivity-temperature-depths (CTDs) along the same coastline from Hana Bay to Waipio Bay. Conducted two daytime and nine nighttime bioacoustic transects around a replicate box grid consisting of transects parallel and oblique to shore. Conducted one Isaacs-Kidd midwater trawl (IKMT) through dense scattering layers observed bioacoustically. Attempted one deepwater CTD, but experienced electronic problems with the CTD fish.
- 26 February Because of moderately high winds off Hana at 0600, the ship transited west along the southeast Maui coast to find more shelter for small boat and diving operations. Conducted small boat/dive safety meeting at 0730. Launched boats in sheltered area off Nu'u Bay and conducted one fish and benthic REA survey. Conducted two fish and two benthic towed-diver surveys and intercomparisons along the forereef habitats of Waiu Bay, Nu'u Bay, and Huakini Bay. By 1100, winds significantly increased in strength to 45 knots and shifted in direction to eliminate most of the protection afforded for small boat and diving operations. As such, all survey operations were aborted. The two towed-diver survey teams transited ~13 nmi downwind/sea to La Perouse Bay for eventual recovery by the *Oscar Elton Sette* at 1400. The two REA survey boats remained at anchor in the protected shelter of Nu'u Bay until the ship recovered them at 1700. Conducted 12 bioacoustic transects consisting of three replicate survey grids parallel and oblique to shore. Departed Maui at 2300 en route to Hilo Bay.
- 27 February Arrived in Hilo Bay, Hawaii at 0700. Conducted small boat/dive safety meeting at 0730. Conducted three fish and benthic REA surveys in Onomea Bay, near Pepeekeo Point, and in Pohakumanu Bay, respectively. Conducted five fish and five benthic towed-diver surveys and intercomparisons along the forereef habitats of the Hamakua coast of Hawaii from Onomea Bay to near Lapahoehoe Point. Conducted 12 shallow water CTDs along the same coastline from south of Hilo and along Hamakua coast. Conducted test of CTD cast to 260 m. Conducted twelve bioacoustic transects consisting of three replicate survey grids parallel and oblique to shore. High wind and sea conditions did not allow planned IKMT operations. Conducted two deepwater CTDs off Pauhau and Honokaa.
- 28 February Evaluated conditions at planned reef assessment sites off the northeast coast of Hawaii at 0600 and determined weather and sea conditions would not allow planned surveys in that area. Transited to area off Mahukona for safer operating conditions. Conducted small boat/dive safety meeting at

0730. Conducted three fish and benthic REA surveys between Holana Bay and Mahukona Harbor. Conducted five fish and five benthic towed-diver surveys and four intercomparisons along the forereef habitats of the North Kohala coast of Hawaii from Umiwai Bay to near Keawanui Bay. Conducted five shallow water CTDs along the same coastline from Holana Bay to Keawanui Bay. Deployed SBE-39 Subsurface Temperature Recorder (STR) #3936859-1668 in 11 m of water at position 20° 11.467'N, 155° 54.210'W. Conducted seven bioacoustic transects consisting of transects parallel and oblique to shore off Mahukona. Departed Mahukona area en route to Cape Kumakahi at 1915.

1 March

Arrived off Cape Kumakahi at 0600. Conducted small boat/dive safety meeting at 0730. Conducted three fish and benthic REA surveys off the Puna coast between Kapoho Bay and Volcanoes National Park. Conducted six fish and benthic towed-diver surveys and intercomparisons along the forereef habitats of the Puna coast between Cape Kumakahi and Volcanoes National Park. Conducted nine shallow water CTDs along the same coastline from Cape Kumakahi to near Volcanoes National Park. Deployed SBE-39 Subsurface Temperature Recorder (STR) #3936859-1660 in 11 m of water at position 19° 29.182'N, 154° 49.056'W off Waiopea Tide Pools. Conducted ten bioacoustic transects, two daytime and eight nighttime, parallel and oblique to shore off Volcanoes National Park and active lava flow into the ocean. Conducted one IKMT within the bioacoustic survey grid. Conducted one deepwater CTD to 500 m.

2 March

Conducted small boat/dive safety meeting at 0730. Conducted two fish and benthic REA surveys off Volcanoes National Park south of the active lava flows. Conducted four fish and benthic towed-diver surveys and intercomparisons along the forereef habitats of Volcanoes National Park. Conducted six shallow water CTDs along the same coastline along Volcanoes National Park. All diving operations were aborted at 1430 when the ship received a notice from the NOAA Dive Center to immediately cancel all diving operations utilizing Scubapro Mk 20 regulators first stages. Coincidentally with the diver recall, weather/sea conditions deteriorated in the afternoon with sustained winds of 25-30 knots onshore. Conducted eight bioacoustic transects consisting of replicate box grids parallel and oblique to shore off an area west of Ka Lae (South Point). Conducted one IKMT within the bioacoustic survey grid. Conducted one deepwater CTD to 500 m.

3 March

Conducted small boat/dive safety meeting at 0730. Conducted three fish and benthic REA surveys in the vicinity of Ka Lae, one on the east side in Kaalualu Bay, one just east of Ka Lae. Conducted six fish and benthic towed-diver surveys and intercomparisons along the forereef habitats of the east (three) and west (three) sides of Ka Lae from Kaiole Bay to near Keliuli Bay. Conducted eight shallow water CTDs along the same coastline in the vicinity of Ka Lae. Deployed SBE-39 Subsurface Temperature Recorder (STR) #3936859-1654 in 14 m of water at position

18° 55.350'N, 155° 41.059'W. Conducted two replicate bioacoustic survey grids consisting of transects parallel to shore and normal to shore off an area west of South Point. Conducted one IKMT within the bioacoustic survey grid. Conducted one deepwater CTD to 500 m.

4 March

Conducted small boat/dive safety meeting at 0730. Conducted three fish and benthic REA surveys along the southeast coast of Hawaii off Kamekame Hill, at Punaluu Bay, and at Honoapu Bay, respectively. Conducted six fish and benthic towed diver surveys and intercomparisons along the forereef habitats from Volcanoes National Park south to Waikapuna Bay. Conducted six shallow water CTDs along the southeast Hawaii coast. Deployed SBE-39 Subsurface Temperature Recorder (STR) #3936859-1655 in 13 m of water at position 19° 07.975'N, 155° 30.132'W. Conducted 10 bioacoustic transects, two daytime and eight nighttime, consisting of a box grid parallel and oblique to shore off an area south of Ka Lae. Conducted an IKMT within the bioacoustic survey grid. Conducted one deepwater CTD off South Point.

5 March

Conducted small boat/dive safety meeting at 0730. Conducted two fish and benthic REA surveys along the northwest Puna coast of Hawaii off Makaukia Point and off Haena, respectively. Conducted four fish and benthic towed-diver surveys and intercomparisons along the forereef habitats along the coast from Cape Kumakahi to near the entrance to Hilo Bay. Conducted seven shallow water CTDs. All boats were on board at 1500 to conclude operations for the cruise and begin the transit back to Honolulu.

6 March

Arrived at Honolulu sea buoy at 1100 and moored at Snug Harbor at 1130 to end cruise. Disembarked all scientific staff.

CRUISE STATISTICS:

Table 1: Cruise statistics for the Main Hawaiian Islands.

	NE Maui	East Maui	Windward Hawaii	Southeast Hawaii	Northwest Hawaii	Southwest Hawaii	Barber's Point, Oahu	Totals
Towed-diver habitat surveys	5	2	9	19	5	3	4	47
Towed-diver fish surveys	5	2	9	19	5	3	4	47
Fish rapid ecological assessments	2	1	5	9	3	2	1	23
Benthic rapid ecological assessments	2	1	5	9	3	2	1	23
STR deployed				2	1	1		4
Deepwater CTDs								7
Shallow water CTDs	10	0	19	25	5	4		63
SCUBA dives								
Bioacoustic transects	11	12	12	35	7			77
IKMT trawls	1			5				6

MISSIONS AND RESULTS:

- A. Established quantitative methods were used to estimate numerical abundance and fish species richness. Site selection was determined through discussions with Division of Aquatic Resources personnel pertaining to biodiversity and human impact concerns and modified as necessary based on local weather and sea conditions. Three sites per day were preselected and spaced to allow survey completion within operational parameters set by the *Oscar Elton Sette* (Appendix A).

A ship grounding site at Barber's Point, Oahu was surveyed on the day of departure. Two sites were surveyed on the northeast coast of Maui while weather and sea conditions permitted only one survey to be performed on Maui's south coast. Nineteen sites were surveyed on the Island of Hawaii including three on the northwest coast, three on the northeast coast, ten on the southeast coast and three on the south coast.

1. Large apex predators such as sharks and jacks were rarely encountered. Only two sharks and one large jack were observed among all sites. Several small jacks (30-40 cm) were observed in total. This is in marked contrast to the Northwestern Hawaiian Islands where large apex predators are common. The most commonly observed predators at most of the Main Hawaiian Island (MHI) sites were smaller snappers such as *Aphareus furca* and *Lutjanus kasmira* and the grouper *Cephalopholis argus*. Fish assemblages were numerically dominated by acanthurids, pomacentrids, and chaetodontids.
- B. Conducted surveys to document the species composition, relative abundance, percent cover, size distribution, and general condition in the MHI (Appendix B).
- C. Used quantitative photoquadrat sampling method to collect species composition and baseline abundance data of reef algae in the MHI (Appendix C).
- D. The non-coral marine invertebrate fauna of coral reefs represents a group of animals that are numerically dominant in their habitat and, in some cases, represent taxonomic groups that are only represented in the marine environment. This group of organisms is surveyed and monitored for the purpose of identifying changes to reef communities. This is accomplished through procedures that quantify a set of target organisms and which also gradually builds an inventory of species to document biodiversity. Macroinvertebrate surveys were conducted to record species composition and abundance in the Main Hawaiian Islands in order to establish baseline data to monitor non-coral invertebrate fauna of each reef system (Appendix D).
- E. Used benthic and fish towed-diver survey methods at three MHI to provide a general description of reef habitat, invertebrates, and reef fishes over a large spatial scale. The methods provided assessments and the foundation for monitoring large-scale disturbances and the general distribution and abundance patterns of macroinvertebrates and reef fishes over 50 cm total length (TL) (Appendix E).

1. A total of 47 towed-diver surveys were conducted totaling approximately 110 linear km of habitat.

Fish Observations:

The redlip parrotfish (*Scarus rubroviolaceus*) and the spectacled parrotfish (*Chlorurus perspicillatus*) were the most commonly observed fish larger than 50 cm TL at all islands. Surveys were conducted along multiple habitats and *S. rubroviolaceus* and *C. perspicillatus* dominated most of the surveys regardless of habitat. Preliminary quantitative results yielded low predator densities (> 50 cm TL) at all island locations during the survey period. Only one whitetip reef shark (*Triaenodon obesus*) and four giant trevally (*Caranx ignobilis*) were observed during the surveys. Although the most commonly observed jack species (Carangidae) was the bluefin trevally (*Caranx melampygus*), most individuals observed were smaller than 50 cm TL.

The finescale triggerfish (*Balistes polylepis*), which is common in the tropical eastern Pacific but thought to be rare in Hawaii, was frequently observed along the south and southeast coasts of Hawaii. Other notable observations included multiple sightings of the spotted knifejaw (*Oplegnathus punctatus*) and a single sighting of a tiger shark (*Galeocerdo cuvier*).

Hawaiian green sea turtles (*Chelonia mydas*) were observed during many surveys and were especially abundant along the southeast coasts of Hawaii. Four hawksbill turtles (*Eretmochelys imbricata*) were observed along the southeast coast of the Island of Hawaii.

Benthic Observations:

The average hard coral cover was relatively high (10 to 20%), with a range of 0-70%. The highest coral cover percentages were found at southwest Hawaii and southeast Hawaii, and the lowest live coral cover percentages were found at east Maui (1-5%). This low cover was a result of one out of the two tows being almost entirely over sand. Stressed hard coral, defined as pale or white in coloration as a result of predation, bleaching, disease, and/or physical damage, was low in all regions and was made up of less than 5% of the colonies. Stressed hard coral in the southwest region of Hawaii appeared to be stressed because of predation by the Crown-of-thorns starfish (COTS), *Acanthaster planci*. This starfish was most abundant in this region. Nevertheless, crown-of-thorns numbers were low and not near outbreak levels. Sand and rubble did not vary among regions. Northwest Hawaii had the lowest cover of macroalgae while northeast Maui and Oahu had the greatest cover of macroalgae. Northwest Hawaii had the greatest number of observed urchins while northeast Maui had the lowest number of observed urchins. Coralline algae were found in similar percentages throughout each region (5-10%). Sea cucumber numbers were low in east Maui and Oahu. Soft coral was detected in low amounts in northeast Maui. Large *Porites* heads were seen in southwest and southeast Hawaii. Wire coral was observed in east Maui and southeast Hawaii and nets and fishing line were observed in southwest and southeast Hawaii. Overall, Oahu and east Maui had a low complexity inherent in its habitats. Although data was not collected on the following information, it may be interesting to note that divers observed Zooanthids frequently

in southeast Hawaii and that most of the substrate along the tows was predominantly basalt boulder.

- F. The Oceanography Team deployed seasurface temperature recorders and conducted shallow water CTD casts to quantify and assess the hydrographic environment in the MHI (Appendix F).
- G. Goals for night operations during OES0502 included shipboard CTD casts and EK60 echosounder transects and associated IKMT plankton net trawls (Appendix G).

SCIENTIFIC PERSONNEL:

Russell Brainard, Ph.D., Chief Scientist, Towboard Team - Habitat, National Oceanic and Atmospheric Administration (NOAA)-Pacific Islands Fisheries Science Center (PIFSC)-Coral Reef Ecosystems Division (CRED)

Molly Timmers, Towboard Team – Habitat, University of Hawaii (UH)-Joint Institute for Marine and Atmospheric Research (JIMAR), PIFSC-CRED

Casey Wilkinson, Towboard Team – Habitat, UH-JIMAR, PIFSC-CRED

Dwayne Meadows, Ph.D., Towboard Team – Habitat, UH-JIMAR, PIFSC-CRED

Brian Zgliczynski, Towboard Team – Fish, NOAA-PIFSC-CRED

Joseph Laughlin, Towboard Team – Fish, UH-JIMAR, PIFSC-CRED

Stephani Holzwarth, Mooring Team, UH-JIMAR, PIFSC-CRED

Benjamin Richards, Towboard Team – Fish, UH-Zoology (JIMAR, PIFSC-CRED)

Scott Godwin, Benthic Team – Invertebrates, Bishop Museum

Ryan Okano, Benthic Team – Algae, Hawaii Department of Land and Natural Resources (DLNR)-Division of Aquatic Resources (DAR)

Ranya Henson, Benthic Team – Algae, Bishop Museum

David Gulko, Benthic Team – Corals, Hawaii DLNR-DAR

Greta Aeby, PhD, Benthic Team – Corals, Hawaii DLNR-DAR

Steve Cotton, Fish Team, Hawaii DLNR-DAR

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Oliver Dameron, Data Manager/Oceanography Team, UH-JIMAR, PIFSC-CRED

Jacob Asher, Divemaster, UH-JIMAR, PIFSC-CRED

DATA COLLECTED:

Digital images of diseased coral

Field notes on signs of coral bleaching or disease

Samples of diseased coral for histopathological analysis

Digital images from algal photoquadrats

Algal voucher specimens

Algal field notes of species diversity and relative abundance

Digital images of the benthic habitat from towboard surveys

Macroinvertebrate counts from towboard surveys

Quantitative surveys of reef fishes (larger than 50 cm TL) to species level from towboards

Habitat lineation from towboard surveys
Benthic composition estimations from towboard surveys
Acoustic Doppler current profiler (ADCP) transects
Conductivity, temperature and depth (CTD) profiles to 500 m

(/s/Russell E. Brainard)
Submitted by: _____
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Attachments

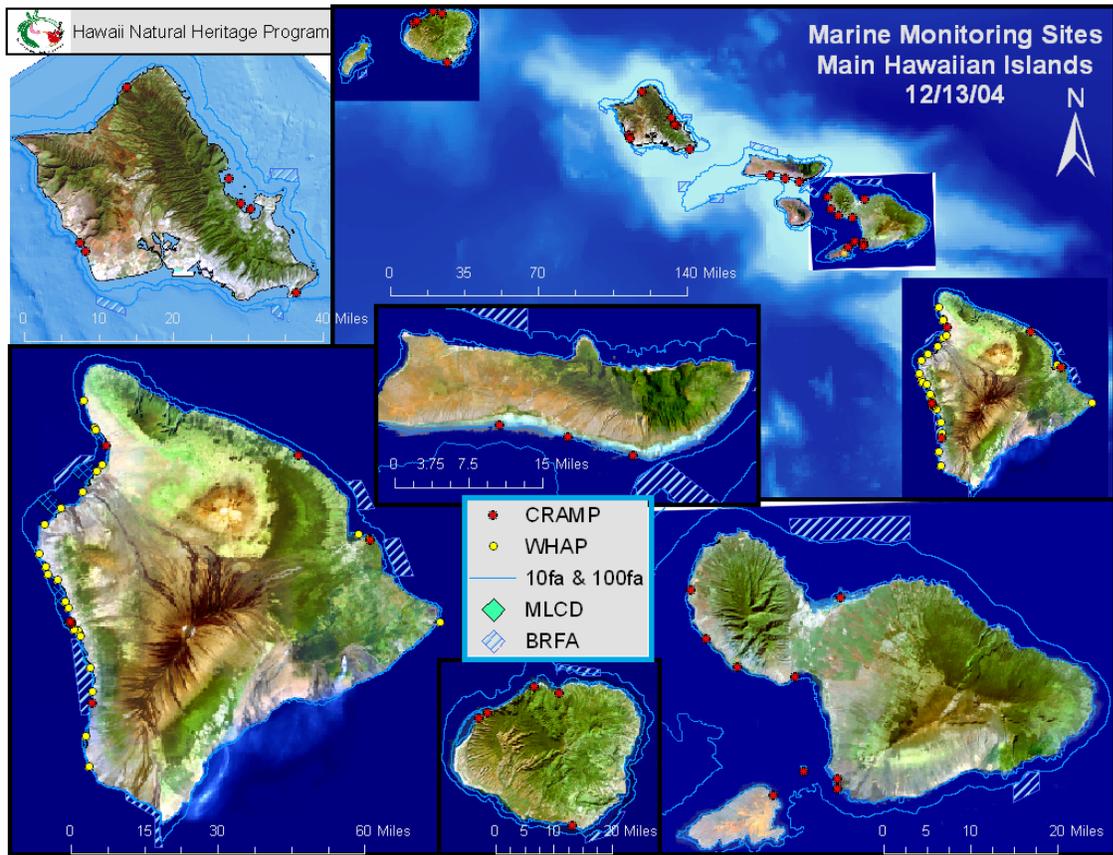


Fig.1. Maps of existing survey sites in the Main Hawaiian Islands. Proposed surveys for OES-05-02 will be windward sides of Hawaii and Maui.

Appendix A: **Fish Rapid Ecological Assessment (REA) Team Activity Summary** (Steve Cotton, Paul Murakawa, Darla White)

Methods

Fish transect stations consisted of three consecutive 25-m lines set along a single depth contour at 13–15 m. As each line was set, quantitative belt transects (BLT) were conducted as the observers swam about 5 m apart 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 (SPC) 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 TL observed in the water column within a cylindrical volume 10 m in radius during a 5-minute period. In addition, the divers recorded the species of fishes seen outside the transect area and outside the SPC counts on an opportunistic basis. During REA surveys, the divers recorded all species observed during the dive. These observations of diversity are combined with fish observed by other divers (benthic team, tow team, or mooring team) to develop an island-wide listing of all fishes observed. In addition, the fish team conducted supplementary collection activities on several dives following the completion of the quantitative surveys when potential new records or unidentifiable fish were observed.

Results

1. Oahu

Anchor Scar 02/24/05

Transects were laid in 12-15 meters depth in the vicinity of the anchor scar from the grounded bulk carrier, the *Flattery*, off of Barber's Point. The third transect ended at the scar. Visibility was approximately 10 meters. The substrate was a hard limestone shelf covered in turfs and light sedimentation, with sparse coral coverage dominated by *Pocillopora meandrina* and *P. eydouxi*. Fishes were sparse in general. The most abundant species on the transects were *Thalassoma duperrey*, *Paracirrhites arcatus*, *Canthigaster jactator*, *Dascyllus albisella*, and *Plectroglyphidodon johnstonianus*. Atypical sightings included an abundance of *Chaetodon kleinii* and *Pseudojuloides cerasinus*, and within the branches of a *P. eydouxi* head, about a dozen *Sargocentron xantherythrum*.

2. Maui

MAI-01 02/25/05

Transects were laid in 8-10 meters depth in a reef community just offshore of the town of Hana. The most abundant species on the transects were *Thalassoma duperrey*, *Acanthurus nigrofuscus*, *Ctenochaetus strigosus*, *Stegastes fasciolatus*, and *Kyphosus* spp. Other abundant species present included *Acanthurus leucopareius*, *Acanthurus triostegus*, and *Melichthys niger*. Larger acanthurids and scarids were common as well.

MAI-02 02/25/05

High relief area; unusual in that there was a drop-off facing the shore, potentially a reverse shelf. Transects were laid in 10-12 meters depth. The most abundant fishes on the transects were

Thalassoma duperrey, *Paracirrhites arcatus*, *Chromis vanderbilti*, *Stegastes fasciolatus*, and *Acanthurus triostegus*. *Scarus rubroviolaceus*, *Acanthurus dussumieri*, *Naso unicornis*, and *N. lituratus* were also abundant. Also sighted were *Decapterus macarellus*, *Desmoholocanthus arcuatus*, and *Oxycirrhites typus*.

MAI-03 02/26/05

Transects at Nu'u Bay ran along the 11-12-meter isobath, just along the bottom of the reef slope near the sand. *Chromis* spp. dominated the transects in general. The most common species on the transects were *Chromis vanderbilti*, *C. agilis*, *C. hanui*, *C. ovalis*, and *Ctenochaetus strigosus*. Also sighted were *Chanos chanos*, *Pseudanthias bicolor*, *Oplegnathus punctatus*, and *Desmoholocanthus arcuatus*. Also common were *Sufflamen fraenatus*.

3. Hawaii

HAW-01 2/27/05

Onomea Bay was predominantly boulders with coral growth and moderate to low visibility. The transects were laid in a U pattern to stay out of silt flats. The prominent families represented were Acanthuridae and Chaetodonidae. The most common species on the transects were *Lutjanus kasmira*, *Mulloidichthys vanicolensis*, *Chromis ovalis*, *Chromis vanderbilti*, and *Centropyge potteri*. Notable common sightings included *Bodianus bilunulatus* and *Lutjanus kasmira* of variable sizes, including terminal phases of the former. Large fishes were prevalent.

HAW-02 2/27/05

This site was chosen as an alternate to Pepe'ekeo Mill, where visibility was 2 feet. The survey started on an 8-meter deep shelf dominated by *Pocilloporoa* spp. and dropped into a 12-14-meter depth slab and boulder habitat. The most common species on the transects were *Chromis vanderbilti*, *Thalassoma duperrey*, *Acanthurus nigrofuscus*, and *A. leucopareius*. Notable mentions: the *Ctenochaetus strigosus* and *Parupeneus* spp. were large, *Bodianus bilunulatus* were common, and a *Desmoholocanthus arcuatus* was sighted.

HAW-03 2/27/05

The transects varied from 12-16 meters depth with moderately low visibility. The most common species on the transects were *Lutjanus kasmira*, *Chromis vanderbilti*, *Acanthurus nigrofuscus*, *Paracirrhites arcatus*, *Thalassoma duperrey* and *A. leucopareius*. Fish were not generally abundant. *L. kasmira* were predominantly small, and a pair of *Desmoholocanthus arcuatus* was sighted.

HAW-04 2/28/05

Transects followed a 10-12-meter depth. Water conditions and visibility were good. The most common fish species along the transect were *Chromis hanui*, *C. vanderbilti*, *Acanthurus nigrofuscus*, *Zebrasoma flavescens*, and *Ctenochaetus strigosus*. An aggregation of juvenile *Acanthurus olivaceus* were present.

HAW-05 2/28/05

Surveys were taken at 10-13 meters depth. Fishes were generally abundant. The most common fish species on the transects were *Chromis agilis*, *Chromis vanderbilti*, *Ctenochaetus strigosus*, *Chromis hanui*, and *Acanthurus nigrofuscus*. Most notable were the large numbers of young *Monotaxis grandoculis*. Also abundant were *Cephalopholis argus*, *Hemitaurichthys polylepis*,

H. thompsoni, juvenile *Zebrasoma flavescens*, *Bodianus bilunulatus*, and scarids. A male *Ostracion whitleyi* was sighted, too.

HAW-06 2/28/05

Transects ran along the 8-meter isobath. Fish species richness was high. The most abundant fishes recorded on the transects were *Ctenochaetus strigosus*, *Acanthurus nigrofuscus*, *Chromis vanderbilti*, *Thalassoma duperrey*, and *C. agilis*. Large schools of *Zebrasoma flavescens* (> 200 individuals) were sighted. Juvenile surgeons were prevalent. *Lutjanus kasmira* and *Naso lituratus* were abundant. Scarids, including terminal phase males, were prevalent and generally large.

HAW-07 3/1/05

Outside of Wai Opae tidepools was a boulder slope with coral growth and high fish species richness. The most abundant species recorded along the transects were *Chromis vanderbilti*, *Ctenochaetus strigosus*, *Acanthurus nigrofuscus*, *Paracirrhites arcatus*, and *Thalassoma duperrey*. Also sighted were *Aprion virescens*. *Lutjanus kasmira* were also abundant.

HAW-08 3/01/05

Transects were lain approximately along the 8-meter isobath and visibility was moderately low. The most abundant species recorded on the transects were *Chromis vanderbilti*, *Acanthurus olivaceus*, *Acanthurus nigrofuscus*, *Paracirrhites arcatus*, *Plectroglyphidodon imparipennis*, and *Thalassoma duperrey*. Also present were *Centropyge fisheri* and *Novaculichthys taeniourus*. Notable were the number of turtles present.

HAW-09 3/1/05

The transects were lain along the 12-meter isobath. A school of *Decapterus macarellus* crossed the transect early in the dive. Apart from that, the most abundant species on the lines were *Chromis vanderbilti*, *Acanthurus nigrofuscus*, *Ctenochaetus strigosus*, *Paracirrhites arcatus*, and *Thalassoma duperrey*. Also abundant in the area were *Lutjanus kasmira*, *Naso unicornis*, and *Melichthys niger*. A large mixed school of *Acanthurus triostegus* and *A. leucopareius* was sighted in the 5-meter depth area. A single *Desmoholocanthus arcuatus* was sighted.

HAW-10 3/2/05

The transect lines approximately followed the 11-meter isobath. The most abundant species recorded were *Chromis vanderbilti*, *Acanthurus nigrofuscus*, *Paracirrhites arcatus*, and *Pseudocheilinus tetrataenia*. *Melichthys niger* were present in large numbers, and *Aphareus furca* and *Naso lituratus* were prominent as well. Most notable were the large sizes and abundance of *Ctenochaetus hawaiiensis*. Three *Chaetodon reticulatus* and a large *Caranx melampygus* were sighted, too.

HAW-11 3/2/05

Halape was a very interesting sight. The fish assemblage was atypical as compared to many of the sites surveyed on the Island of Hawaii. The transects were lain from 10 to 15 meters. Of notable mention were the high numbers of post-recruit sized fishes, especially *Zebrasoma flavescens*. The most abundant fish species on the transects were *Ctenochaetus strigosus*, *Chromis vanderbilti*, *Naso lituratus*, *Acanthurus leucopareius*, and *A. olivaceus*. *Cephalopholis argus* were common and large, *Kyphosus* spp. were abundant, a large *Caranx ignobilis* was

recorded, a hybrid *Acanthurus achilles-nigricans* was sighted, *Aphareus furca* and scarids were abundant, and a school of large *Hyporhamphus acutus* were recorded.

HAW-12 3/3/05

The transects were lain from 12 to 8 meters in depth. The general topography was basalt finger reefs with sand channels. The dominant fish family was Acanthuridae. The overall species richness was moderately low. The most abundant species recorded were *Acanthurus olivaceus*, *A. blochii*, *Paracirrhites arcatus*, *Ctenochaetus strigosus*, and *Zebrasoma flavescens*. A couple of *Aprion virescens* were also counted. *Zebrasoma flavescens* of variable sizes were noted, including post-recruit sizes of 5 cm TL.

HAW-13 3/3/05

This site had high species richness with most families well represented. On the transects, the most numerous fishes were *Chromis vanderbilti*, *Paracirrhites arcatus*, *C. agilis*, *Zebrasoma flavescens*, and *C. ovalis*. Larger fishes prominent in the area were *Aphareus furca*, *Kyphosus* spp., and *Scarus rubroviolaceus*; *A. furca* was particularly abundant. A school of *Decapterus macarellus* stayed in the vicinity. A *Desmoholcanthus arcuatus* was recorded on the transect.

HAW-14 3/3/05

The primarily boulder habitat dropped off steeply close to shore. On the transects the most abundant species were *Chromis agilis*, *C. verater*, *C. hanui*, *Ctenochaetus strigosus*, and *Zebrasoma flavescens*, including 5-cm sizes in a non-*Porites compressa* habitat. Outside the lines, the prominent species represented were *Decapterus macarellus*, *Aphareus furca*, *Naso lituratus*, *Acanthurus dussumieri*, and *Cephalopholis argus*. And two *Aluterus scriptus* were also recorded. Of notable mention were an aggregation of *Abudefduf abdominalis* and *A. vaigiensis* around a sizable egg mass on the side of a boulder.

HAW-15 3/4/05

Our first shark sightings of the trip were at this site. Two *Triaenodon obesus* were present. The most numerous fishes on the transects were *Chromis vanderbilti*, *Paracirrhites arcatus*, *Ctenochaetus strigosus*, *Zebrasoma flavescens*, and *Pseudocheilinus octotaenia*. Other abundant larger fishes in the area were *Lutjanus kasmira*, *Acanthurus dussumieri*, *Myripristes berndti*, and *Kyphosus* spp. Two *Aprion virescens* and an *Acanthurus xanthopterus* were also recorded.

HAW-16 3/4/05

The transects were lain along a 13-meter isobath. The most numerous fish species on the transects were *Chromis vanderbilti*, *Acanthurus nigrofuscus*, *A. dussumieri*, and *Plectroglyphidodon johnstonianus*. Larger abundant fishes recorded include *A. olivaceus*, *Naso lituratus*, *Scarus rubroviolaceus* and other scarids, and *A. blochii*. In general, fish abundance and richness were very low.

HAW-17 3/4/05

This site had a prominent boulder habitat in the shallows, which turned into an exceptionally high coral cover area as you go deeper. The transect was lain about where the two habitats meet in about 10-12 meters depth. Most abundant fish species on the transects were *Chromis vanderbilti*, *Lutjanus kasmira*, *Acanthurus triostegus*, *Thalassoma duperrey*, and *Paracirrhites arcatus*. Larger abundant fishes included *Scarus rubroviolaceus*, *Acanthurus duperrey*, and *Cephalopholis argus*. Although not a fish, of notable mention was a hawksbill turtle.

HAW-18 3/5/05

This site had a high relief and a strong current. The most abundant fishes on the transects were *Chromis vanderbilti*, *Acanthurus nigrofuscus*, *A. leucopareius*, *Ctenochaetus strigosus*, and *Paracirrhites arcatus*. The larger abundant fishes recorded include *Naso lituratus*, *A. olivaceous*, and *Acanthurus blochii*. Large *A. achilles* were noted. A *Desmoholacanthus arcuatus* was sighted, too.

HAW-19 3/5/05

This site was approximately one-half mile offshore and still in 10 meters of water. The substrate was flat with large pinnacles, the tops of most in 3-5 meters depth. The site in general had low species richness and low abundance. The most abundant fishes on the transects were *Chromis vanderbilti*, *Macropharyngodon geoffroy*, *Acanthurus olivaceous*, *Thalassoma duperrey*, and *Paracirrhites arcatus*. We saw three *Chaetodon reticulatus*, a pair of very large *Chaetodon miliaris*, and a large *Naso hexacanthus*.

Appendix B: Coral Rapid Ecological Assessment (REA) Team Activity Summary (Dave Gulko and Greta Aeby)

Methods

Two, 25-m transect lines, previously laid out by the fish team, were videotaped. The videotapes will be used at a later time to analyze percent cover data and will provide a permanent record of the condition of the benthos. Colony counts along two 25-m by 1-m belt transects were conducted. All corals whose colony center fall within 0.5 meters on either side of the transect line were enumerated and placed into one of seven size classes: <5 cm, 5-10, 11-20, 21-40, 41-80, 81-160, and >160 cm. Coral cover was documented by the line-intercept method at 50-cm intervals. Coral bleaching and disease was assessed along both transects, as time allowed, in a wider 25-m by 6-m belt. Any diseased corals encountered were enumerated, photographed, and samples collected for follow-up laboratory analysis. Videotaping and coral colony counts were conducted by Dave Gulko, DAR and a line-intercept and disease assessment were conducted by Greta Aeby, DAR.

Results

1. Maui

Surveys were conducted along three sites around Maui between February 25 and 26, 2005.

Maui 01 was a reef community off the coast of Hana. It was a spur-and-groove zone with an average of 50% coral cover. *Pavona duerdeni* and *Porites lobata* were the most abundant of the 16 coral species noted at the site. Large, massive colonies of *Pavona duerdeni* and *Porites lobata* were present. Occurrence of diseases included *Porites trematodiasis* and *Porites* growth anomalies.

Maui 02 was a reef community off Keanae near Wainapanapa. The area was characterized by a lava spur extending out from shore which was covered with a variety of coral and dropped sharply on the shoreward side from roughly 15 feet down to 80+ feet, and sloped downwards on the seaward side. Average coral cover was 25 percent. *Pocillopora meandrina* was the most dominant coral seen, while *Porites lobata* and *Pocillopora eydouxi* were abundant at the site. A total of 17 coral species were seen; unusual corals included black coral (*Antipathes* sp.), *Psammocora stellata* and *Leptoseris incrustans*. The largest number of coral colonies observed was in the smallest size classes suggesting active coral colonization and/or frequent disturbance resulting in fragmentation and colony size restriction. Four diseases were encountered including *Porites* trematodiasis, *Porites*, growth anomalies, *Montipora* growth anomalies and *Montipora* tissue loss syndrome. COT predation on montiporids was also observed.

Maui 03 was a reef community/apron reef facing west along a rocky peninsula shoreline extending out from the southeast Maui coastline and protected from the prevailing tradewind-generated swell which affects the majority of this coastline. Slope was at a 30-40 degree angle and was covered in thick sediment. Coral cover averaged 65% and was dominated by *Porites compressa*, including some large, expansive patches of this coral. A total of 18 coral species were noted, including unusually large numbers of wire coral (*Cirripathes* sp.) which were seen at the base of the slope. *Pocillopora meandrina* was the most common coral near the top of the

slope. Unusual corals included *Porties rus*, *Psammocora stellata*, and *Montipora verrilli*. Coral diseases included *Porites trematodiasis* and *Porites* growth anomalies.

2. Hawai'i

Surveys were conducted along 19 sites around the Big Island between February 27 and March 5, 2005. Majority of surveys were conducted off the eastern side of the island. The majority of the habitats encountered were reef communities atop either large boulder or rocky spur-and-groove substrates. No extensive fringing reefs were encountered. Most coral communities were in high wave-energy environments.

Hawai'i 01 was off the northern side of Onomea Bay. It was a boulder habitat with a very light cover of coral growing atop it averaging far less than 5 % coral cover. *Porites lobata* was the most frequently seen coral of the 14 species noted at the site. A single specimen of *Leptoseris papyracea*, a coral usually found at deep depths, was noted growing on the underside of a large boulder in the lee of the prevailing swell. Water was turbid at this site.

Hawai'i 02 was originally slated to occur directly off the old mill site at Pepeako; however, the Fish Team, upon descending to the transect depth, noted visibility of less than 2 feet and a bottom devoid of any coral, consisting of loose sediment and pavement. The survey site was then moved about a mile or two to the north, where a boulder habitat was encountered with an average of 20% coral cover encompassing 10 species of coral. *Pocillopora meandrina* dominated, with *Porites lobata* and the zoanthid *Palythoa cesia* being very common.

Hawai'i 03 was a boulder habitat directly to the south of Kolekole Beach Park near Honomu. Coral cover averaged 5% with the most common corals being *Pocillopora meandrina* and *Porites lobata*. Twelve coral species were noted at the site, with the vast majority being in the smaller size ranges.

Hawai'i 04 was a reef community off the northwestern side of the island, in Holoana Bay. Coral cover was estimated to be 25%, with *Porites lobata* being the most abundant of the four coral species noted at the site. Majority of corals seen were in the smaller size classes.

Hawai'i 05 was a reef community on a sloped habitat consisting primarily of *Porites* corals and rubble off of Haena Point on the northwestern side of the island. *Porites lobata* and *Porites compressa* were the most abundant of the four coral species noted at the site. Large, expansive colonies of *Porites compressa* and *Porites lobata* were present.

Hawai'i 06 was an apron reef community off Makaonule near Mahukona Harbor on the northwestern side of the island. Coral cover was estimated at 50%, with *Porites lobata* dominating the five coral species noted at the site. Large, expansive colonies of *Porites lobata* were present.

Hawai'i 07 was a reef community occurring atop a rocky spur-and-groove habitat directly offshore of the Waiopae Tidepools Marine Life Conservation District in the Kapoho area of the Puna District of the Big Island. Corals occurred throughout the spur-and-groove zone with an average of 50% coral cover. The site was dominated by *Pocillopora meandrina*, with *Porites lobata* and the zoanthid *Palythoa cesia* being very common. Thirteen coral species noted at the

site, including *Pocillopora ligulata*; interestingly, this coral occurred on many of the following transects south of this point, but prior to this survey was rarely noted in the Main Hawaiian Islands from other frequently surveyed areas other than the outside barrier reef region of Kaneohe Bay.

Hawai'i 08 was a reef community occurring atop a boulder habitat offshore of the Opihikau. Coral cover averaged 30%, with *Pocillopora meandrina* being the most commonly encountered coral. A total of 18 coral species were noted at the site, including the rarely encountered *Coscinaraea wellsi* and *Montipora verrilli*.

Hawai'i 09 was a reef community occurring atop a rocky slope with boulders on the northern side of the bay fronting Kahena Black Sand Beach. Coral cover averaged 35%, with *Pocillopora meandrina* and the soft coral *Anthelia edmonsoni* being the most commonly encountered corals. A total of 23 coral species were noted at the site, making this the most coral species rich of the areas surveyed on this trip. A number of shade-adapted species were noted within small holes and crevices including the endemic gorgonian *Acabaria bicolor* and the ahermatypic *Balanophyllia affinis*. The majority of coral seen at this site was in the smaller size classes.

Hawai'i 10 was a thin veneer of coral atop a lava substrate with some boulders offshore of the Hawksbill sea turtle nesting area at Apua Point in Volcanoes National Park. Coral cover averaged 50%, with *Pocillopora meandrina*, *Pocillopora eydouxi* and *Porites lobata* being the most commonly encountered corals. A total of 13 coral species were noted at the site. A few large, massive colonies of *Porites evermanni* and *Porites lobata* were noted far off the transect in deeper water.

Hawai'i 11 was a reef community occurring atop a rocky habitat offshore of the Hawksbill sea turtle nesting area at Halape in Volcanoes National Park. Coral cover averaged 25%, with *Pocillopora meandrina*, *Porites lobata* and *Porites compressa* being the most commonly encountered corals. A total of 22 coral species were noted at the site, including the rarely encountered *Montipora verrilli*. Large, expansive colonies of *Porites compressa* and *Porites lobata* were present, as were a number of shade-adapted species such as the endemic gorgonian *Acabaria bicolor*, the ahermatypic *Balanophyllia affinis*, wire coral (*Cirrhopathes sp.*) and small black coral (*Antipathes sp.*) colonies. This site was the second most species rich site from a coral perspective for this expedition.

Hawai'i 12 was a reef community occurring atop a rocky spur-and-groove habitat offshore of Ka'alaulu near the southern end of the island. Coral cover averaged 60%, with *Porites lobata* and *Porites compressa* being the most abundant coral species. A total of 19 coral species were noted at the site, including the rarely encountered *Montipora verrilli*. Large, massive colonies of *Porites evermanni* and *Porites lobata* were present in the grooves at deeper depths off the transect. Also found within holes and crevices along the sides of the spurs were a number of shade-adapted species such as *Leptoseris incrustans*, and the ahermatypic coral *Balanophyllia affinis*.

Hawai'i 13 was a steep-sloped boulder community located along the cliff base just northwest of Ka Lae Point (South Point). The reef community had a coral cover of 20%, with *Pocillopora meandrina* and *Pocillopora eydouxi* being the most abundant corals. A total of 16 coral species were noted at the site, with the vast majority of all species of coral encountered being in the

smaller size classes. A number of shade-adapted species were encountered under boulders and crevices and included *Leptoseris incrustans*, the ahermatypic coral *Balanophyllia affinis*, and wire coral (*Cirrhopathes sp.*). Crown-of-Thorns seastar (*Acanthaster planci*) damage was seen along with two COTs.

Hawai'i 14 was a very steep-sloped boulder community located off a cliff base about 4 miles northwest of Ka Lae Point (South Point). The site was chosen because of its use as a mooring site for large live-aboard dive charters. The reef community had a coral cover of 35%, with *Porites compressa* being the most abundant coral species. A total of 18 coral species were noted at the site, including a number of shade-adapted species such as the ahermatypic coral *Balanophyllia affinis*, the wire coral (*Cirrhopathes sp.*), small black coral colonies (*Antipathes sp.*), and the endemic gorgonian *Acabaria bicolor*. A single specimen of the fungid *Cycloseris vaughni* was found as were a number of unidentified fungid specimens.

Hawai'i 15 was a rocky boulder community located offshore of the Hawksbill sea turtle nesting site at Kamehame, north of Punalu'u. The reef community had a coral cover of 15%, with *Pocillopora meandrina*, *Porites lobata*, *Montipora capitata*, the zoanthid *Palythoa cesioa*, and the soft coral *Anthelia edmondsoni* being the most abundant species. A total of 18 coral species were noted at the site, with the majority of all species of coral encountered being in the smaller size classes.

Hawai'i 16 was a basalt lava-sloped spur-and-groove habitat with black sand in the base of the grooves and high coralline algae cover atop the rocky substrate. The area was located along the north side of the small embayment of Punalu'u. The reef community had a coral cover of 25%, with *Montipora capitata*, *Montipora patula* and *Porites lobata* being the most abundant corals. A total of 14 coral species were noted at the site, with a couple of large, massive *Porites lobata* and *Porites evermanni* colonies being noted off the transect in the black sand in the middle of some of the grooves.

Hawai'i 17 was a large boulder community located off Honoapu Bay. The reef community had a coral cover of over 80%, with large colonies of montiporid species such as *Montipora capitata* and *Montipora patula* completely covering many of the boulders. A total of 17 coral species were noted at the site. A number of shade-adapted species were encountered under boulders and crevices and included *Leptoseris incrustans*, the ahermatypic coral *Balanophyllia affinis*, and wire coral (*Cirrhopathes sp.*). Off the transect line, in slightly deeper water, a large number of the *Porites* colonies formed shapes resembling 3-foot tall button mushrooms.

Hawai'i 18 was a rocky community located along the shore near Makaukiu Point. The reef community had a coral cover of 60%, with *Montipora capitata* and the zoanthid *Palythoa cesia* being the most abundant corals. A total of 21 coral species were noted at the site, with most of the colonies encountered being in the smaller size classes. A number of large colonies of *Porites* were spotted near some of the deeper portions of the transect. A number of shade-adapted species were encountered under boulders and crevices and included *Leptoseris incrustans*, the ahermatypic coral *Balanophyllia affinis*, and wire coral (*Cirrhopathes sp.*). Extremely strong current and swell conditions were encountered at this site.

Hawai'i 19 was a rocky, shallow spur-and-groove community located about 3/4 of a mile offshore of Haena in the Puna district of the Big Island. The most distinguishing (and unusual)

characteristic of the site was a large number of erect rock pillars, some of which were over 12 m in diameter and extending up from the bottom almost 40 feet to the surface. The reef community had a coral cover of 15%, with *Porites lobata* being the most abundant coral species. A total of 17 coral species were noted at the site, with the vast majority of all species of coral encountered being in the smaller size classes. The invasive soft coral *Carijoa riisei* was found within a small cave.

Coral Disease Surveys

1. Maui

A total of four coral diseases were found on the reefs of Maui (*Porites* trematodiasis, *Porites* growth anomalies, *Montipora* white syndrome and *Montipora* growth anomalies). *Porites* trematodiasis and *Porites* growth anomalies were the most commonly encountered diseases (Fig. 1). Coral disease was found at all three sites (100%). COT predation on montiporids was also observed. The line-intercept method found coral cover to vary from 18.6% to 64.0% (Fig. 2).

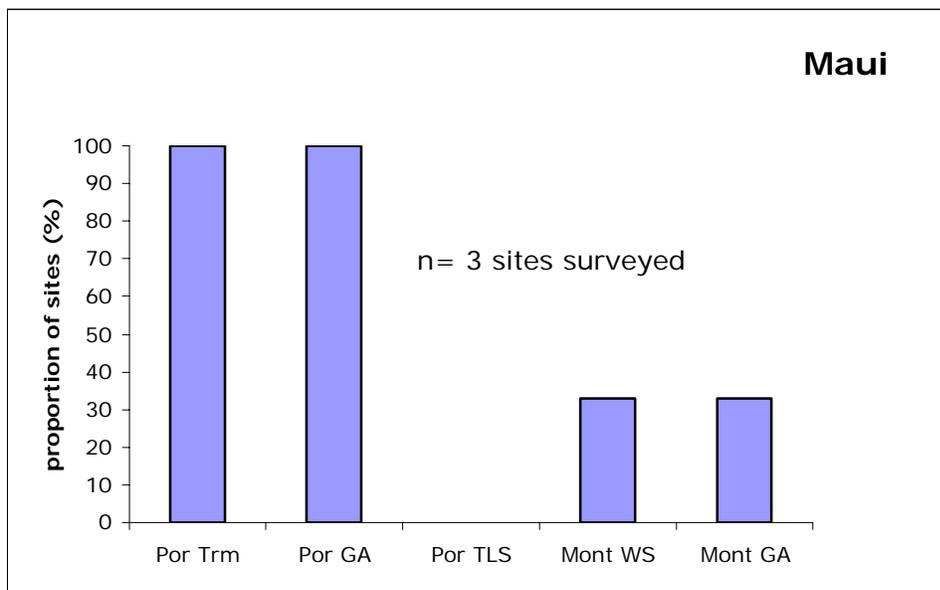


Fig. 1. Frequency of occurrence of different diseases on the reefs of Maui

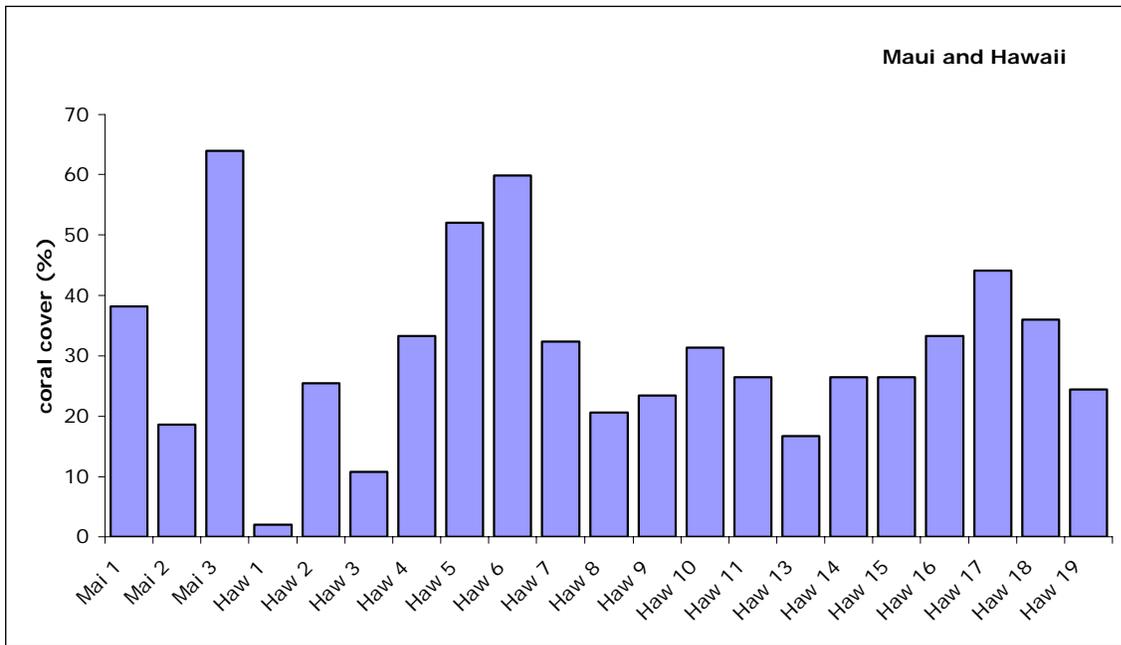


Fig. 2. Average coral cover found on the reefs of Maui and Hawaii.

2. Hawaii

A total of four coral diseases were documented on the reefs of Hawaii (*Porites* trematodiasis, *Porites* growth anomalies, *Porites* tissue loss syndrome, and *Montipora* growth anomalies). Coral disease was found at 18 of the sites (95%) with *Porites* trematodiasis, *Porites* growth anomalies and *Montipora* growth anomalies being the most frequently encountered (Fig. 3). The occurrence of the different types of coral disease differed from what has been found in the NWHI with both *Porites* and *Montipora* growth anomalies being much more common on Hawaii. These diseases were each encountered at 47% of the sites surveyed on Hawaii compared to 0% and 1.4% of the sites respectively in the NWHI (Fig. 4). Table 1 shows the distribution of the different diseases around Hawaii. Coral cover varied from 2.0% to 59.8% (Fig. 2).

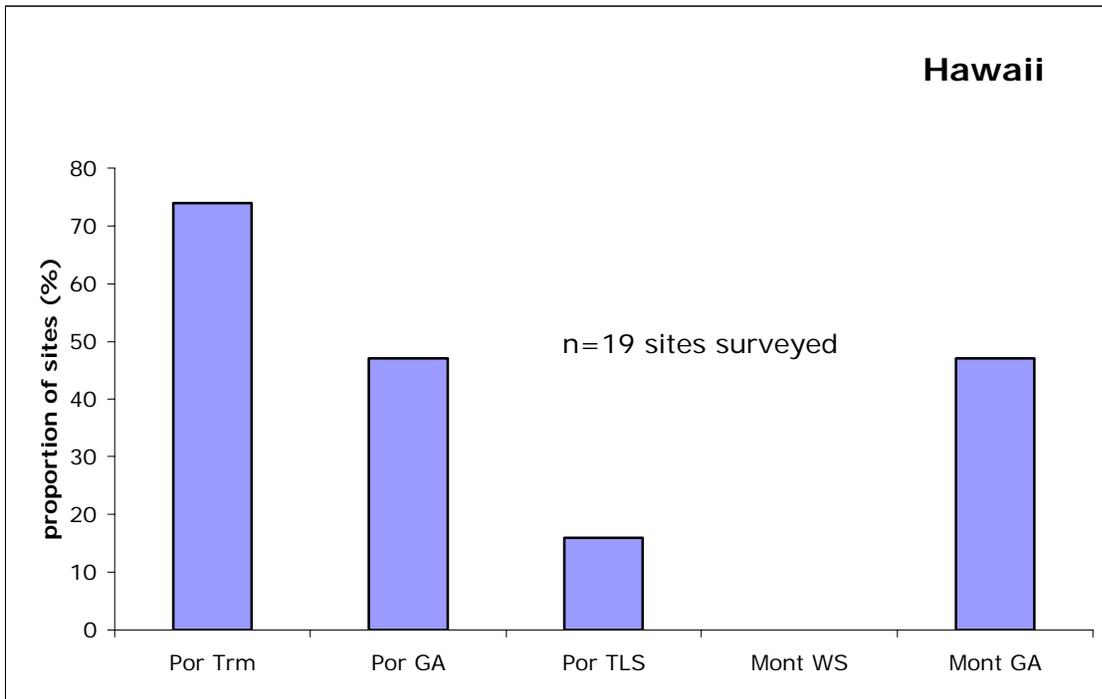


Fig. 3. Frequency of occurrence of different coral diseases on the reefs of Hawaii.

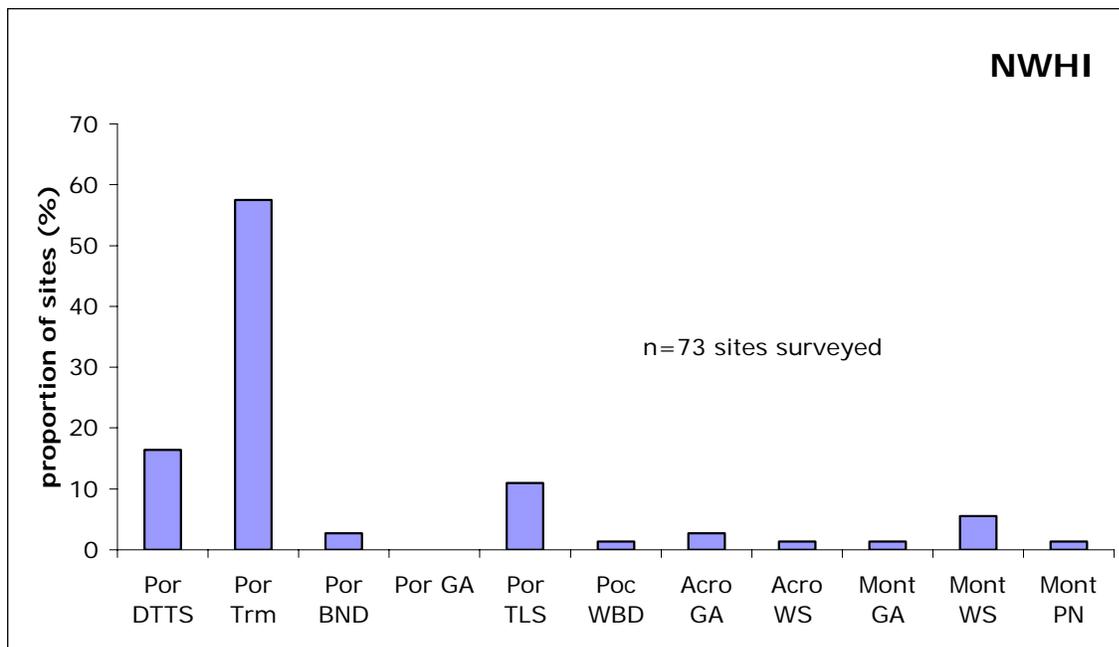


Fig. 4. Frequency of occurrence of different coral diseases on the reefs of the NWHI.

Table 1. Distribution of different coral diseases on the reefs of Hawaii.

		Por Trm	Por GA	Por TLS	Mont GA
Hawaii 1	Onomea Bay	X	X		
Hawaii 2	n of Peekeo Mill	X			
Hawaii 3	Lohuawehi Pt		X		
Hawaii 4	Holoana Bay	X	X		
Hawaii 5	Haena Pt	X	X		
Hawaii 6	Makaohuli Pt.	X	X	X	
Hawaii 7	Waiopae MLCD	X	X		X
Hawaii 8	Opihikau	X	X		X
Hawaii 9	Kehena				
Hawaii 10	Apua	X			
Hawaii 11	Halape	X		X	X
Hawaii 12	Kaalualu Bay	X			X
Hawaii 13	Ka Lae	X			
Hawaii 14	slide	X		X	X
Hawaii 15	Kamehame				X
Hawaii 16	Punalulu	X			X
Hawaii 17	Honu Apo Bay				X
Hawaii 18	Makaukiu Pt.		X		X
Hawaii 19	Haena	X	X		

Appendix C: **Algal Rapid Ecological Assessment (REA) Team Activity Summary** (Ryan Okano and Ranya Henson)

Methods

Standardized quantitative sampling methods for remote tropical Pacific islands were developed and published for marine algae (Preskitt et al., Pacific Science 2004). To allow for vertical sampling in areas of high relief (walls), the method was modified slightly by Vroom et al. (in review, Coral Reefs) and entails photographing quadrats, collecting algal voucher specimens, creating in situ algal species lists, and ranking relative algal abundance. This modified “Preskitt method” that has been used by the Coral Reef Ecosystem Division (CRED) since 2003 in the Northwestern Hawaiian Islands, Guam/Mariana Islands, Pacific Remote Island Areas, and American Samoa is now used in the Main Hawaiian Islands.

1. Oahu (Table C-1)

Barbers Point (ship grounding), 2/24/05

This site was on the edge of the reef crest in the depth range of 40-45 ft. This site was a substrate flat pavement covered with a layer of turf with intermittent *Pocillopora* heads. There was minimal macroalgae present but, the most common species was *Neomeris annulata*. Fish were very low in number on the transects and the dominant invertebrate was sea urchins of various species.

Table C-1: Algae of Barbers Point, Oahu. 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. Asterisks indicate algae found during the random swim that did not occur in photoquadrats sampled.

	Barbers Pt.
Green algae	
<i>Avrainvillea amadelpha</i>	*
<i>Halimeda discoidea</i>	8.33 2
<i>Neomeris annulata</i>	66.67 2.375
<i>Dictyosphaeria cavernosa</i>	*
Red algae	
<i>Asparagopsis taxiformis</i>	*
<i>Gibsmithia hawaiiensis</i>	*
<i>Haloplegma duperreyi</i>	*
Brown algae	
<i>Padina sp.</i>	25 3.33
Blue-green algae	25 2
Algal turf	100 1

2. Maui (Table C-2)

MAI-1, 2/25/05

This site was located in front of Hana within the bay. The transects were located in the proximity of the reef where the hard calcified reef turned to sand in the depth range of 25-35 ft. Dominant algal species were turf, coralline crustose algae, and *Amansia glomerata*. The reef was quite complex with numerous overhangs and holes. *Pavona varians* was the dominant coral. Although the reef was near inhabitations there was still many high grade food fish.

MAI-2, 2/25/05

This site was located near the inhabited peninsula of Keanae. The transects were laid on top of an outcrop spur in the depth range of 25-30 ft. There was a diverse assemblage of algae on the transects including *Padina melemele*, *Caulerpa taxifolia*, and *Asparagopsis taxiformis*. Based on the minimal yet impressive surge we believe it to be a high energy site. The dominant coral species was *Pocillopora meandrina*. Near the site there were deeper grooves which were inhabited by species such as Black and Snowflake corals.

MAI-3, 2/26/05

This site was in Nu'u Bay, which seemed to be a popular fishing site because of the amount of fishing gear found on the bottom. The transects were in the depth range of 40-45 ft. across a sloping *Porites compressa* reef with a sandy bottom. Turf algal species such as *Rhipidosiphon javensis* and *Jania* sp. were present at the base of compressa fingers. The only macroalgae detected between the compressa fingers was *Halimeda opuntia*. The fish species were primarily smaller damselfish and surgeonfish that were feeding out in the sand flat.

Table C-2: Algae of Maui. 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.

	MAI-1	MAI-2	MAI-3	Island average
Green algae				
<i>Caulerpa peltata</i>		*		
<i>Caulerpa taxifolia</i>		*		
<i>Dictyosphaeria cavernosa</i>	*	*	8.33 <i>5.00</i>	
<i>Halimeda opuntia</i>		*	8.33 <i>2.50</i>	
<i>Neomeris annulata</i>	*			
<i>Rhipidosiphon javensis</i>			*	
<i>Siphonocladus tropicus</i>		*		
Red algae				
<i>Acanthophora pacifica</i>	8.33 <i>4.00</i>	8.33 <i>3.00</i>		8.33 (0.71) <i>3.50</i> <i>(0.71)</i>
<i>Amansia glomerata</i>	91.67	50.00		70.83

	MAI-1	MAI-2	MAI-3	Island average
	2.00	3.00		(0.71) 2.50 (0.71)
<i>Asparagopsis taxiformis</i>		*		
<i>Galaxaura marginata</i>		8.33 4.00		
<i>Gelid sp.</i>	16.67 4.00			
<i>Haloplegma duperreyi</i>		*		
<i>Jania sp</i>			58.33 3.29	
<i>Peyssonnelia sp.</i>	16.67 1.00			
<i>Plocamium sandvicense</i>	*	*		
<i>Portieria hornemannii</i>		*	8.30 2.00	
Brown algae				
<i>Dictyota ceylanica</i>		*		
<i>Padina melemele</i>		8.33 4.00		
<i>Sargassum sp.</i>		16.67 3.50		
<i>Turbinaria ornata</i>		*		
Blue-green algae	16.67 3.00	*	*	
Algal turf	91.67 1.55	100.00 1.00	100.00 1.00	97.22 (0.31) 1.18 (0.31)
Coralline crustose algae	66.67 2.75	91.67 2.09	50.00 2.17	0.00 (0.36) 2.34 (0.36)

3. Hawaii (Table C-3)

HAW-1, 2/27/05

This site was located in Onomea Bay. It was a boulder field exposed to a lot of fresh water via the stream mouth at the center of the bay. There were few macroalgal species; the algae present consisted of turf covering the boulders. The few macroalgae species found were *Padina melemele* and *Dasya iridescens*. There were not many corals or invertebrates.

HAW-2, 2/27/05

This site was located near a local fishing spot called Turtle Back. There was a lot of surge during the dive that made taking photoquadrats difficult. The first transect was in 15-20 ft. on top of a ledge with many *Pocillopora* heads. The algal species were mostly turf, with a few *Amansia glomerata*. The second part of the transect was in 50 ft. of water. It was a boulder field

with few coral species. Although the algal community could be considered turf it was quite diverse with many macroalgae that were small in stature, including *Padina melemele*, *Asparagopsis taxiformis* and *Caulepera webbiana*. We were surprised to find two seasonal algal in the genus *Scinaia*.

HAW-3, 2/27/05

This site was much like the second part of HAW-2, a boulder field. It was located just north of Kolekole. Because of equipment malfunction only one diver was able to make the survey. The algal species present were mostly turf with other small macroalgae.

HAW-4, 2/28/05

This site is located in Puakea Bay in the Kohala district. The transects were in the 40-50 ft. depth range. It was a coralline algal reef with few macroalgal species, but *Galaxaura marginata* was found in decent abundance.

HAW-5, 2/28/05

This site was located near Haena Point in the district of Kohala. The transects were in the 30-40 ft. depth range. Although macroalgae cover was not high, there was good macroalgae diversity. It was coralline algal reef.

HAW-6, 2/28/05

This site was located near Makaohule point just north of Mahukona in the district of Kohala. This site was similar to HAW-5.

HAW-7, 3/1/05

This site was located just offshore of the Waiopae Marine Life Conservation District (MLCD) in the district of Puna; it was in 25-35 ft. Transects went over a boulder field. Fish were in high abundance, which may explain why macroalgae was absent in our quadrats. The only macroalgae detected was *Platoma ardreanum* in drift.

HAW-8, 3/1/05

This site was located offshore of the Opihikao community in the district of Puna. The transects were on a reef flat spur surrounded by black sand and rubble. The first transect was in 35 feet and the second was in 20 feet. Although the algal community was small in stature and could be considered turf, a trained Phycologist eye could detect numerous macroalgae such as *Sargassum* sp., *Asparagopsis taxiformis*, and *Padina melemele*. The strong surge and numerous *Pocillopora meandrina* heads suggest a high energy reef.

HAW-9, 3/1/05

This site was located offshore on the north side of Kehena beach (naked beach) in the district of Puna. Transects were in the depth range of 30-45 ft. on a relatively young reef slope for the Hawaiian Archipelago. There were a diverse assemblage of algae, invertebrates, corals, and fish at this site. Some of the macroalgae found here was *Turbinaria ornata*, *Halimeda opuntia*, and *Acanthophora pacifica*.

HAW-10, 3/2/05

This site was located just south of Apua point within the boundaries of the Volcanoes National Park. Transects were in the depth range of 30-40 ft. The algal community was quite diverse and

evenly spread. All macroalgae detected were found in our quadrats. Some of the more common alga were *Lobophora varigata*, *Dictyota flabellata*, and *Jania* sp. *Pocillopora meandrina* was the most common coral at this site at this boulder field reef and the fish community was diverse and abundant.

HAW-11, 3/2/05

This site was located just south of Keaoli Islet near the Halape campsite within the Volcanoes National Park. Transects were in the depth range of 30-50 ft. The algal community at this site was quite diverse. Some of the common macroalgae were *Halimeda opuntia*, *Dictyota flabellata*, and *Lobophora varigata*. We also found *Predaea weldii* even though it was quite early in the season. This boulder field reef seemed to be relatively pristine for the Main Hawaiian Islands because of the abundance of food fish and lobsters.

HAW-12, 3/2/05

Because of equipment difficulties the algal team did not dive at this site.

HAW-13, 3/3/05

This site was located just south of the broken boat ramp down Kalae. Transects were in the depth range of 35-50 ft. This reef was a boulder field dominated by *Pocillopora meandrina*. The algal community was dominated by turf, coralline crustose algae, and a brown crust. Although macroalgae were uncommon we did detect *Tubinaria ornate* and *Padina melemele*.

HAW-14, 3/3/05

This site was located near the north end of Pali Haukeuke in the district of Kau. The transects were on a 75° slope (quite steep) in the 35-50 ft depth range. This reef was a slope with intermittent boulders. The algal community was dominated by turf and coralline crustose algae. The macroalgae community was quite diverse at this site; some of the macroalgae detected was *Caulerpa macrophysa*, *Galaxaura marginata*, and *Microdictyon setchellianum*.

HAW-15, 3/4/05

This site was located near Kamehame Hill. The transects were laid along a reef slope at 45-60 ft. There were cold fresh water springs at this site. Among the numerous boulders there were *Pocillopora* and *Montipora* corals and a lot of turf algae. There were many macroalgae though, including *Dictyota ceylanica* and *Dictoyota flabellata* found among the dead *Pocillopora* heads. Other alga present was *Dudresnaya* sp. This is the only site we saw sharks, two white tips.

HAW-16, 3/4/05

This site was located at the north end of Punalu'u Bay, also known as the popular Black Sand Beach. It was the site with the most macroalgae during the trip, most likely as a result of the fresh water input and the nutrients from a nearby golf course located to the south. Some of the more abundant algae found were *Acanthophora pacifica*, *Portieria hornemannii*, *Dictyota ceylanica* and *Amansia glomerata*. There were numerous invertebrates, but few fish.

HAW-17, 3/4/05

This site was south of Honu'apo Bay. It was a sloping boulder field with not much algae, but the boulders were covered with many species of *Montipora* corals. The algae present were dominated by coralline crustose; others found were *Kallymenia sessilis* and *Ventricaria ventricosa*. There were many invertebrates at this site, including tiger cowries and lobsters.

HAW-18, 3/4/05

This site was located near Maku'u in the Puna District. It was a complex habitat of fingers and valleys with depths varying from 40 to 50 ft. Turf and coralline crustose were dominant algae. Others present were *Asperigopsis taxiformis*, *Padina melemele*, and *Lobophora variegata*.

HAW-19, 3/4/05

This site was located near Wahinemakanui Islet. It was a reef flat with many large pinnacles that were home to many invertebrates, such as slipper and spiny lobsters and snowflake coral. There were not many macroalgae detected in the photoquadrats but we found many in the area: *Laurencia parvipapillata*, *Padina melemele*, and *Actinotrichia fragilis*.

Table C-3: Algae of the Big Island of Hawaii. 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.

	HAW-1	HAW-2	HAW-3	HAW-4	HAW-5	HAW-6	HAW-7	HAW-8	HAW-9	HAW-10
Green algae										
<i>Acetabularia</i> sp.										8.33 <i>4.00</i>
<i>Caulerpa macrophysa</i>										
<i>Caulerpa peltata</i>						*				
<i>Caulerpa serrulata</i>						*				
<i>Caulerpa taxifolia</i>				*						
<i>Caulerpa webbiana</i>		*								
<i>Dictyosphaeria versluysii</i>										
<i>Halimeda</i> sp.	*									
<i>Halimeda discoidea</i>										
<i>Halimeda opuntia</i>					*				*	
<i>Microdictyon setchellianum</i>										
<i>Neomeris annulata</i>	*	8.33 <i>3.00</i>		16.67 <i>3.00</i>	25.00 <i>3.33</i>	16.67 <i>2.50</i>				
<i>Phyllocladon anastomosans</i>					*					
<i>Rhipidosiphon javensis</i>					*	*				
<i>Siphonocladus tropicus</i>										
<i>Ventricaria ventricosa</i>					*	*				

	HAW-1	HAW-2	HAW-3	HAW-4	HAW-5	HAW-6	HAW-7	HAW-8	HAW-9	HAW-10
Red algae										
<i>Acanthophora pacifica</i>	*	*						8.33 5.00	8.33 3.00	
<i>Actinotrichia fragilis</i>									8.33 4.00	
<i>Amansia glomerata</i>	*	*						8.33 3	8.33 2	
<i>Amphiroa sp.</i>										
<i>Asparagopsis taxiformis</i>		25.00 2.33						*		
<i>Botryocladia skottsbergii</i>										
<i>Dasya iridescens</i>	*									
<i>Dotyella hawaiiensis</i>	8.33 2.00	8.33 4.00								
<i>Dudresnaya sp.</i>										
<i>Galaxaura marginata</i>				8.33 3.00	*	*				
<i>Galaxaura rugosa</i>										
<i>Gelid sp.</i>										
<i>Gibsmithia hawaiiensis</i>				8.33 4	*	*				
<i>Haliptilon subulatum</i>		*								
<i>Haloplegma duperreyi</i>		16.67 2.00				8.33 4.00				
<i>Halymenia stipitata</i>										

	HAW-1	HAW-2	HAW-3	HAW-4	HAW-5	HAW-6	HAW-7	HAW-8	HAW-9	HAW-10
<i>Jania sp</i>		*			*	16.67 3.00			8.33 3.00	16.67 3.50
<i>Kallymenia sessilis</i>										
<i>Laurencia sp.</i>								8.33 2.00		
<i>Laurencia parvipapillata</i>										
<i>Neomartensia flabelliformis</i>										
<i>Peyssonnelia sp.</i>				8.33 1.00					25.00 2.00	
<i>Peyssonnelia inamoena</i>										
<i>Platoma ardreanum</i>							*		*	
<i>Plocamium sandvicense</i>		*								
<i>Portieria hornemannii</i>	*			*				16.67 3.50	*	
<i>Predaea weldii</i>										
<i>Scinaia furcata</i>		*								
<i>Scinaia hormoides</i>		*								
<i>Tolypocladia glomerulata</i>					*	*	8.33 3.00		25.00 3.33	
Brown algae										
<i>Brown crust</i>										
<i>Dictyota sp.</i>								16.67 4.00		16.67 3.00

	HAW-1	HAW-2	HAW-3	HAW-4	HAW-5	HAW-6	HAW-7	HAW-8	HAW-9	HAW-10
<i>Dictyota ceylanica</i>					*	16.67 2.50			33.33 2.75	16.67 4.00
<i>Dictyota flabellata</i>								*	8.33 4.00	8.33 3.00
<i>Lobophora varigata</i>										33.33 3.00
<i>Padina melemele</i>	*	16.67 3.50						41.67 3.60	*	
<i>Sargassum sp.</i>		16.67 3.50						75.00 2.22		
<i>Turbinaria ornata</i>						*			8.33 3.00	
Blue-green algae	*	*		16.67 3.00	8.33 3.00	*	*	*	*	*
Algal turf	100.0 1.00	91.67 1.00		100.0 1.17	100.0 1.33	83.33 1.00	100.0 1.42	100.0 1.00	100.0 1.25	100.0 1.00
Coralline crustose algae	16.67 2	41.67 2.2		91.67 2	75.00 1.56	66.67 2	91.67 1.55	41.67 2.8	91.67 2.18	100.0 2

	HAW-11	HAW-13	HAW-14	HAW-15	HAW-16	HAW-17	HAW-18	HAW-19	Island average
Green algae									
<i>Acetabularia sp.</i>									
<i>Caulerpa macrophysa</i>			8.33 4.00						
<i>Caulerpa peltata</i>									
<i>Caulerpa serrulata</i>			*		8.33				

	HAW-11	HAW-13	HAW-14	HAW-15	HAW-16	HAW-17	HAW-18	HAW-19	Island average
					7.00				
<i>Caulerpa taxifolia</i>									
<i>Caulerpa webbiana</i>									
<i>Dictyosphaeria versluysii</i>								8.33 3.00	
<i>Halimeda sp.</i>									
<i>Halimeda discoidea</i>					8.33 4.00				
<i>Halimeda opuntia</i>	25.00 4.33		*	25.00 4.00		*		*	25 (0) 4.17 (0.24)
<i>Microdictyon setchellianum</i>			*					*	
<i>Neomeris annulata</i>	*	16.67 3.5	8.33 4.00		8.33 5.00	*		*	14.29 (6.3) 3.48 (0.82)
<i>Phyllocladon anastomosans</i>								*	
<i>Rhipidosiphon javensis</i>			8.33 6.00						
<i>Siphonocladus tropicus</i>	*								
<i>Ventricaria ventricosa</i>		8.30 4.00	*			*			
Red algae									
<i>Acanthophora pacifica</i>					25.00 3.33	*	8.33 4.00	*	12.5 (8.33) 3.83 (0.88)
<i>Actinotrichia fragilis</i>				16.67 4.00	*			*	12.5 (5.89) 4 (0)
<i>Amansia glomerata</i>	*			8.33 4	75.00 3.22	*	16.67 4	*	23.33 (29.11) 3.24 (0.83)
<i>Amphiroa sp.</i>			8.33 3	16.67 2.5	16.67 3				13.89 (4.81) 2.83 (0.29)
<i>Asparagopsis taxiformis</i>							*		
<i>Botryocladia skottsbergii</i>					8.33 8.00				
<i>Dasya iridescens</i>	*				*				
<i>Dotyella hawaiiensis</i>					8.33				8.33

	HAW-11	HAW-13	HAW-14	HAW-15	HAW-16	HAW-17	HAW-18	HAW-19	Island average
					6.00				(1.19) 4 (2)
<i>Dudresnaya sp.</i>					*				
<i>Galaxaura marginata</i>	*		*						
<i>Galaxaura rugosa</i>					*				
<i>Gelid sp.</i>					16.67 2.00				
<i>Gibsmithia hawaiiensis</i>	*		8.33 3		*		*	*	8.33 (0) 3.5 (0.71)
<i>Haliptilon subulatum</i>				*	*				
<i>Haloplegma duperreyi</i>	*				33.33 2.25				19.44 (12.73) 2.75 (1.09)
<i>Halymenia stipitata</i>					*				
<i>Jania sp</i>	25.00 4.33		33.33 3.50	33.33 3.50	16.67 3.50	16.67 3.00	66.67 3.13	41.67 3.20	27.5 (17.15) 3.37 (0.41)
<i>Kallymenia sessilis</i>						*		*	
<i>Laurencia sp.</i>	*		16.67 3.50				8.33 4.00		11.11 (4.81) 3.17 (1.04)
<i>Laurencia parvipapillata</i>								*	
<i>Neomartensia flabelliformis</i>	8.33 3.00		8.33 5.00		*		*	*	8.33 (0) 4 (1.41)
<i>Peyssonnelia sp.</i>									16.67 (11.79) 1.5 (0.71)
<i>Peyssonnelia inamoena</i>				*			*		
<i>Platoma ardreanum</i>								*	

	HAW-11	HAW-13	HAW-14	HAW-15	HAW-16	HAW-17	HAW-18	HAW-19	Island average
<i>Plocamium sandvicense</i>									
<i>Portiera hornemannii</i>				8.33 4.00	16.67 4.00				13.89 (4.81) 3.83 (0.29)
<i>Predaea weldii</i>	8.33 6.00		*						
<i>Scinaia furcata</i>									
<i>Scinaia hormoides</i>									
<i>Tolypocladia glomerulata</i>	25.00 4.33		8.33 3.00	8.33 3.00		8.33 4.00	8.33 4.00		13.1 (8.13) 3.52 (0.57)
Brown algae									
<i>Brown crust</i>		16.67 2.00							
<i>Dictyota sp.</i>		50.00 3.00	8.33 3.00	8.33 3.00	16.67 3.00				19.44 (15.52) 3.17 (0.41)
<i>Dictyota ceylanica</i>				41.67 3.40	16.67 3.00		41.67 3.60	8.33 3.00	25 (12.6) 3.16 (0.48)
<i>Dictyota flabellata</i>	16.67 3.50		8.33 3.00	25.00 5.33	8.33 5.00	8.33 3.00	8.33 3.00	8.33 4.00	11.11 (5.89) 3.8 (0.9)
<i>Lobophora varigata</i>	8.33 3.00		*	*					20.83 (17.68) 3 (0)
<i>Padina melemele</i>		*			*		*	*	29.17 (17.68) 3.55 (0.07)
<i>Sargassum sp.</i>	16.67 3.00	16.67 2.50	8.33 4.00						26.67 (27.26) 3.04 (0.73)
<i>Turbinaria ornata</i>	*	*	8.33 5.00				*		13.89 (9.62) 3.67 (1.15)
Blue-green algae	*	*	*	*	*	*	*	*	12.5

	HAW-11	HAW-13	HAW-14	HAW-15	HAW-16	HAW-17	HAW-18	HAW-19	Island average
									(5.89) 3 (0)
Algal turf	100.0 1.00	100.0 1.00	100.0 1.00	100.0 1.08	100.0 1.00	100.0 1.33	100.0 1.58	100.0 1.00	98.51 (4.40) 1.13 (0.19)
Coralline crustose algae	100.0 2		100.0 2	75.00 1.89	58.33 3.29	100.0 1.67	100.0 1.42	91.67 2	74.07 (30.77) 2.03 (0.45)

Appendix D: **Macroinvertebrate Rapid Ecological Assessment (REA) Team Activity Summary** (*Scott Godwin*)

Introduction

Surveys focusing on marine invertebrates other than corals were performed in conjunction with surveys of coral and macroalgae, collectively termed the benthic survey. This benthic survey was conducted collaboratively with fish surveys. This report will cover the non-coral invertebrates encountered and from this point forward any mention of marine invertebrates will mean this particular group.

Methods

Quantitative counts for specific target marine invertebrates were done along two separate 2 by 25-meter belt transects. This was followed by two 10 by 25-meter quadrat surveys accomplished by swimming a zigzag search pattern. A quadrat survey was conducted in conjunction with both 2 by 25 transects, which were used as the reference line for the long axis. The counts from these two 10 by 25 quadrats were combined into a single 10 by 50-meter area. Additionally, five .25m² quadrats were enumerated for each 2 by 25-meter belt transect to determine the average percent cover of certain sessile target species or for subsampling large populations of mobile species (e.g., boring urchins).

Based on data from previous rapid ecological assessments, a group of target species was chosen for quantitative counts. The species in this list were chosen because they have been shown to be common components of the reef habitats of the central and southern Pacific, and they are species that are generally visible (i.e.; non-cryptic) and easily enumerated during the course of a single 50-60-minute SCUBA survey.

These target species were:

CNIDARIA

Zoanthids – rubber corals

Actiniaria – Anemones

Hydrocorals – Lace corals

ECHINODERMS

Echinoids – sea urchins

Holothuroids – sea cucumbers

Asteroids – sea stars

MOLLUSCA

Bivalves – ark shells, spondylid oysters, pearl oysters, tridacnid clams

Nudibranchs – sea slugs

Gastropods – snails

Cephalopods - octopus

CRUSTACEA

hermit crabs, lobsters, large crabs and shrimp

Collections of species that could not be identified in the field and samples of coral rubble were brought back to the laboratory on the research vessel. The cryptic organisms found in the rubble were picked out and preserved and the sand samples were dried and bagged so they could be examined for micromollusks at a later date.

1. Oahu

Anchor scar at Cape Flattery grounding – Barber's Point

This area was the site of a ship grounding by a 550-foot bulk carrier. The site that was surveyed was the location of an anchor scar caused by the efforts to remove the vessel from the reef. The habitat was flat carbonate pavement with scattered *Pocillopora* heads and thick turf algal cover. There was an abundance of the hermit crab *Calcinus latens* and the boring urchins *Echinostrephus aciculatus* and *Echinometra mathaei*. The large urchin *Echinostrephus calamaris* was also abundant and the sea stars *Culcita novaeguineae* and *Acanthaster planci* were rare. The sponge *Liosina paradoxa* was quite common, beginning on sloping areas.

2. Maui

MAI-01

This was a spur-and-groove type habitat found off the shore north of Hana. The zoanthid *Palythoa caesia* was the most abundant macroinvertebrate throughout the site and became more prevalent in shallower zones (15-20 feet). The urchins *Heterocentrotus mammilatus* and *Echinothrix calamaris* were rare. When rubble was overturned in the channels of the spur-and-groove, the brittle star *Ophiocoma erinaceus* was common.

MAI-02

Located north of Keanae Point on the ridge of a finger of basalt that was 20 feet at the peak and 55 feet deep at the base. The ridge area was sparsely populated by zoanthids and a few *Echinothrix calamaris* urchins. The sloping sides had regularly occurring collector urchins (*Tripneustes gratilla*) and *Echinothrix calamaris*. Sponges were occasional on the slope as was the octocoral *Acabaria bicolor* and bryozoan *Reteporellina*.

MAI-03

Located in the embayment west of Nu'u Point. The site was a gently sloping reef dominated by *Porites compressa* that continued into a broad sand area with interspersed coral heads. This site appeared to receive quite a sediment load of mostly coarse basaltic sand and organic matter. Within the coral area there were abundant urchins (*Echinothrix calamaris*, *Tripneustes gratilla*, and *Heterocentrotus mammilatus*) and the hermit crabs *Calcinus latens*. In the sand expanse there were a surprising number of wire corals (*Cirrhopathes anguina*) and a rare occurrence of the urchin *Chondrocidaris gigantea*.

3. Hawai'i

HAW-01,02,03

These three sites were along the Hamakua Coast and were composed of boulders and varying sizes and coarse basaltic sediments. There were very little in the way of macroinvertebrates except for sponges. The sponges were not numerous and two species from the family Spongiidae dominated the individuals present. Cone shells were seen occasionally in these three sites but were not very abundant. Echinoderms were rare and only were represented by the urchins species *Echinothrix calamaris*, *Echinometra mathaei*, *Echinostrephus aciculatus*, *Eucidaris metularia*, and *Actinocidaris thomasi* and a single starfish species, *Asteropsis carinifera*.

HAW-04,05,06

Sites located along the Kohala Coast that were dominated by coral, coral rubble, and sand channels. Sea urchins were the dominant macroinvertebrate and the two species *Tripneustes gratilla* and *Echinothrix calamaris* were very abundant. There were rare occurrences of the sea stars *Acanthaster planci*, *Linckia multifora*, *Linckia guildingi*, and *Culcita novaeguineae*. The hermit crab *Calcinus laurentae* was common at all sites, and the flatworm *Pseudoceros ferrugineus* was common at HAW-04. The predatory mollusk *Charonia midas* was noted at HAW-06 but was rare. Lobster (*Panulirus marginatus*) were noted at both HAW-05 and 06 but were rare.

HAW-07

No invertebrate dive was conducted

HAW-08

The site was located at Opihikao and was a boulder field with coral rubble. The boring urchin *Echinometra mathaei* was the most numerous macroinvertebrate, followed by the zoanthid *Palythoa caesia*. The urchins *Echinothrix calamaris*, *Heterocentrotus mammilatus* and *Tripneustes gratilla* were also present but in lesser numbers.

HAW-09

The site was located on the east of the bay at Kahena. There was a reef slope from a depth of 20 feet down to 47 feet. At the base of the slope was an unconsolidated rubble area that continued into a coarse basalt sand expanse. This site had large numbers of urchins and numerous zoanthid colonies. The most numerous urchins were the boring urchin *Echinometra mathaei* and the striped urchin *Echinothrix calamaris*.

HAW-10,11

Complex habitat of boulder and basalt with *Pocillopora* and *Porites* and unconsolidated rubble. The dominant macroinvertebrate at each site was the boring urchin *Echinometra mathaei*. Sponges of the genus *Clathria*, *Stylinos*, and *Suberites* were common. The urchins *Echinothrix calamaris*, *Echinothrix diadema*, and *Tripneustes gratilla* were common and the urchins *Echinostrephus aciculatus* and *Chondrocidaris gigantea* were rare. The lobster *Panulirus marginatus* was common at both sites and octopus was occasional.

HAW-12

No invertebrate dive was conducted.

HAW-13,14

West side of Ka Lae Point in an embayment with steeply sloping boulder field. *Acanthaster planci* was common at site HAW-13 but rare at HAW-14. The wire coral *Cirrhopathes anguina* was very common at both sites. Other than *Acanthaster*, echinoderms were not common at either site. The sponge *Spirastrella* was very common at both sites.

HAW-15

Boulder habitat offshore from Kamehame Hill; coarse basaltic sediment. The sea star *Linckia multifora* was commonly seen, as was the boring urchin *Echinometra mathaei*. The zoanthid *Palythoa caesia* has patchy coverage at depths from 60 feet to 30 feet. Above this depth there was far more uniform coverage of this zoanthid.

HAW-16

Shallow reef areas composed of an even ratio of boulder and rubble with coarse basaltic sediment off the black sand beach at Punaluu. The zoanthid *Palythoa caesia* was patchily distributed and was mostly on boulders. There were abundant gastropods (*Conus miles*, *Conus flavidus* and *Latirus nodatus*) and sea stars (*Linckia guildingi*). There was a rare occurrence of the boring urchins *Echinostrephus aciculatus* and *Echinometra mathaei*, as well as the sea star *Asteropsis carinifera*. The spiny lobster *Panulirus marginatus* and slipper lobster *Parribacus antarticus* were rare.

HAW-17

Boulder habitat at Honu with good coral cover. Echinoderms were rare overall and were represented by the urchins *Echinostrephus calamaris*, *Echinometra mathaei*, and *Echinostrephus aciculatus*, and the sea stars *Acanthaster planci* and *Linckia multifora*. The cowry *Cypraea tigris* was seen commonly throughout the site.

HAW-18

Complex habitat of rock outcrops and channels with coarse basaltic sand. *Echinometra* and *Echinothrix* urchins were common throughout the site. Sponges were common on the wall and under ledges and were represented by the genus *Clathria*, *Stylinos*, *Spirastrella* and the stony sponge *Leiodermatium*, which dwells mostly in caves and under overhangs.

HAW-19

A broad flat expanse with periodic basaltic pinnacles. The urchin *Echinothrix diadema* was very abundant throughout the site and the pencil urchin *Heterocentrotus* was occasional. Within caves and overhangs at this site the octocoral *Carijoa* was present. Two sponges species (*Stylinos* and *Clathria*) were present throughout. The large hermit crab *Aniculus maximus* was noted at the site.

Discussion

Echinoderms were the most abundant component of the habitats surveyed, with the exception being the Hamakua coast of Hawaii. By biomass the zoanthid *Palythoa caesia* was the most abundant of the sessile marine invertebrates, especially in areas shallower than 25 feet. Tables below show the average abundance within the 2 by 25-m belt transects (AVG/50m²) and within the 10 by 25 swimming quadrats for echinoderms. Another table shows the average percent cover of zoanthid by site. The abundance of zoanthid is not clearly shown by this data since it is restricted to a narrow depth zone and small area. Sponges were common but not consistently abundant throughout all sites in Maui and Hawaii.

OAHU	EAST MAUI	HAMAKUA	KOHALA	PUNA	KA LAE
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Average/50m²

	Anchor Scar	MAI-01	MAI-02	MAI-03	HAW-01	HAW-02	HAW-03	HAW-04	HAW-05	HAW-06	HAW-08	HAW-09	HAW-10	HAW-11	HAW-15	HAW-16	HAW-17	HAW-18	HAW-19	HAW-13	HAW-14	
Echinodermata-Echinoids																						
Echinostrephus	30								2					3.5		2	9	4	8			
Echinometra sp.	11							30.5				44.5	59	18.5	18	3	2.5	22	40.5			
Echinothrix sp.	5		4		3	1.5		2.5	1	1.5	2			2				2	1			4
Heterocentrotus								1	1	7.5	1							1.5	1.5			
Tripneustes	1.5							18	26.5	2.5	1	3		2.5	0.5							
Other Echinoid									0.5													

Average/250m²

Echinodermata-Holothuroids																						
Holothuria atra														1		1	0.5					
Holothuria whitmaei																0.5						
Actinopyga obesa												0.5										
Actinopyga mauritiana												1										
Other Holothuroid																						
Echinodermata-Asteroidea																						
Linckia multifora														4				0.5	9			
Linckia guildingi								1											0.5	6.5		
Acanthaster planci	1							2	0.5													0.5
Mithrodia fisheri																						
Culcita novaegineae								1														

Average abundance of echinoderm species at sites on Maui and Hawaii

Average % Cover

	Anchor Scar	MAI-01	MAI-02	MAI-03	HAW-01	HAW-02	HAW-03	HAW-04	HAW-05	HAW-06	HAW-08	HAW-09	HAW-10	HAW-11	HAW-15	HAW-16	HAW-17	HAW-18	HAW-19	HAW-13	HAW-14
Palythoa caesia		6.5	2	4.5	0.7						1.8						5.8	3.6	3.6	17	

Average percent cover of the zoanthid Palythoa caesia in a depth range of 50-35 feet.

Appendix E: **Towed-Diver Habitat/Fish Survey Team Activity Summary** (*Brian Zgliczynski, Molly Timmers, Joe Laughlin, Casey Wilkinson, Russell Brainard, Dwayne Meadows, Ben Richards, and Stephani Holzwarth*)

Methods

The fish towboard, outfitted with a forward-looking digital video camera, recorded fish distribution and habitat complexity. The diver on this board recorded fishes larger than 50 cm total length along a 10-m swath. The downward looking benthic towboard, affixed with a high-resolution digital camera with dual strobes, photographed the benthic substrate every 15 seconds. The diver on this board calculated substrate percentage every 5 minutes and tallied the quantity of macroinvertebrates. Each towboard was equipped with an SBE 39 which recorded temperature and depth every 5 seconds along the tow. A GPS was used to record each tow track to georeference the collected data.

Results

Location	Days surveyed	# of Benthic tows	Towed km
NE Maui	1	5	9.47
East Maui	1	2	5.8
Windward Hawaii	2	9	19.25
Southeast Hawaii	3	19	47.16
Northwest Hawaii	1	5	12.69
Southwest Hawaii	1	3	6.17
Barber's Point, Oahu	1	4	9.66
Total	10	47	110.21

Appendix F: Mooring Deployments and Oceanographic Data Collection (Kyle Hogrefe and Oliver Dameron)

Monitoring and assessment methodology

The Coral Reef Ecosystem Division has been conducting multidisciplinary research cruises in the Northwestern Hawaiian Islands (NWHI) since the NWHI Coral Reef Assessment and Monitoring Program of 2000. The oceanographic component of these cruises has been well established but has not been applied to research in the Main Hawaiian Islands (MHI). Therefore, the oceanographic sampling and instrumentation deployments conducted during OES0502 represent an effort to establish comparable methods of oceanographic study between the NWHI and the MHI. The intent is to monitor long-term trends and assess oceanographic conditions with consistent methodology throughout the archipelago.

Generally, long-term oceanographic monitoring is accomplished by deployment and retrieval of a variety of internally recording and near real time telemetered instrument platforms. On OES0502 only one type of instrument (described below) was deployed to initiate monitoring in the MHI. More comprehensive deployments are planned for future cruises.

1. Subsurface Temperature Recorders (STRs) are moored instruments that measure high resolution subsurface temperatures. STRs must be recovered and downloaded at a later date in order to process the data.

Oceanographic assessments in the MHI were accomplished by:

1. Shallow Water conductivity-temperature-depth (CTD) casts (max 100 feet), including turbidity measurements, were performed using an SBE 19+ at a 2- mile interval around each island. These casts sample vertical profiles of water properties providing indications for water mass movement and local sea water chemistry changes.
2. Deep Water CTD casts (max 500 m) were performed in conjunction with bioacoustic transects performed using an EK60 echo sounder. These casts sample vertical water profiles of water properties providing indications for water mass movement and local seawater chemistry changes. Refer to the Night Operations Activities Summary for more information on bioacoustic surveys and deep water CTD casts.
3. Continuous recording of surface and subsurface water temperatures as a function of depth were kept 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 for site and isobath information. This data is part of the tow team Arcview project.
4. Acoustic Doppler current profiler (ADCP) transects, which provide information on current strength and direction at different depth strata, were conducted by the Survey Technician of the *Oscar Elton Sette* throughout the cruise.

Oceanographic data collection and instrumentation activities

Maui:

No STRs were deployed in the vicinity of Maui because of limited survey time and marginal weather. In the one day available for survey work, one shallow-water CTD transect with a 2-mile interval was completed off of the northeast coast of the island for a total of 10 casts. One deepwater CTD cast was performed off of the northeast coast of the island.

Hawaii:

A total of four STRs were deployed around the Island of Hawaii. Three of them are positioned off of the northern, eastern and southern points of the island, while the fourth is located outside of the channel of Punaluu Harbor. Seven shallow-water CTD transects with 2-mile intervals were completed from the north point along the east coast to the south point of the island with a total of 53 casts being conducted. Six deepwater CTD casts were conducted during night operations.

Appendix G: Night Operations Activities Summary (Marc Lammers)

Methods

The ship's two EK60 echosounders (38 kHz and 120 kHz) were used to characterize the diel migratory pattern of local sound scattering layers (SSLs). Table X.1 reports the settings used on both echosounders.

Table X.1 – EK60 echosounder settings

Frequency (kHz)	Pulse length (μ sec)	Power (W)	2-way beam angle (dB)	3-dB beamwidth	Gain (dB)	Sa corr. (dB)
38	256	1000	-20.50	7.20	23.20	-1.13
120	256	500	-20.90	6.90	25.08	-0.75

Surveys were conducted in the form of rectangular 'box' transects along the coast. All transects had both an inshore and offshore leg parallel to the coast, as well as two shore-normal legs that completed the 'box'. Shore parallel legs were always approximately 3 nmi long, while shore-normal legs were approximately 1.3 nmi long. Echosounder surveys were conducted at a speed of 6 knots, allowing the entire transect to be completed in approximately 1.5 hours. Surveys were typically begun between 1830 and 1900 and then repeated beginning at 2330. When cruise logistics allowed, transects were also conducted during the day and during the evening period between 2000 and 2230.

The biological composition of the biota observed was established by trawling for samples using an Isaacs-Kidd midwater trawl plankton net. Trawls were conducted on nights that wind and sea conditions were deemed workable by the ship's Senior Survey Tech. These typically occurred between 2100 and 2300 and lasted 30 minutes (net at target depth). The depth of the trawl was determined by locating the densest part of the layer of interest, as observed using the echosounders. Trawl samples were sorted by size class and photographed. A representative fraction was preserved in 10% formaldehyde and the rest was frozen.

Oceanographic conditions associated with each transect were measured through Conductivity, Temperature and Depth (CTD) cast. One cast was typically conducted per night either between survey periods or following the last survey at a location where mid-water biota was observed.

Results

Nighttime surveys were conducted on 8 of the 11 nights of the cruise. The vessel was in transit during the other 3 nights. Strong winds during part of the cruise limited the duration of surveys on 3 nights, as the ship needed time to transit to sheltered locations for the following day's dive operations. The same winds also did not allow trawling for samples on those nights. The cruise's nighttime operations are summarized chronologically below:

February 25

A box transect was created off windward Maui, centered on lat. 20°50N, long. 156°04W (Maui transect B). Two of the transect's Legs (I and II) were surveyed during the afternoon. All four legs were subsequently surveyed beginning at 1830 and then again at 2100 and 2330. A CTD cast was conducted along Leg I at lat. 20°51.296N, long. 156°04.641W at 2030. A 30-minute trawl was conducted along leg III beginning at approximately 0030.

February 26

A box transect was created off Maui's southeastern coast, centered on lat. 20°35N, long. 156°14W (Maui transect D). The entire transect was surveyed once during the day and then again at 1830 and 2030. Strong winds in the Alenuihaha channel did not allow a CTD cast or a trawl. The site was left at approximately 2230 in order to allow sufficient transit time to the next day's dive sites on the Big Island.

February 27

A box transect was created off the Big Island's Hamakua coast, centered on lat. 20°05N, long. 155°24W (Big Island transect C). The entire transect was surveyed beginning at 1830, 2030, and 2330. Strong winds during the night did not allow a CTD cast or a trawl.

February 28

A box transect was created off the Big Island's western Kohala coast, centered on lat. 20°10N, long. 155°55W (Big Island transect G). The transect was surveyed once during the day and partly at 1830 before the decision was made to leave the area for the next day's dive sites.

March 1

A box transect was created off the Big Island's Puna coast, centered on lat. 19°17N, long. 155°01W (Big Island transect J). The transect was surveyed beginning at 1900 and again at 2330. Calmer wind conditions allowed a 30-minute trawl to be conducted beginning at approximately 2200. A CTD cast was conducted along Leg II at lat. 19°03.348N, long. 155°03.345W at 0130.

March 2

A box transect was created off the western side of the Big Island's South Point, centered on lat. 18°57N, long. 155°44W (Big Island transect L). The transect was surveyed beginning at 1900 and again at 2330. It was also surveyed during daylight hours the following day. Calm wind conditions allowed a 30-minute trawl to be conducted beginning at approximately 2200. A CTD cast was conducted along Leg III at lat. 18°56.921N, long. 155°44.596W at 0130.

March 3

A box transect was created off the eastern side of the Big Island's South Point, centered on lat. 18°55N, long. 155°37W (Big Island transect M). The transect was surveyed beginning at 1830 and again at 2330. Legs I and III were also surveyed at 2030. Calm wind conditions allowed a

30-minute trawl to be conducted between transect Legs I and II beginning at approximately 2200. A CTD cast was conducted at the end of Leg II at lat. 18°55.951N, long. 155°35.586W at 0100.

March 4

A box transect was created south of the Big Island's South Point, centered on lat. 18°53N, long. 155°40W (Big Island transect N). The transect was surveyed beginning at 1830 and again partially at 2000. Two 30-minute trawls were conducted beginning at approximately 2130. The first trawl was conducted on the center of the bank extending south of the point in waters less than 100 m. The second trawl was conducted in waters approximately 1.5 miles west of the bank in waters deeper than 1000 m. The site was left at approximately 2330 in order to allow sufficient transit time to the next day's dive sites.

Summary of Findings

Surveys at the various locations revealed a consistent pattern of vertical and horizontal nocturnal migration by a diverse community of zooplankton, larval fish, and micronekton. Echosounder surveys found evidence of mid-water sound-scattering biota at all locations examined. A nonquantitative assessment of the data found that the most extensive layers occurred along and on banks shallower than 200 m. The occurrence of mid-water biota was patchier along sites adjacent to steep drop-offs with relatively shallow water.

The six trawls conducted consistently obtained a diverse mix of zooplankton and fish larvae. Interestingly, however, larger micronekton such as myctophid fish, shrimp, and squid were only collected on two of the trawls. The significance of this variability is presently not yet clear, but may be tied to restrictions in the migratory pattern of the larger micronekton. The specific nature of these restrictions will require further work to clarify. However, it is presently safe to say that zooplankton and larval fish do appear to be engaging in significant migrations towards shallower coastal areas at night. Whether these migrations directly interface with the coral reef habitat remains undetermined, but is not unlikely.