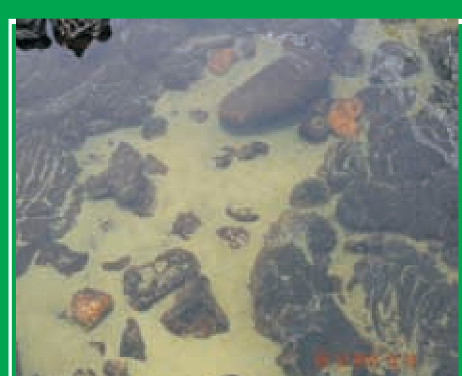
WHALE Environmental Services LLC
P.O. Box 455, KAHUKU, HI 96731 808-294-9254
www.whalees.com

NELHA Benthic and Biota Monitoring Study June 2015

prepared for:

Natural Energy Laboratory of Hawaii Authority
P.O. Box 1749
Kailua-Kona, HI 96745

Contract # 63722
eRFQ-15-03-NELHA



Prepared by: WHALE Environmental Services LLC www.whalees.com

WHALE Environmental Services LLC

June 28th, 2015

Mr. Keith Olson
Natural Energy Laboratory of Hawaii Authority (NELHA)

Dear Mr. Olson:

WHALE Environmental Services LLC is pleased to submit the Marine Monitoring Report for benthic and biota monitoring at the NELHA facility using industry-standard Habitat Evaluation Procedures (HEP) to assess the quantify the location and extent of benthic and biota species at six shoreline coastal areas and 16 inland pond locations. This work was done with surveys consistent and in accordance with past reviews. WHALE Environmental Services LLC performed the studies with the assistance in the shoreline coastal work with Plan B Consultancy.

Sincerely;
WHALE Environmental Services LLC

Bonnie Howland

____

Bonnie Howland
Co-Manager - WHALE Environmental Services LLC
P.O. Box 455, Kahuku, HI 96731
Woman-Owned Small Business
808-294-9254
bonnieleehowland@hawaii.rr.com
markahowland@hawaii.rr.com

EPA award winner for Environmental Technology Innovation
for stormwater mitigation design and erosion control

Table of Contents

Executive Summary

The Natural Energy Lab of Hawaii Authority (NELHA) is a state agency that is a division of the State of Hawaii Department of Business, Economic Development and Tourism (DBEDT). NELHA operates the Hawaii Ocean Science and Technology Park at Kailua-Kona on the Island of Hawaii which is focused on research, education, and commercial activities that support sustainable industry development in Hawaii.

Near shore marine resources in this area (Keahole Point) have long been recognized as very abundant and diverse, especially the near shore fish community. After the building of NELHA, which included infrastructure on the reef, a comprehensive monitoring program was commenced to ensure the long term health and protection of marine systems in the area. This monitoring program includes water quality, anchialine ponds, benthic communities and near shore fish communities. Since 1989 a series of more than 45 surveys has been conducted and extensive reports have been prepared. Results, summaries and references to those reports can be found throughout this report which presents the results of this 2015 survey.

The anchialine ponds in the vicinity of the NELHA facility are located on grounds on the northern end of the property (N1-N5 series of ponds) and another southern group of ten (10) ponds (S1-S10 series of ponds). A faunal census of each pond in the vicinity of the NELHA facility was undertaken on the 12th and 13th of May 2015. Temperature and salinity measurements were taken and visual observations of organisms within each pond were supplemented by photographs and high-definition video.

The results of the 2015 anchialine pond survey were consistent with previous surveys. The only difference in consistency of the surveys is that in 2015, a tenth pond (S10) was added to the survey requirements which had not been surveyed in prior years. There is however a research document detailing findings at this small anchialine pond. In a document titled "*STATUS OF THE ANCHIALINE POOL LOCATED ON THE OTI PROJECT SITE, HOST PARK, NELHA, KEAHOLE POINT, HAWAI'I* " found as Appendix C to the Draft EA done for proposed development on S10's parcel; Dr. Richard Brock of Environmental Assessment LLC found that "*The OTI anchialine pool has the usual complement of common anchialine species (Halocaridina rubra and Metabetaeus lohena) and is a permanent pool (containing water through all stages of the tidal cycle. The high number of the alpheid shrimp, Metabetaeus lohena present in the pool was unusual, he stated*".

Based on the faunal census performed, the fifteen (15) anchialine ponds in the vicinity of the NELHA facility, supported anchialine pond communities of abundant and diverse native organisms. Further, most ponds with fish had clear water and were not overgrown by opportunistic algae though three pools were found with algae. This may indicate that the opae 'ula were still active in the ponds at night to avoid predation by the introduced fish.

There are six other biota and benthic survey sites located along the NELHA coastline, containing three 50 m transects at one of three depths, 15 ft., 35 ft., and 50 ft. representing three different habitat zones. Benthic biota studies have shown a gradual increase in coral cover over time with *Porites meandrina* and *Porites lobata* always among the dominant species. Data from the present study show a similar pattern.

Over all, coral cover across the six study sites in 2013 was 52%, a statistically significant increase compared prior years and 50.58% in 2015. The two most dominant corals were Porities lobata (29.21%) and Pocillopora meandrina (12.02%) which were present on all transects. Other corals present were Leptastrea purpurea, Montipora capitata, Montipora flabellata, Montipora patula, Pavona varians, Pocillopora eydouxi, Pocillopora lingulata, Pocillopora meandrina, Porites compressa, Porites evermanni, Sarcothelea edmoedsoni and Tubastrea coccinea. These corals accounted for approximately 9% of the coral cover and represent some species not previously reported.

The fish community was monitored at the same six (6) sites as the benthic community but on 25 meter transects. Historical results show a highly variable fish community from year to year. Data from the 2015 study showed a range from 111 fish at one depth (35') to 509 fish at another (50'). Some of that may be attributable to natural variation and some of it is likely due to strata variations.

The results of the anchialine pond biota, benthic biota and near shore fish biota studies all support a conclusion that the habitats and communities adjacent to the NELHA facility are not impacted by human-mediated inputs.

Anchialine Pond Survey

Introduction

Anchialine pools and ponds are characterized as land-locked brackish bodies of water influenced by input from terrestrial groundwater and tidal influx from the marine environment with no surface connections to the sea but apparent subterranean connections. These results in measurable salinities in their pond/pool tidal influenced surface waters which rises and falls with the tides. Thus some anchialine pools and ponds may have no surface water present at low tides but on high tides cover a considerable ground area depending on the configuration of the basin. There are over 1000 anchialine pools in the islands and 85% of these are found on the island of Hawai'i with most being located on the West Hawai'i coast (Brock 2012). Anchialine systems are reported from over 30 islands within in the Pacific Ocean, the Western Indian Ocean, on Ascension Island in the Atlantic Ocean, as well as inland sites in North America, Mesoamerica, and at Ras Muhammad in the Red Sea (Chace & Manning, 1972; Holthuis, 1973; Maciolek, 1983; Iliffe, 1991; Hobbs, 1994; Brock & Bailey-Brock, 1998). Anchialine systems are commonly found along the shoreline of West Hawai'i, but also occur on O'ahu, Maui, Moloka'i, and Kaho'olawe (Brock *et al.*, 1987; Bailey-Brock & Brock, 1993).

Hawaiian anchialine pools harbor a unique assemblage of organisms, some of which are only known from this habitat. The environmental conditions of anchialine systems often result in groups of native and/or endemic species (Peck, 1994). As elsewhere, the organisms found in the anchialine system throughout Hawai'i are uniquely suited to this habitat including plants, mollusks, arthropods, and other taxa. Table 1 summarizes the species previous reported from the ponds located near Keāhole Point, Hawai'i. However, these sites are primarily distinguished by the presence of two decapod shrimp species *Halocaridina rubra* ('ōpae 'ula) and *Metabetaeus lohena.* Due to the critical role in the ecology of this unique habitat in Hawai'i, the fate of the habitat is intimately tied to that of *Halocaridina rubra.*

Table 1. List of species previously reported from anchialine ponds and surrounding areas adjacent to the NELHA facility (Compiled from Brock, 2008, and Ziemann & Conquest, 2008).

	Taxon	Common Name
Anchialine ponds	*Cladophora* sp.	Algae
	Enteromorpha sp.	Algae
	Rhizoclonium sp.	Algae
	Trichocorixa reticulata	Algae
	Lygnbya sp. Cyanophyte	mat

	Taxon	Common Name
	Schizothrix clacicola	Cyanophyte mat
	Ruppia maratima	Aquatic flowering plant
	Halocaridina rubra	Ōpae ʻula, shrimp
	Metabataeus lohena	Shrimp
	Macrobrachium grandimanus	Ōpae ʻoʻhaʻa, shrimp
	Metopograspus messor	Black rock crab
	Graspsus tenuicrustatus	Shore crab
	Assemenia sp.	Snail
	Melania sp.	Gastropod snail
	Theodoxus cariosa	Hihiwai, limpet
	Oligochaeta sp.	
Terrestrial	*acopa* sp.	Pickleweed
	Cladium sp.	Sedge
	Ipomoea pes-caprae	Pōhuehue
	Morinda citrifolia	Noni
	Pennisetum setaceum	Fountain grass
	Pluchea odorata	Pluchea
	Prosopis pallida	Kiawe
	Scaevola taccada	Naupaka
	Schinus terebinthifolius	Christmas berry
	Sesuvium portulacastrum	ʻĀkulikuli
Anchialine ponds	exotic *Poecilia* sp.	Topminnows, mosquito fish
	Palaemon debilis	Glass shrimp, ʻōpae
	Macrobrachium lar	Prawn

Along with the tremendous growth in population along the West Hawaiʼi coast over the last several decades, has come development to many coastal areas as well as improved public access. This results in that much of the coastal area and resources are now used by the public. Along with this use has come the indiscriminate introduction of alien fishes such as tilapia and topminnows (Family Poecilidae) into anchialine pools with the mistaken purpose for mosquito control or as possible baitfish for shoreline fishing. Over the last 40 years it is estimated that between 90 to 95% of the West Hawaiʼi anchialine pool resource has been biologically-degraded by the introduction and spread of these alien fishes which serve as predators on many of the unique native anchialine species. Alien fishes are able to complete their lifecycles in the anchialine system, thus permanently precluding many native species as long as water remains in the pool. At present there are no legal means of effectively removing alien fishes from Hawaiian anchialine pools (Brock 2012).

Ōpae ʻula utilize the ponds to feed, but most of the reproduction and dispersal within the anchialine system occurs in the subterranean (hypogeal) portion of the habitat. *Halocaridina rubra*, through its grazing mode of feeding, maintains a standing crop of plants, bacteria, diatoms, and protozoans that prevents overgrowth by opportunistic algae (Bailey-Brock & Brock, 1993). This “sustainable management” contributes to the overall health of the anchialine communities in Hawaiʻi allowing other species to exploit the sunlit (epigeal) portion of the habitat. This shrimp, therefore, plays the role of the keystone species. However, the effect on, and response of, ʻōpae ʻula to the introduction of exotic fish species into the anchialine habitat has been to either reduce their abundance through increased predation or to precipitate a shift in their foraging behavior (Capps *et al.*, 2009) forcing them to be active at night. This has led to ponds in which exotic fish have become established being devoid of shrimp species during the day.

Anchialine pools go through a natural senescence, where sediments accumulate in the pool basin, gradually filling in and replacing the water, eventually becoming a dry pocket of land in lava fields. Much of the sediment comes from leaf litter and encroaching vegetation. The presence of alien fish keeps native herbivorous shrimps from the pond allowing benthic algae to cover much of the pond substratum and changing both the benthic community and ecological succession in the pond. Thus senescence is increased in the presence of alien fishes. Thus the outlook for the native biological resources found in Hawaiian anchialine pools appears to be poor in the absence of adequate restoration and management. This statement is particularly true in light of the aquarium trade that has developed in the last ten years utilizing native anchialine shrimp which are sold primarily via the internet with the end result of further declines in the abundance of these organisms as well as decimation of the habitat by collectors (Brock 2012).

A study to elucidate the structure of *Halocaridina rubra* populations from the island of Hawaiʻi has shown there to be two distinct lineages on the east and west coasts, and that within small geographic areas along each coast the populations are structured with low levels of gene flow (Santos, 2006). This suggests that monitoring of the anchialine ecosystem in Hawaiʻi should be centered at local scales, (i.e. at the level of ponds and pool complexes), as is the case at the NELHA facility at Keāhole Point as presented in this study and those in the past.

While the pools offer windows into the habitat of *Halocaridina rubra*; the two groups of ponds in the vicinity of the NELHA facility have been surveyed for more than 35 years (see Brock, 1995, 2002, 2008; Oceanic Institute, 1997, 2007; Ziemann & Conquest, 2008; Bybee Consulting LLC 2013; and included citations). Through the continuing monitoring program at the NELHA sites, a gradual change in the community of organisms has been noted by surveys after 1989 with the endemic shrimp species becoming absent in a number of the ponds (Brock, 2008; and Ziemann & Conquest, 2008, Bybee Consulting LLC 2013). This may be explained by the establishment of exotic, poecilid fish species in ponds south of the NELHA facility. The findings of the May 2015 anchialine ponds/pools survey as part of NELHA's Comprehensive Environmental Monitoring Program (CEMP) are reported here by WHALE Environmental Services LLC.

Methods

The anchialine ponds and pools in the vicinity of the NELHA facility are grouped in northern and southern complexes (Figure 1) consisting of five (5) ponds in the North group and ten (10) in the South group.

Figure 1 - NELHA Facility - Location of Anchialine Pond/Pool Complexes

The northern pond/pool complex, ponds/pools N -1 to N - 5, was roughly 50 to 100 meters inland of the cobble beach at Hoona Bay (Figure 2),

Figure 2 - Location of Northern Complex of Anchialine Ponds/Pools

and the southern complex, ponds S–1 to S–10, were 200 – 225 meters from the shore at Wawaloli Beach Park adjacent to Makako Bay Drive (Figure 3).

Figure 3 - Location of Southern Complex of Anchialine Ponds/Pools

On the next page, Table 2 details the following on each pond at the NELHA site are detailed:

- Pond ID (i.e – S-4)
- Size (meters squared – m2)
- Depth (inches)
- Temperature (degrees Centigrade)
- Salinity (PPT)
- Latitude (ddm)
- Longitude (ddm)

WHALE Environmental Services LLC

BIOTA POND DATA

South Series

Site ID	Size (m2)	Depth (inches)	Temperature (degrees Centrigrade)	Salinity (PPY)	Latitude	Longitude
S1	1.65	5	26.5	17	19.7168	-156.0490
S2	1.00	3.5	26.8	13	19.7167	-156.0489
S3	1.00	4	26.7	18	19.7168	-156.0487
S4	0.01	0.05	27.9	18	19.7168	-156.0487
S5	5.00	3	28.3	19	19.7169	-156.0487
S6	0.01	0	n/a	n/a	19.7166	-156.0482
S7	1.40	3	27.2	16	19.7165	-156.0481
S8	1.00	1	28.2	17	19.7168	-156.0481
S9	0.01	1.5	26.3	15	19.7168	-156.0481
S10	0.85	17	21.9	13	19.7138	-156.0482

North Series

Site ID	Size (m2)	Depth (inches)	Temperature (degrees Centrigrade)	Salinity (PPY)	Latitude*	Longitude*
N1	92.00	8	28	18	19.7315	-156.0566
N2	1.20	4	29.2	19	19.7314	-156.0566
N3	23.50	6	28	16	19.7314	-156.0565
N4	4.50	8	29.1	18	19.7314	-156.0565
N5	20.50	3	29.3	19	19.7315	-156.0566

* differs from previous studies very slightly

Table 2: Data Chart for GPS Location, Temperature and Salinity for anchialine ponds complexes adjacent to the NELHA facility.

For accuracy, a Garmin hand-held GPS unit was used to record latitude and longitude coordinates for each pond. As well, coordinates were verified via GPS Windows 8 software via mobile devices, and from a Nikon Precision GP-1 GPS adapter attached to a Nikon D3200 which imprints Lat/Long information on to digital photos taken at each pond location.

It should be noted that Lat/Long coordinates varied slightly from the previous 2013 study in the one-hundred decimal points. This is a very minor difference and could be accounted by the difference in equipment use. WHALE Environmental Services LLC used the coordinates reported from their triple readings of coordinates off the three devices used (which were identical).

Pond size was documented from measurements previous reported by Brock (2008) and Bybee (2013); and pond dimensions and basin characteristics were also field verified by field measurements. As anchialine habitats are characterized by tidal influences, the water level and appearance of ponds varied with tide level. The effect of tide level was also more notable in the group of pools N1–5. At high tide, the pools essentially form a single body of water as the shallow gullies between them filled up. However, the pools were distinct and separated at lower tidal levels. Observations of organisms within the ponds, were taken at low to mid-tide levels and below the daily high tide maximum to provide sufficient waters in order to sample each pond but also be able to treat each pond/pool as separate.

While the water levels in the ponds in the southern complex were likewise affected by the tide level, the continuity of each pond however remained mostly unchanged in all but ponds/pools S–6 and S-10. Both ponds were found moist but with no standing water during this survey. From the Makako and Hoona Bay tidal charts for the study period, sampling of the ponds appears to have been conducted during tidal levels swings ranging from +0.6 to +2.0 feet.

Photo Credit: Bybee 2013

Ponds N3 to 5 as high tide recedes resuming distinct configurations

North Pond 1

North Pond 2

North Pond 3

North Pond 4

North Pond 5

Photos from Southern Group of Ponds/Pools (S1-S10)

South Pond 1

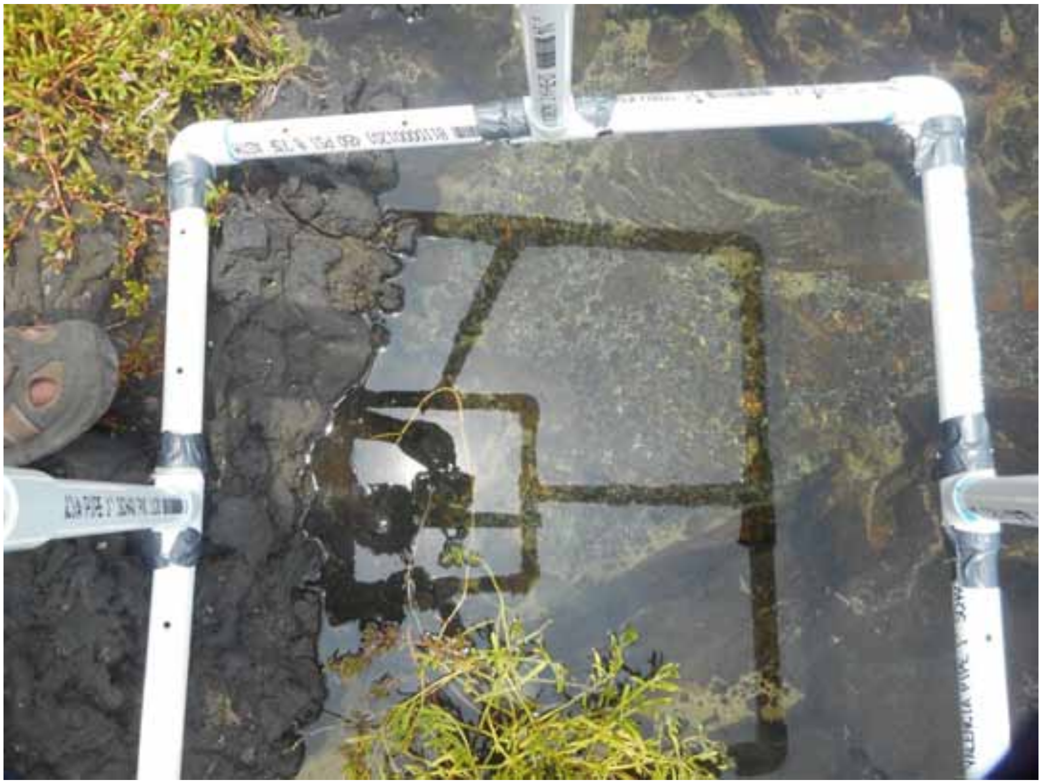
South Pond 2

South Pond 3

South Pond 4

South Pond 5

South Pond 6

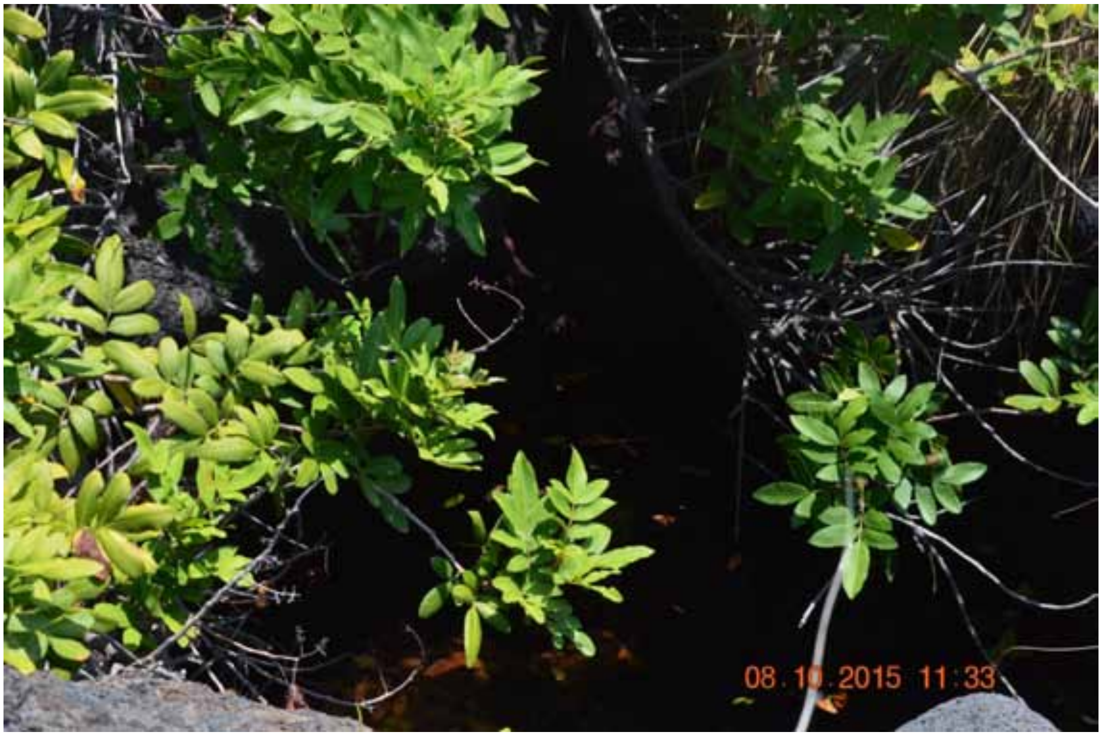


South Pond 7

South Pond 8

South Pond 9

South Pond 10



A faunal census of each pond in the vicinity of the NELHA facility was undertaken May 11-13, 2015. Temperature and salinity measurements were taken concurrently employing a hand-held thermometer and hydrometer. This combination meter was rented from a Kailua supplier and calibrated before use with distilled water. Visual observations of organisms within each pond were supplemented by photographs and two (2) minute high-definition video extractions taken with a Nikon CoolPix underwater digital camera and waterproof housing.

Randomly selected photo-quadrats were isolated from video footage that had been obtained by placing the camera and housing in the pond-mounted PVC frame. As well, still footage was taken after insertion adjustment of the PVC frame by organisms at consistent framings and height above pond for additional viewing.

These still and video photo-quadrats were used to identify organisms and measure their densities. However, one pond with low water levels (S6) was surveyed visually and only by still photography due to lack of depth to support video capture. The intent is to note presence or absence of flora and fauna. All densities were calculated for an area of 0.1 m^2 to facilitate comparisons among ponds within this survey and with previous anchialine pond/pool surveys at these sites. Only the absence or presence of non-native organisms was recorded for this survey.

Results

The measurements of physical characteristics and results of the faunal census are summarized in Table 3. While ponds within each group share a similar composition of species, the differences between the two groups stem from the physical features of the local areas in which they are found. There are also impacts from the introduction of exotic species and active management of the ponds. The historical introductions of poecilid fish have affected the species composition anchialine ponds reducing the abundance of the keystone species of the habitat, opae ʻula. Moreover, the modification through building of rock walls has changed the ponds over time, especially seen in the northern group of ponds. This activity influences tidal influences and penetration and has, at higher tidal levels, led to ponds N – 2 through N – 5 to fill and constitute a single water body allowing motile organisms to expand and contract their distribution throughout these ponds. The results of the 2015 anchialine pond survey, still, were consistent with previous surveys reviewed by Brock (2008) and reported in Ziemann & Conquest (2008) and furthermore by ByBee 2013 *with some exceptions.*

Exceptions are found mainly in the northern pond/pool complexes. Previously, little to known algae was detected during surveys. Whether due to the later time period and higher air temperature of a study conducted on May 2015 rather than April 2013, or the disappearance of *Halocaridina rubra* populations that were not observed or detected in some of the northern ponds, some exceptions are noted. Particularly ponds N1, N2 and N3 had varying amounts of algal growth, estimated by *PhotoQuad* at 70%, 20%, and 80% respectively. No *Halocaridina rubra* populations were detected in these ponds, though they may be more evident in nighttime hours and are still grazing in non-compete periods to somewhat of a lesser efficiency. Past reporting of two large fish in pond N1 was not observed during the first observation period. A second review was done and a fleeting glimpse of one 4-5 inch dark-colored fish with ripples 1-1.5’ in front of the fish was observed, but no photo was possible. It suggests the large fish in N. still exist.

In the Southern ponds/pools, only S2 and S5 some initial algae intrusion (20% and 30% respectively) was observed. Both North and South pools/ponds areas detected *Halocaridina* *rubra* populations. Both Southern and Northern anchialine ponds were dominated by Halocaridina rubra at about the same densities when present with the exception of Southern Pond 10 which had them in dominance and abundance.

BIOTA POND FAUNA DATA

South Series

Site ID	Halocaridina Mean +/- Standard Deviation - No. of Indiv/0.1m2	Ruppia Maratime (wideongrass) Presence	Poecilids Presence	Temperature	Salinity (PPT)	Algae Presence	Macrobracium (prawn) Melania (snail) or Metabalaeus (pool shrimp) Presence
S1	8.5 +/- 3.8	Absent	Absent	26.5	17	0.00%	n/a
S2	184.44=/- 65.1	Absent	Present	26.8	13	20.00%	Metabataeus
S3	4.68 =/- 5.2	Absent	Present	26.7	18	0.00%	Metabataeus
S4	2.54 +/- 2.58	Absent	Absent	27.9	18	0.00%	n/a
S5	4.22 +/- 2.32	Absent	Present	28.3	19	30.00%	n/a
S6	0.00	n/a	n/a	n/a	n/a	0.00%	n/a
S7	0.00	Absent	Absent	27.2	16	0.00%	n/a
S8	0.00	Absent	Present	28.2	17	0.00%	Macrobracium
S9	0.00	Absent	Absent	26.3	15	0.00%	n/a
S10	155+/- 45.2	Absent	Absent	21.9	13	0.00%	Metabataeus

North Series

Site ID	Halocaridina Mean +/- Standard Deviation - No. of Indiv/0.1m2	Ruppia Maratime (wideongrass) Presence	Poecilids Presence	Temperature (degrees Centrigrade)	Salinity (PPY)		
N1	104.68 =/- 85.0	Present	Present	28	18	70.00%	n/a
N2	54.20 =/- 13.2	Present	Absent	29.2	19	20.00%	n/a
N3	4.21 =/- 11.2	Present	Absent	28	16	80.00%	Macrobracium
N4	9.2 =/- 10.5	Present	Absent	29.1	18	0.00%	Melania
N5	14.8 +/- 12.8	Absent	Absent	29.3	19	0.00%	Melania

Table 3 – Fauna Data for Northern and Southern Ponds/Pools

The clearest difference between the communities of organisms found in the two groups of ponds this year was again the absence of exotic poecilid fish in the northern ponds (with the exception of N1) and again their presence in now five (5) of ten ponds in the southern group.

The second clearest difference is the decline of the Halocaridina rubra populations from the last survey (with the exception of S10) and the initiation or expansion of algal growth particularly in the northern complex of ponds/pools.

Additional qualitative results utilizing sections of video, photos and field notes augmented data collected from photo-quadrates to account for the mobile, cryptic, or less abundant taxa in the ponds. Differentiating between live and dead Melania sp. individuals was difficult, video observation showed actively foraging, making it possible to determine density of populations.

For pond S-10, the fountain grass and Christmas berry noted in the 2012 EA has grown to encompass over 50% of the perimeter of the pool, shading it more. Neither eradication of those species, or fencing of the area has occurred as suggested in the 2012 EA. The pool had about 17.2 inches of water in about 13.4 SF area. The pond is a very deep crevice in the lava, with the surface of the water approximately 1.5 feet down. These waters had noticeably cooler temperatures, due no doubt by the deepness of the waters and the shading from its rock walls and over-bearing vegetation at the rim.

In 2012, this was the comment about S-10:

"Aquatic species seen include the ubiquitous opae'ula (Halocaridina rubra) occurring at densities between 80 to 125 shrimp/0.1 m_2 and the native alpheid shrimp, Metabetaeus lohena (the latter being a Category 5 Candidate Endangered Species) initially occurring at a density of roughly one individual/0.5 m_2. However with the application of bait used to draw out cryptic predaceous species, the abundance of M. lohena dramatically rose to more than 20 individuals/0.1 m_2 (see Figure 5). During the 1.5 hours of observation, several small unidentified red amphipods were also seen in the pool. Although not seen by us, melanid snails which are very common in most anchialine habitats are probably also present in this pool."

In 2015, the same species were noted with a higher percentage of *opae'ula (Halocaridina rubra)* noted. Unlike the northern ponds, this pond's *opae'ula (Halocaridina rubra)* populations were very active foraging during the peak sunlit time of day.

A waxed paper plate was within the pond, H. rubra populations were moving under and about the plate in abundance as seen in the photo to the right. Waxed papers in water often generate small air bubbles on which, the H. rubra was observing to nuzzle. Despite it man-made presence, we did not remove the waxed paper plate due to its apparent utilization.

Discussion

The anchialine ecosystem is one of the unique resources in Hawai'i and though seen elsewhere in the world, its preservation as a habitat type is vital, and the monitoring of two complexes of ponds adjacent to the NELHA facility is essential to continuing to build knowledge and improve management of this resource locally and throughout the island.

This year's (2015) survey echoed largely the results of previous studies of the site showing that the ponds within the two groups have similar communities of organisms, but that the two groups are distinguishable based on their physical features, effects of exotic fish introductions, and modification of the ponds. It is felt that in the northern ponds, that previous alien species eradication effort are not as effective and that opae 'ula are not as dominant as previously, thus allowing more algal growth and proliferation. From temperature and salinity measurements, it is not apparent that the decline in population is human-induced, but rather a condition of alien species introduction from other environs and competition. There is no observed or detected evidence that any changes are man-made induced.

Previously it was reported that the northern complex of ponds have been modified through wall construction producing a single large pond encompassing ponds N–2 through N–5 at high tidal levels which provides the potential for organisms to move among the ponds both in the epigeal and hypogeal portion of the habitat; however, the surface boundaries of pond N-1 are separate and distinct from the other ponds in the complex. A community of native species characterized by high abundances of opae 'ula were able to re-colonize and become established in the northern ponds following the removal of exotic fish in 2007 (Brock, 2008).

These shrimp contribute to the water quality of the ponds by maintaining a standing crop of plants, bacteria and diatoms preventing the overgrowth of algae which allows other native organisms to exploit the anchialine habitat (Bailey- Brock & Brock, 1993). *"If the introduction of exotic fish can continue to be prevented, the current community of organisms and quality of ponds in this complex would be expected to remain in the currently robust state"* it was stated. Since populations of opae 'ula seem diminished in the northern ponds and algae are establishing themself, a review of mitigation or adaptive measures to lessen alien influences seems appropriate.

For the southern ponds, *status quo* seems to be an appropriate phrase – conditions remain similar, fauna populations varied but not as different in past studies, and past warnings still need to be implemented. For the southern ponds, the warnings about leaf litter, plant presence crowding ponds, sediment entry are all factors that can lead to decreased water capacity of tidal storage, effect on organisms, and change in pool habitats to wetland habitats dominated by vegetation rather than aquatic fauna species. The 2012 EA for the OTI parcel of pond/pool S-10 cautioned that allowing fountain grass, kiawe, and Christmas berry to grown unchecked could potential have effect on anchialine pools. That caution should be re-visited.

For the NELHA, there is no evidence that its activities create any impact. Parameters that would have created concern to the anchialine pools if present, such as temperature increase, are simply not present and NELHA is believed to not be a factor in any change seen in this 2015 study versus the 2013 or prior studies.

Marine Benthic Biota Survey

Introduction

The Natural Energy Lab of Hawaii Authority (NELHA) is a Department of Business, Economic Development and Tourism (DBEDT) agency that operates an ocean science and Technology Park at Kailua-Kona on the Island of Hawaii. Its focus is on research, education, and commercial activities and supports sustainable industry development in Hawaii.

One of the unique technological aspects of the park is the pumping of warm surface water and deep cold sea water to the surface through large pipes that have been installed along the reef in specific locations. The nutrient-rich water is used in a variety of aquaculture and desalinization activities on land. Concerns over water discharge from those facilities and the potentially negative effects to the adjacent reef communities have prompted regular monitoring of the benthic communities. Benthic communities are often sensitive indicators of environmental change (Gray and Pearson 1982).

Since 1991, more than 36 surveys have been conducted on the benthic communities adjacent to NELHA. Extensive reports have been prepared detailing the results of each survey. Results and summaries of reports can be found in the following references: 1991-1995 are summarized in Marine Research Consultants, 1995. Surveys for 1995 and 1997 are reported in Oceanic Institute, 1997. Surveys conducted between 1997- 2002 are in Marine Research Consultants, 2002. Surveys from July 2005 to January 2007 are found in Oceanic Institute 2007. For October 2007 and July 2008 surveys, summary is in Marine Research Consultants 2008. For October 2008, May 2009 and May 2010 surveys are reported in Ziemann 2008, 2009 and 2010. The results of the 2012 survey were reported in Bybee and Barrett 2012 and the results of the April 2013 survey are reported in Bybee 2013. Results for the May 2015 survey are reported here.

Methods

There are six survey sites located along the NELHA coastline with three 50 m transects conducted at each site, at one of three depths (15 ft., 35 ft., and 50 ft.) (Figure 1). On all transect delineations, 10 quadrats, each 1.0 m x 1.0 m, were defined at random locations along the transects. All invertebrate species in the quadrats were evaluated and numerated by divers using SCUBA and sampling equipment; and assessed in terms of percent cover of the bottom. Substrate was also evaluated in terms of percent area coverage.

As well, each permanent quadrat was photographed using an underwater camera with a wide angle lens mounted on a quadruped frame. Each photograph was labeled to designate the location of each photo-frame within each transect. Photographs were taken using high resolution digital photography. Photographs may be found in the Appendix. Using desktop methods, accurate estimates of the benthic cover of biota and substrata were performed using the software Photoquad overlaying the photoframe grid which divides the photographs into 16 equal sized segments and uses 100 points per image. Biota and substrate type at each point were identified. Statistical analysis of the data was performed using ANOVA, Tukey and pairwise comparisons. Results of these tests were considered to show significant differences in measured variables (coral cover, total fish, diversity etc.) between stations, habitats or years when they produced p-values of 0.05 or less. Values greater than 0.05 were not considered statistically significant.

Results

Benthic biota observed in this study included stony corals, coralline algae, turf algae, echinoderms (sea urchins), sponges, and gastropod molluscs. All were present in very small numbers except for the stony corals which comprised the vast majority of the benthic biota. Percent cover and diversity of corals and other benthic biota as well as non-coral substrate are presented in detail in EXCEL Spreadsheets found in the Appendix and summarized in Table 1.

Benthic biota studies have shown a gradual increase in coral cover over time with *Porites meandrina* and *Porites lobata* always among the dominant species. Data from the present study show a similar pattern.

Over all, coral cover across the six study sites in 2013 was 52%, a statistically significant increase compared prior years and 50.58% in 2015. The two most dominant corals were Porities lobata (29.21%) and Pocillopora meandrina (12.02%) which were present on all transects. Other corals present were Leptastrea purpurea, Montipora capitata, Montipora flabellata, Montipora patula, Pavona varians, Pocillopora eydouxi, Pocillopora lingulata, Pocillopora meandrina, Porites compressa, Porites evermanni, Sarcothelea edmoedsoni and Tubastrea coccinea. These corals accounted for approximately 9% of the coral cover and represent some species not previously reported.

Porites compressa was abundant in the deepest transects (50 feet) in all six (6) study zones unlike previous reporting that had its presence at only at the three northern sites (Ho'ona

Bay, NPPE and 12" Pipe North). Porites compressa was also present in lower numbers in the middle transects (35 feet) at all sites except for 12" Pipe South. In the shallow transects (15 feet) P. compressa was not observed at all sites. Color photographs of all quadrats are presented in the Appendix.

Table 1 which follows, shows a comparison of the percent coral cover between sites and habitats. The NPPE site was the highest in total coral cover (69.73%) due mostly to its abundant P. lobata and P. compressa. Five (5) of the sites (Ho'ona Bay, NPPE 12" Pipe North, 12" Pipe South, and 18" Pipe) had coral around the 50% of higher in cover. Only Wawalou had low coral cover at 28.13%. Porites lobata was also found in its highest densities at the four (4) most northerly stations (Ho'ona, NPPE, 12" Pipe N&S), but P. meandrina was most abundant around the pipe sites (NPPE, 12' North, 12' South and 18'). The lowest overall coral cover (28.13%) was observed at Wawaloli, the southernmost site and increased at each site moving northward. The highest P. lobata cover was observed at NPPE followed by Ho'ona Bay while the lowest concentration of P. lobata occurred at Wawalou.

Coral cover was higher in the shallow and middle transects than the than the deep stations. Among the deep stations coral was most abundant at 12" Pipe North and NPPE sites followed by Ho`ona Bay. Porites lobata was the dominant coral at all six sites.

Though measurable, most of the above mentioned differences were not statistically significant. The only significant differences detected between sites in this study were diversity, % total coral and % P. meandrina.

The non-significant difference was observed between habitats of %total coral ($p = 0.46$, ANOVA) in which middle and deep stations were slightly higher than shallow stations.

The difference in diversity was observed between habitats ($p = 0.019$, ANOVA) in which deep stations were slightly higher than shallow stations and the difference is significantly different between sites.

<u>Other Benthic Invertebrates</u>

At all stations there were clusters of gastropod molluscs visible on some of the rocks. They were small, oval in shape and only noted while analyzing photos in the lab so no specimens were collected in the field for species identification.

Other species observed in low numbers at all stations were Spirastrealla vagabunda, Palythoa tuberculosa.

Table 1 - summary of Photoquadrat Information from bethnic surveys conducted June 2015

Station	Wawaloli Beach				18" Pipe				12" Pipe South			
Transect	Shallow	Mid	Deep	Overall	Shallow	Mid	Deep	Overall	Shallow	Mid	Deep	Overall
% Total Coral	30.1	34.6	19.7	28.43	55	46.2	39.8	57.4	35	58.7	45.3	46.33
% P. Lobata	13.2	15.8	10.9	13.3	19	15	20.5	18.1	8.5	24	20.6	17.7
% P. Compressa	0	8	41	16.33	0	5	20	8.33	0	0	1	0.33
% Poc. Meandrina	10.1	8.5	11	9.87	19	12.8	11	14.27	19.5	14	9.1	14.20
Species	4	5	4	4.33	6	8	6	6.67	6	8	10	8.00
Diversity	1.03	3.51	4.10	2.88	0.94	3.25	3.40	2.53	1.38	3.02	3.25	2.55

Station	12" Pipe North				NPPE				Ho`ona Bay			
Transect	Shallow	Mid	Deep	Overall	Shallow	Mid	Deep	Overall	Shallow	Mid	Deep	Overall
% Total Coral	36.9	45	67.5	49.8	58.7	75.5	75	69.73	40.3	65.7	50.3	52.1
% P. Lobata	14.4	18	31.5	21.3	26	32	31	29.6	20	38.8	17.6	25.8
% P. Compressa	0	10	12.5	7.5	0	10	24	11.33	0	6.5	24	10.17
% Poc. Meandrina	19.5	20	15.5	18.33	20.5	14.5	8	14.33	15	14	0	9.67
Species	5	7	6	6.00	4	7	6	5.67	5	5	5	5.00
Diversity	1.39	3.28	2.87	2.51	1.27	2.76	2.77	2.27	1.38	2.90	3.17	2.48

Comparative Review

The goal of the current study is not to duplicate that information but instead to discuss some of the main points of those previous studies in consideration of the current data from 2015. In previous reports, total coral abundance estimates showed "a clear pattern over time" (Ziemann 2010). This pattern was one of general increase from 1992 - 2008 ranging from 16.9% to 54.7%. In the years following, reported estimates declined to 39.5% in 2009 then rose to 43.2% in 2010, 44% in 2012 and 52% in 2013 which followed the noted pattern of increase over time. For 2015, the slight decrease to 50.58% in 2015 is not a significant decrease and may be simply a variation due to climate changes, observation differences, or impact from the winter's high swells and two hurricanes which are specific examples of climate change for the locale.

Regardless of the slight decrease, it is encouraging to note that the abundance and spread of major coral species has expanded out of the northern sites to now include the middle site and even one of the bottom sites (18" pipe). Only Wawaloli Beach remains underpopulated, but it should be noted there are improvements in general coral spread and diversity among the sites.

As noted by previous authors (Dollar 1975, Dollar and Tribble 1993, Ziemann 2010), there is a recognizable zonation on many parts of Hawaii's coral reefs. Those zonation patterns

(Pocillopora meandrina and Porites lobata co-dominant in the upper regions and Porites compressa dominant on the deeper reefs) are visible off the shore of NELHA and were observed in this study as they have been in the past (Ziemann 2010, MRC 2008, Bybee 2013).

Taking into consideration the historical data from previous monitoring reports showing a general increase in coral cover over time and the concurring data presented herein for 2015 showing no significant decrease, there is no indication that the benthic community is being negatively impacted by the presence or activities of NELHA.

Marine Fish Biota Survey

Introduction

The Natural Energy Lab of Hawaii Authority (NELHA) is a Department of Business, Economic Development and Tourism (DBEDT) agency that operates an ocean science and Technology Park at Kailua-Kona on the Island of Hawaii. Its focus is on research, education, and commercial activities and supports sustainable industry development in Hawaii.

One of the unique technological aspects of the park is the pumping of warm surface water and deep cold sea water to the surface through large pipes that have been installed along the reef in specific locations. The nutrient-rich water is used in a variety of aquaculture and desalinization activities on land. Concerns over water discharge from those facilities and the potentially negative effects to the fish communities using nearby habitat have prompted regular monitoring of the biota communities. Biota communities are often sensitive indicators of environmental change (Grey and Pearson 1982).

The near shore fish populations off Keahole point where NELHA is located have long been noted for their unusual abundance and diversity among the Hawaiian Islands (Brock 1954, Brock, 1985; Brock, 1995). As such, they should be the focus of efforts in conservation, management, research and monitoring. Concerns over the possible decline in water quality due to activities at NELHA have prompted regular surveys of fish populations to monitor any detectable changes that might indicate negative impacts linked to the NELHA facilities.

Since 1991, more than 45 surveys have been conducted on the biotic communities adjacent to NELHA. Extensive reports have been prepared detailing the results of each survey. Results and summaries of reports can be found in the following references: 1991-1995 are summarized in Marine Research Consultants, 1995. Surveys for 1995 and 1997 are reported in Oceanic Institute, 1997. Surveys conducted between 1997- 2002 are in Marine Research Consultants, 2002. Surveys from July 2005 to January 2007 are found in Oceanic Institute 2007. For October 2007 and July 2008 surveys, summary is in Marine Research Consultants 2008. For October 2008, May 2009 and May 2010 surveys are reported in Ziemann 2008, 2009 and 2010. The results of the 2012 survey were reported in Bybee and Barrett 2012 and the results of the April 2013 survey are reported in Bybee 2013. Results for the June 2015 survey are reported here.

Methods

The fish community was monitored at the same six (6) survey sites as the benthic community located along the NELHA coastline with three (3) four (4) m by 25 m transects conducted at each site, at one of three depths (15 ft., 35 ft., and 50 ft.) (Figure 1) (18 transects total) (Figure 1). Fish communities were assessed using a visual census to estimate the abundance and biomass of fish present (Brock 1954). Data collected include a listing of all species present, the numbers of individual species and the estimated length of each for estimates of standing crop using linear regression techniques. The census was conducted over the entire length of a 4 X 25 meter transect line. All fish within the transect area from the aquatic floor to the water's surface were recorded on video by SCUBA divers and later counted and identified while reviewed on a computer monitor display.

In previous studies it was noted that permanent transects were identified with subsurface floats to allow repeat studies of transect lines (Brock 2008). In 2012, Bybee noted these markers were not present, so surveys were conducted at three depths at each of the six stations. For the June 2015 survey, the same technique was used. A lead diver feeds the transect line out in a pattern of non-disturbance as possible. The transect line is set perpendicular to the shoreline at the chosen depth and the diver moves in a north/south configuration at the chosen depth filming along the way. A second diver follows at a distance while photographing the benthos.

Visual length estimates were converted to weight using the standard conversion formula of **M = a * Lb;** where M = mass in grams, L = standard length in mm and a and b are fitting parameters. Fitting parameters were obtained from Fishbase (Froese and Pauley 2000). Diversity was calculated, as in previous reports (Ziemann 2010, Bybee 2012) using Shannon's Index.

$$H = -\sum_{i=1}^{k} p_i \log p_i$$

Results

A summary of the major variables measured during this study (total number of individuals, number of species, diversity and biomass) is found in Table 1.

Table 1 - summary of Biota Fish Data and Information from biota bethnic surveys conducted June 2015

Station	Wawaloli Beach				18" Pipe				12" Pipe South			
Transect	Shallow	Mid	Deep	Overall	Shallow	Mid	Deep	Overall	Shallow	Mid	Deep	Overall
Total Number Fish	238	245	131	614	272	315	296	883	159	306	509	974
Species Variety	22	13	19	18.00	27	23	28	26.00	8.5	22	23	17.83
Diversity	0.94	1.58	2.21	1.58	1.17	1.13	0.25	0.85	1.58	2.43	0.85	1.62
BioMass (g/m2)	21.8	18.73	42.54	27.69	72.7	114.36	312	166.35	70.24	69.96	153.02	97.74

Station	12" Pipe North				NPPE				Ho`ona Bay			
Transect	Shallow	Mid	Deep	Overall	Shallow	Mid	Deep	Overall	Shallow	Mid	Deep	Overall
Total Number Fish	203	204	158	565	168	111	296	575	246	131	236	613
Species Variety	14	16	22	17.33	20	17	22	19.67	20	21	15	18.67
Diversity	1.02	1.77	2.03	1.61	1.23	2.38	1.4	1.67	0.91	2.21	1.63	1.58
BioMass (g/m2)	78.22	104.32	53.43	78.66	84.96	35.83	149.69	90.16	111.24	32.56	55.55	66.45

Total number of individual fish per transect was not significantly different between sites (p = .33, ANOVA) with a range of 565-974 individuals. Nor was it significantly different between habitats (p = .54, ANOVA). The highest number of individuals occurred at the 12" Pipe South deep transect (509 individuals). The lowest count occurred at NPPE middle transect (111 individuals). Total number of fish was higher at the deep stations (though not significantly) in northern stations and also higher in deep sections on the southern stations.

Number of Species

Table 1 above shows the number of species per transect recorded during the present study. The number of species per transect ranged from 509 at the 12" Pipe deep transects to 111 at the NPPE Mid sites. Overall there was no statistically significant difference observed between sites (p = 0.53, ANOVA).

The most abundantly represented families in this survey were the chaetodontids (butterfly fish), pomacentrids (damsel fish) and acanthurids (surgeon fish). The most abundant species were Chromis vanderbilti, Chromis hanui, Chromis ovalis, Zebrasoma flavescens, Ctenochaetus hawaiiensis, Ctenochaetus strigosus, Thalassoma duperrey and Acanthurus nigrofuscus. They were present in almost all habitats and transects.

A complete list of fish is as follows:

A.nigrofuscus, C. vanderbilti, C.agilis, C.multicinctus, C.quadrimaculatus, C.strigosus, D.albisella, G.varius, H. ornatissimus, M.kuntee, N.literatus, N. unicornus, O.unifaciatus, P.johnstonianus, P. arcatus, P. multifasciatus, S. bursa, T.duperrey, C. sordidus, N. samara and Z.flavescens.

Species Diversity and Biomass

Species diversity ranged from .25 at 18" Pipe deep to 2.43 at 12" Pipe South. None of the differences among station or habitat were statistically significant (p = .61 and .07 respectively, ANOVA).

Biomass was highest at 18" Pipe and lowest at Wawaloli. No significant differences in mean biomass were detected between sites or habitats (p = .25 and 0.22 respectively, ANOVA).

<u>Comparative Review</u>

The goal of the current study is not to duplicate that information but instead to discuss some of the main points of those previous studies in consideration of the current data from 2015. Previous studies have determined that even though much year-to-year variation has been observed, there have been no significant overall changes to fish populations, during an 18-year study period, that can be attributed to anthropogenic affect (Ziemann 2010).

Data from Bybee 2012 was an extreme example of the wide variation mentioned above. Total number of fish per transect, number of species, diversity and biomass were all significantly lower than 2010 measurements. Data from the 2015 current study show a very significant increase in total when compared to 2012 data as discussed below.

Ziemann (2010) noted the presence of large schools of fish that roamed between zones and had a dramatic impact on the abundance calculations. During the present study, large schools were noted along transect lines during data collection.

He also concluded that these fish communities are "highly variable in nature over very small time and space scales" and that "any conclusions of change in fish community abundance or distribution need to be examined carefully in the context of natural variability."

As an illustration of that point, there were significant differences between 2010, 2012, 2013 and 2015 data as mentioned above. Although this difference may be partially the result of natural variability, it is much more likely to be the result human variability in implementation of the survey method used.

From the 2012 Bybee study, a team of multiple divers worked each transect simultaneously. The transect line was laid out by the 3 divers going from north to south. Upon reaching the 25 meter mark two of the divers turned around and moved along the transect line from south to north taking photoquadrats of the benthic community. Slightly behind them another diver moved from north to south collecting fish data along the same transect line. It is highly likely that many fish were disturbed by this activity and stayed out of sight the majority of the time. Anecdotal observations supported that idea.

A change in methodology for 2015 was implemented to minimize diver disturbance to do the fish counts separate from the benthic coral photo quads. This created less frightening of the fish. That change resulted in significant increases in total fish, species and diversity measured this year.

Another factor that may have affected the data was weather related. During the period of the April 2012/2013survey there was spring swell that affected the study site's coastline and water conditions. 2015 survey in the latter part of June saw calmer waters.

In summary, when taking into account all data from this long term study of the fish biota off NELHA, despite much variability from year to year and site to site there is no convincing evidence that activities at NELHA are negatively affecting the reef fish community.

Taking into consideration the historical data from previous monitoring reports detailing the fish biota over time and the concurring data presented herein for 2015 showing no significant decrease, there is no indication that the fish biota community is being negatively impacted by the presence or activities of NELHA.

References

Bailey-Brock, and J. H., Brock, R. E. 1993. Feeding, reproduction, and sense organs of the Hawaiian anchialine shrimp *Halocaridina rubra* (Atyidae). Pacific Science 47(4): 338-355.

Bailey-Brock, J. H., Brock, V. R., and Brock, R. E. 1999. Intrusion of anchialine species in the marine environment: the appearance of an endemic Hawaiian shrimp, *Halocaridina rubra*, on the south shore of O'ahu. Pacific Science 53: 367-369.

Brock, R. E. 1985. An assessment of the conditions and future of the anchialine pond resources of the Hawaiian Islands. Pp. C-1 – C-12. In: Us Army Corps of Engineers. Final Environmental Impact Statement, U. S. Department of the Army Permit Application. Waikoloa Beach Resort, Waikoloa, South Kohala District, Island of Hawaii. Honolulu.

Brock, R. E., Norris, J. E., Ziemann, D. A., and Lee, M. T. 1987. Characteristics of water quality in anchialine ponds of the Kona, Hawaii Coast. Pacific Science 41(1-4): 200-208.

Brock, R. E. 1995. Cooperative Environmental Monitoring Program for the Natural Energy Laboratory of Hawaii. Survey for Anchialine and Marine Fish Resources. 23 June 1995 Survey. Prepared for NELHA, Kailua-Kona, Hawaii. EAC Report No. 95-07. 56 pp.

Brock, R. E., Bailey-Brock, J. H. 1998. An unique anchialine pool in the Hawaiian Islands. International Review of Hydrobiology 83(1): 65-75.

Brock, R. E. 2002. Cooperative Environmental Monitoring Program for the Natural Energy Laboratory of Hawaii. Survey for Anchialine and Marine Fish Resources. May 2002 Survey. Prepared for NELHA, Kailua-Kona, Hawaii. EAC Report No. 2002-13A. 61 pp. plus Appendix.

Brock, R. E. 2008. Cooperative Environmental Monitoring Program for the Natural Energy Laboratory of Hawaii. Survey for Anchialine and Marine Fish Resources. Synopsis of 2007-2008 Surveys. Prepared for NELHA, Kailua-Kona, Hawaii. EAC Report No. 2008-16. 60 pp. plus Appendix.

Brock, V. E. 1954. A preliminary report on a method of estimating reef fish populations. J. Wildlife Mgmt. 18:297-304.

Bybee, D.R., and Barrett, B. 2012. Marine Biota Monitoring Program for Natural Energy Laboratory of Hawaii Authority Keahole Point, District of North Kona Island of Hawaii. Survey Report April 2012. Prepared for Natural Energy Laboratory of Hawaii Authority (NELHA), Kailua-Kona, HI. 55 pp. + Appendices A - E

Bybee, D.R., and Barrett, B. 2013. Marine Biota Monitoring Program for Natural Energy Laboratory of Hawaii Authority Keahole Point, District of North Kona Island of Hawaii. Survey Report April 2012. Prepared for Natural Energy Laboratory of Hawaii Authority (NELHA), Kailua-Kona, HI. 31 pp. + Appendices A - E

Capps, K. A., Turner, C. B., Booth, M. T., Lombardozzi, D. L., McArt, S. H., Chai, D., and Hairston, N. G., Jr. 2009. Behavioral responses of the endemic shrimp *Halocaridina rubra* (Malacostraca: Atyidae) to an introduced fish, *Gambusia affinis* (Actinopterygii: Poeciliidae) and implications for the trophic structure of Hawaiian anchialine ponds. Pacific Science 63(1): 27- 37.

Chace, F. A., Jr., and Manning, R. B. 1972. Two new caridean shrimps, one representing a new family, from marine pools on Ascension Island (Crustacea: Decapoda: Natantia). Smithsonian Contributions to Zoology 131: 1-18.

Dollar, S. J. 1975. Zonation of reef corals off the Kona Coast of Hawaii. M.S. thesis, Dept. of Oceanography, University of Hawaii, Honolulu, 183 pp.

Dollar, S. J. 1982. Wave stress and coral community structure in Hawaii. Coral Reefs 1: 71-81.

Dollar, S. J. and G. W. Tribble. 1993. Recurrent storm disturbance and recovery: a long-term study of coral communities in Hawaii. Coral Reefs 12:223-233.

Froese, R. and D. Pauly, Editors. 2000. FishBase 2000: concepts, design and data sources. ICLARM, Los Baños, Laguna, Philippines. 344 p.

Google Inc. 2015. Google Earth Pro Mountain View, CA.

Gray, J. H., and Pearson, J. H. 1982. Objective selection of sensitive species indicative of pollution-induced change in benthic communities. I. Comparitive methodology. Marine Ecology Progress Series 9: 111-119.

Hobbs, H. H. I. 1994. Biogeography of subterranean decapods in North and Central America and the Caribbean region (Caridea, Astacidae, Brachyura). Hydrobiologia 287(1): 95-104.

Holthuis, L. B. 1973. Caridean shrimps found in land-locked saltwater pools at four Indo-West Pacific localities (Sinai Peninsula, Funafuti Atoll, Maui and Hawaii Islands), with the description of one new genus and four new species. Zoologische Verhandelingen 128: 1-48.

Iliffe, T. M. 1991. Anchialine fauna of the Galapagos Islands. Topics in Geobiology 8: 209-231.

Oceanic Institute. 1997. Marine Biota Monitoring Program for Natural Energy Laboratory of Hawaii Authority, Final Report - November 1995 - May 1997.

Prepared for Natural Energy Laboratory of Hawaii Authority, Kailua-Kona. 35 pp. + Appendices A - E.

Oceanic Institute. 1997. Marine Biota Monitoring Program for Natural Energy Laboratory of Hawaii Authority, Final Report – November 1995-1997. Prepared for Natural Energy Laboratory of Hawaii Authority, Kailua-Kona. 35 pp. + Appendices A - E.

Oceanic Institute. 2005a. Marine Biota Monitoring Program for Natural Energy Laboratory of Hawaii Authority, Survey Report – July 2005. Prepared for Natural Energy Laboratory of Hawaii Authority, Kailua-Kona. 37 pp. + Appendices A - D.

Oceanic Institute. 2005b. Marine Biota Monitoring Program for Natural Energy Laboratory of Hawaii Authority, Survey Report – November 2005. Prepared for Natural Energy Laboratory of Hawaii Authority, Kailua-Kona. 37 pp. + Appendices A - D.

Oceanic Institute. 2006. Marine Biota Monitoring Program for Natural Energy Laboratory of Hawaii Authority, Survey Report - July 2006. Prepared for Natural Energy Laboratory of Hawaii Authority, Kailua-Kona. 38 pp. + Appendices A - D.

Oceanic Institute. 2007. Marine Biota Monitoring Program for Natural Energy Laboratory of Hawaii Authority, Final Report - January 2007. Prepared for Natural Energy Laboratory of Hawaii Authority, Kailua-Kona. 38 pp. + Appendices A - D.

Maciolek, J. A., and Brock, R. E. 1974. Aquatic survey of the Kona coast ponds, Hawai'i Island. Sea Grant Advisory Report, UNIHISEAGRANT-AR-74–04. U.S. Department of Commerce and Hawaii Cooperative Fishery Unit. Honolulu, HI,

Maciolek, J. A. 1983. Distribution and biology of Indo-Pacific insular hypogeal shrimp. Bulletin of Marine Science 33: 606-618.

Marine Research Consultants. 1995. Benthic Marine Biota Monitoring Program at Keahole Point, Hawaii. Report XI, May 1995. Prepared for the Natural Energy Laboratory of Hawaii Authority, Kailua-Kona. 15 pp. + figs. and appendices.

Marine Research Consultants. 1998. Benthic Marine Biota Monitoring Program at Keahole Point, Hawaii. November 1997. Prepared for the Natural Energy Laboratory of Hawaii Authority, Kailua-Kona. 17 pp. + figs. and appendices.

Marine Research Consultants. 2002. Benthic Marine Biota Monitoring Program at Keahole Point, Hawaii. June 2002. Prepared for the Natural Energy Laboratory of Hawaii Authority, Kailua-Kona. 15 pp. + figs.and appendices.

Marine Research Consultants. 2008. Benthic Marine Biota Monitoring Program at Keahole Point, Hawaii. July 2008. Prepared for the Natural Enerty Laboratroy of Hawaii Authority, Kailua-Kona. 13 pp. + tables, figures and appendices.

Peck, S. B. 1994. Diversity and zoogeography of the non-oceanic Crustacea of the Galapagos Islands, Ecuador (excluding terrestrial Isopoda). Canadian Journal of Zoology 72(1): 54-69.

Santos, S. 2006. Patterns of genetic connectivity among anchialine habitats: a case study of the endemic Hawaiian shrimp *Halocaridina rubra* on the I sland of Hawaii. Molecular Ecology 15: 2699–2718.

Ziemann, D. A., and Conquest, L. D. 2008. Marine Biota Monitoring Program for Natural Energy Laboratory of Hawaii Authority Keahole Point, District of North Kona Island of Hawaii. Survey Report October 2008. Prepared for Natural Energy Laboratory of Hawaii Authority (NELHA), Kailua-Kona, HI. 49 pp. + Appendices A - E.

Ziemann, D. A., and Conquest, L. D. 2008. Marine Biota Monitoring Program for Natural Energy Laboratory of Hawaii Authority Keahole Point, District of North Kona Island of Hawaii. Survey Report October 2008. Prepared for Natural Energy Laboratory of Hawaii Authority (NELHA), Kailua-Kona, HI. 49 pp. + Appendices A - E.

Ziemann, D. A., and Conquest, L. D. 2009. Marine Biota Monitoring Program for Natural Energy Laboratory of Hawaii Authority Keahole Point, District of North Kona Island of Hawaii. Survey Report May 2009. Prepared for Natural Energy Laboratory of Hawaii Authority (NELHA), Kailua-Kona, HI. 38 pp. + Appendices A - E.

Ziemann, D. A., and Conquest, L. D. 2010. Marine Biota Monitoring Program for Natural Energy Laboratory of Hawaii Authority Keahole Point, District of North Kona Island of Hawaii. Survey Report March 2010. Prepared for Natural Energy Laboratory of Hawaii Authority (NELHA), Kailua-Kona, HI. 38 pp. + Appendices A - E.

Appendix A

Coral Benthic Data Charts

WHALE Environmental Services LLC
www.whalees.com
P.O. Box 455, KAHUKU, HI 96731 808-294-9254

Site	Depth	Location	Sub-Categories	Coral	cypag	cypoc	Funscu	Leppur	lepinc	Moncap	Monfla	Monpat	Monsp	Pavdue	Pavvar	Pocdam	Poceyd	Poclig	Pocmea	Porcom	Porev	Porlob		Tubcoc		Inorganics	Basalt		Limest	Quad	Sand
					Cyphastrea agassizi (cypag)	Cyphastrea ocellina (cypoc)	Fungia scutaria (Funscu)	Leptastrea purpurea (Leppur)	Leptoseris incrustans (lepinc)	Montipora capitata (Moncap)	Montipora flabellata (Monfla)	Montipora patula (Monpat)	Montipora species (Monsp)	Pavona duerdeni (Pavdue)	Pavona varians (Pavvar)	Pocillopora damicornis (Pocdam)	Pocillopora eydouxi (Poceyd)	Pocillopora ligulata (Poclig)	Pocillopra meandrina (Pocmea)	Porites compressa (Porcom)	Porites evermanni (Porev)	Porites lobata (Porlob)	Porites rus	Tubastrea coccinea (Tubcoc)	Sarcothelia edmondsoni		Basalt (Basalt)	Rubble	Limestone (Limest)	Quad (Quad)	Sand (Sand)
12N	50	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	35	0	0	0	0	0	0	0	0	0
12N	50	2		0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	70	0	0	0	0	0	0	0	0	0
12N	50	5		0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	20	35	0	20	0	0	0	0	0	0	0	0	0
12N	50	10		0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	20	20	0	35	0	0	0	0	0	0	0	0	0
12N	50	14		0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	5	0	0	20	0	0	0	0	0	0	0	0	5
12N	50	17		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	40	0	25	0	0	0	0	0	0	0	0	0
12N	50	26		0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	15	20	0	25	0	0	0	0	0	0	0	0	0
12N	50	31		0	0	0	0	0	0	5	0	0	0	0	0	0	15	0	20	10	0	20	0	0	0	0	0	0	0	0	5
12N	50	36		0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	20	0	0	40	0	0	0	0	0	0	0	0	0
12N	50	34		0	0	0	0	0	0	10	0	5	0	0	0	0	0	0	25	0	0	25	0	0	0	0	0	0	0	0	15
12N	35	4		0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	25	0	0	10	0	0	0	0	10	0	0	0	0
12N	35	10		0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	20	0	0	30	0	0	0	0	0	0	0	0	5
12N	35	16		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	10	0	35	0	0	0	0	0	0	0	0	0
12N	35	18		0	0	0	0	0	0	5	0	0	0	0	0	0	15	0	10	0	5	30	0	0	0	0	0	0	0	0	20
12N	35	25		0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	20	0	0	35	0	0	0	0	0	0	0	0	30
12N	35	28		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	15	0	0	0	0	0	0	0	0	0
12N	35	35		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	10	0	0	0	0	30	0	0	0	0
12N	35	39		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0	10	0	0	5	0	0	0	0	0	0
12N	35	40		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0	5	0	0	0	0	0	10	0	0	10
12N	35	41		0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	15
12N	15	6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0	2	0	0	0	0	0	0	0	0	30
12N	15	8		0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	15	0	0	7	0	0	0	0	0	0	0	0	30
12N	15	12		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	50	0	0	0	0	0	0	0	0	15
12N	15	19		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	35	0	0	0	0	0	0	0	0	10
12N	15	27		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	5	0	0	0	0	0	0	0	0	10
12N	15	35		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0	5	0	0	0	0	0	0	0	0	15
12N	15	37		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	20
12N	15	39		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	25	0	0	0	0	0	0	0	0	5
12N	15	41		0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	20	0	15	15	0	0	0	0	0	0	0	0	0
12N	15	48		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0

Site	Depth	Location	Sub-Categories	Inverts	Acanpla	Actmaur	Actobe	Chongig	Coloat	Diapau	Echmat	Echobl	Echinot	Hemam	Holatr	Holwit	Ophio	Ophspec	Spigig	Sponge	Sponge	
					Acanthaster planci (Acanpla)	Actinopyga mauritiana (Actmaur)	Actionopyga obesa (Actobe)	Chondrocidaris gigantea (Chongig)	Colobocentrotus atratus (Coloat)	Diadema paucispinum (Diapau)	Echinometra mathaei (Echmat)	Echinometra oblonga (Echobl)	Echinothrix species (Echinot)	Heterocentrotus mammillatus (Hemam)	Holothuria atra (Holatr)	Holothuria whitmaei (Holwit)	Ophiocomoa species (Ophio)	Ophodesomoa spectabilis (Ophspec)	Spirobranchus giganteus (Spigig)	Sponge (Sponge)	Spirastrealla vagabunda	Palythoa tuberculosa
12N	50	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	50	2		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	50	5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	50	10		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	50	14		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	50	17		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	50	26		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	50	31		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	50	36		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	50	34		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	35	4		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	35	10		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	35	16		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	35	18		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	35	25		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	35	28		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	35	35		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	35	39		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	35	40		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	35	41		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	15	6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	15	8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	15	12		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	15	19		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	15	27		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	15	35		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	15	37		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	15	39		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	15	41		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12N	15	48		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Site	Depth	Location	Sub-Categories	Algae	Asptax	Caurac	Caulser	Caulsert	Codara	CCA	BG	Dasyir	Dichmar	Dictcav	Dictver	Dicty	Gibhaw	Halop	Lobvar	Marflab	Marfrag	Neoman	Padina	Porhor	Prewel	Sarg	Turbor	Turf	venven	
					Asparagopsis taxiformis (Asptax)	Caulerpa racemosa (Caurac)	Caulerpa serrulata (Caulser)	Caulerpa sertularioides (Caulsert)	Codium arabicum (Codara)	Crustose Coralline (CCA)	Cyanophyta (BG)	Dasya iridescens (Dasyir)	Dichotomaria marginata (Dichmar)	Dictyospaeria cavernosa (Dictcav)	Dictyosphaeria versluysii (Dictver)	Dictyota species (Dicty)	Gismithia hawaiiensis (Gibhaw)	Halimeda opuntia (Halop)	Lobophora variegata (Lobvar)	Martensia flabelliformis (Marflab)	Martensia fragilis (Marfrag)	Neomeris annulata (Neoman)	Padina species (Padina)	Portieria hornemanii (Porhor)	Predaea weldii (Prewel)	Sargassum (Sarg)	Turbinaria ornata (Turbor)	Turf (Turf)	Ventricaria ventricosa (venven)	green algae
12N	50	1			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0
12N	50	2			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0
12N	50	5			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0
12N	50	10			0	0	0	0	0	5	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	10	0	0
12N	50	14			0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0
12N	50	17			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0
12N	50	26			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0
12N	50	31			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0
12N	50	36			0	0	0	0	0	5	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	25	0	0
12N	50	34			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0	2
12N	35	4			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0
12N	35	10			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0
12N	35	16			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0
12N	35	18			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0
12N	35	25			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0
12N	35	28			0	0	0	0	0	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0
12N	35	35			0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0
12N	35	39			0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0
12N	35	40			0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0
12N	35	41			0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0
12N	15	6			0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0	0
12N	15	8			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33	0	0
12N	15	12			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0
12N	15	19			0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0
12N	15	27			0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0
12N	15	35			0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	20	0	0
12N	15	37			0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0
12N	15	39			0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	5
12N	15	41			0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0
12N	15	48			0	0	0	0	0	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	0	0

Site	Depth	Location	Sub-Categories	Coral	Cyphastrea agassizi (cypag)	Cyphastrea ocellina (cypoc)	Fungia scutaria (Funscu)	Leptastrea purpurea (Leppur)	Leptoseris incrustans (lepinc)	Montipora capitata (Moncap)	Montipora flabellata (Monfla)	Montipora patula (Monpat)	Montipora species (Monsp)	Pavona duerdeni (Pavdue)	Pavona varians (Pavvar)	Pocillopora damicornis (Pocdam)	Pocillopora eydouxi (Poceyd)	Pocillopora ligulata (Poclig)	Pocillopra meandrina (Pocmea)	Porites compressa (Porcom)	Porites evermanni (Porev)	Porites lobata (Porlob)	Porites rus	Tubastrea coccinea (Tubcoc)	Sarcothelia edmondsoni	Inorganics	Basalt (Basalt)	Rubble	Limestone (Limest)	Quad (Quad)	Sand (Sand)
					cypag	cypoc	Funscu	Leppur	lepinc	Moncap	Monfla	Monpat	Monsp	Pavdue	Pavvar	Pocdam	Poceyd	Poclig	Pocmea	Porcom	Porev	Porlob		Tubcoc			Basalt		Limest	Quad	Sand
12S	50	2		0	0	0	0	0	0	5	0	6	0	7	0	8	0	9	0	10	0	11	0	12	0	13	0	14	0	15	0
12S	50	5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	20	10	0	0	5	0	0	0	0	0	0
12S	50	11		0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	25	0	0	15	0	0	0	0	0	10	0	0	0
12S	50	12		0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	40	0	0	20
12S	50	14		0	0	0	0	0	0	10	0	10	0	0	0	0	0	0	10	0	0	25	0	0	0	0	0	0	0	0	15
12S	50	16		0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	15	0	0	30	0	0	0	0	0	0	0	0	5
12S	50	17		0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	5	0	5	40	0	0	0	0	0	0	0	0	0
12S	50	20		0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	1	0	0	15	0	0	0	0	10	0	0	0	0
12S	50	21		0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	15	0	0	30	0	0	0	0	10	0	0	0	0
12S	50	23		0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	5	0	5	25	0	0	0	0	0	0	0	0	20
12S	35	5		0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	5	0	0	10	0	0	0	0	0	0	0	0	0
12S	35	6		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	20	0	0	30	0	0	0	0	0	0	0	0	10
12S	35	16		0	0	0	0	0	0	0	0	15	0	0	0	0	20	0	20	0	15	10	0	0	0	0	0	0	0	0	4
12S	35	20		0	0	0	0	0	0	10	0	15	0	0	5	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	20
12S	35	27		0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	20	0	0	20	0	0	0	0	0	10	0	0	20
12S	35	32		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	10	0	0	0	0	10	0	0	0	0
12S	35	34		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	35	0	0	0	0	0	10	0	0	20
12S	35	36		0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	10	0	0	40	0	0	0	0	0	0	0	0	0
12S	35	38		0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	15	0	10	35	0	0	0	0	0	0	0	0	0
12S	35	41		0	0	0	0	20	0	0	0	20	0	0	0	0	0	0	25	0	0	20	0	0	0	0	0	0	0	0	0
12S	15	4		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	5	0	0	0	0	0	5	0	0	10
12S	15	5		0	0	0	0	0	0	5	0	5	0	0	0	0	0	0	15	0	25	25	0	0	0	0	0	10	0	0	10
12S	15	8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0
12S	15	10		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	35	0	0	0	0	0	0	0	0	10
12S	15	13		0	0	0	0	0	0	20	0	0	0	0	0	0	15	0	15	0	0	20	0	0	0	0	0	0	0	0	0
12S	15	21		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0
12S	15	28		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0
12S	15	45		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0
12S	15	48		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	15
12S	15	49		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0

Site	Depth	Location	Sub-Categories	Inverts	Acanpla Acanthaster planci (Acanpla)	Actmaur Actinopyga mauritiana (Actmaur)	Actobe Actionopyga obesa (Actobe)	Chongig Chondrocidaris gigantea (Chongig)	Coloat Colobocentrotus atratus (Coloat)	Diapau Diadema paucispinum (Diapau)	Echmat Echinometra mathaei (Echmat)	Echobl Echinometra oblonga (Echobl)	Echinot Echinothrix species (Echinot)	Hemam Heterocentrotus mammillatus (Hemam)	Holatr Holothuria atra (Holatr)	Holwit Holothuria whitmaei (Holwit)	Ophio Ophiocomoa species (Ophio)	Ophspec Ophodesomoa spectabilis (Ophspec)	Spigig Spirobranchus giganteus (Spigig)	Sponge Sponge (Sponge)	Sponge Spirastrealla vagabunda	Palythoa tuberculosa
12S	50	2		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	50	5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	50	11		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	50	12		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	50	14		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	50	16		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	50	17		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	50	20		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	50	21		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
12S	50	23		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	35	5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
12S	35	6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	35	16		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
12S	35	20		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	35	27		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	35	32		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	35	34		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	35	36		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	35	38		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	35	41		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	15	4		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	15	5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	15	8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	15	10		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	15	13		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	15	21		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	15	28		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	15	45		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	15	48		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12S	15	49		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Site	Depth	Location	Sub-Categories	Algae	Asptax	Caurac	Caulser	Caulsert	Codara	CCA	BG	Dasyir	Dichmar	Dictcav	Dictver	Dicty	Gibhaw	Halop	Lobvar	Marflab	Marfrag	Neoman	Padina	Porhor	Prewel	Sarg	Turbor	Turf	venven	
					Asparagopsis taxiformis (Asptax)	Caulerpa racemosa (Caurac)	Caulerpa serrulata (Caulser)	Caulerpa sertularioides (Caulsert)	Codium arabicum (Codara)	Crustose Coralline (CCA)	Cyanophyta (BG)	Dasya iridescens (Dasyir)	Dichotomaria marginata (Dichmar)	Dictyospaeria cavernosa (Dictcav)	Dictyosphaeria versluysii (Dictver)	Dictyota species (Dicty)	Gismithia hawaiiensis (Gibhaw)	Halimeda opuntia (Halop)	Lobophora variegata (Lobvar)	Martensia flabelliformis (Marflab)	Martensia fragilis (Marfrag)	Neomeris annulata (Neoman)	Padina species (Padina)	Portieria hornemanii (Porhor)	Predaea weldii (Prewel)	Sargassum (Sarg)	Turbinaria ornata (Turbor)	Turf (Turf)	Ventricaria ventricosa (venven)	green algae
12S	50	2			0	0	0	0	0	5	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	18	0	0
12S	50	5			0	0	0	0	0	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0
12S	50	11			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0
12S	50	12			0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0
12S	50	14			0	0	0	0	0	20	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	8	0	0
12S	50	16			0	0	0	0	0	25	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	20	0	0
12S	50	17			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0
12S	50	20			0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	49	0	0
12S	50	21			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0
12S	50	23			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0
12S	35	5			0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	0	0
12S	35	6			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	0	0
12S	35	16			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0
12S	35	20			0	0	0	0	0	10	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	5	0	0
12S	35	27			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0
12S	35	32			0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54	0	0
12S	35	34			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0
12S	35	36			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0
12S	35	38			0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0
12S	35	41			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0
12S	15	4			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	0	0
12S	15	5			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0
12S	15	8			0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0
12S	15	10			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0
12S	15	13			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0
12S	15	21			0	0	0	0	0	45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0
12S	15	28			0	0	0	0	0	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0
12S	15	45			0	0	0	0	0	45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0
12S	15	48			0	0	0	0	0	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0
12S	15	49			0	0	0	0	0	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0

Site	Depth	Location	Sub-Categories	Coral	Cyphastrea agassizi (cypag)	Cyphastrea ocellina (cypoc)	Fungia scutaria (Funscu)	Leptastrea purpurea (Leppur)	Leptoseris incrustans (lepinc)	Montipora capitata (Moncap)	Montipora flabellata (Monfla)	Montipora patula (Monpat)	Montipora species (Monsp)	Pavona duerdeni (Pavdue)	Pavona varians (Pavvar)	Pocillopora damicornis (Pocdam)	Pocillopora eydouxi (Poceyd)	Pocillopora ligulata (Poclig)	Pocillopra meandrina (Pocmea)	Porites compressa (Porcom)	Porites evermanni (Porev)	Porites lobata (Porlob)	Porites rus	Tubastrea coccinea (Tubcoc)	Sarcothelia edmondsoni	Inorganics	Basalt (Basalt)	Rubble	Limestone (Limest)	Quad (Quad)	Sand (Sand)
18	50	2		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	54
18	50	4		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	20	0	0	24
18	50	6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	10	0	0	0	0	0	20	0	0	25
18	50	7		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	10	0	0	30
18	50	8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	10	0	0	0	0	0	0	0	0	25
18	50	16		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	10	0	25	0	0	0	0	0	4	0	0	20
18	50	24		0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	15	0	0	25	0	0	0	0	0	0	0	0	20
18	50	28		0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	10	0	0	15
18	50	33		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	35	0	0	0	0	0	0	0	0	10
18	50	34		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	25	0	0	30	0	0	0	0	0	0	0	0	5
18	35	5		0	0	0	0	0	0	1	0	20	0	0	0	0	20	0	10	0	0	20	0	0	0	0	0	10	0	0	5
18	35	7		0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	30	5	0	15	0	0	0	0	0	0	0	0	5
18	35	8		0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	15	0	0	20	0	0	5	0	0	0	0	0	0
18	35	16		0	0	0	0	0	0	5	0	10	0	0	0	0	0	0	15	0	0	5	0	0	0	0	10	0	0	0	0
18	35	17		0	0	0	0	0	0	30	0	20	0	0	0	0	0	0	5	0	0	15	0	0	0	0	0	0	0	0	10
18	35	23		0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	10	0	0	25	0	0	0	0	10	0	0	0	0
18	35	31		0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	15	0	0	10	0	0	0	0	0	0	0	0	0
18	35	37		0	0	0	0	0	0	10	0	15	0	0	0	0	0	0	30	0	0	20	0	0	0	0	0	0	0	0	20
18	35	38		0	0	0	0	0	0	15	0	7	0	0	0	0	10	0	0	0	0	20	0	0	0	0	0	0	0	0	10
18	35	39		0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	8	0	10	20	0	0	0	0	0	0	0	0	10
18	15	0		0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	20	0	0	25	0	0	0	0	0	0	0	0	10
18	15	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	35	0	0	0	0	0	0	0	0	5
18	15	4		0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	25	0	10	10	0	0	0	0	0	0	0	0	0
18	15	7		0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	15	0	0	25	0	0	0	0	0	0	0	0	10
18	15	11		0	0	0	0	5	0	10	0	15	0	0	0	0	0	0	10	0	0	15	0	0	0	0	0	0	0	0	5
18	15	13		0	0	0	0	0	0	0	0	35	0	0	0	0	0	0	5	0	0	25	0	0	0	0	0	0	0	0	5
18	15	16		0	0	0	0	10	0	5	0	0	0	0	0	0	0	0	10	0	0	20	0	0	0	0	0	0	0	0	10
18	15	23		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	10	0	0	0	0	0	0	0	0	0
18	15	24		0	0	0	0	0	0	20	0	5	0	0	0	0	0	0	25	0	0	15	0	0	0	0	0	0	0	0	0
18	15	27		0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	40	0	0	10	0	0	0	0	10	0	0	0	0

Site	Depth	Location	Sub-Categories	Inverts	Acanpla	Actmaur	Actobe	Chongig	Coloat	Diapau	Echmat	Echobl	Echinot	Hemam	Holatr	Holwit	Ophio	Ophspec	Spigig	Sponge	Sponge	
					Acanthaster planci (Acanpla)	Actinopyga mauritiana (Actmaur)	Actionopyga obesa (Actobe)	Chondrocidaris gigantea (Chongig)	Colobocentrotus atratus (Coloat)	Diadema paucispinum (Diapau)	Echinometra mathaei (Echmat)	Echinometra oblonga (Echobl)	Echinothrix species (Echinot)	Heterocentrotus mammillatus (Hemam)	Holothuria atra (Holatr)	Holothuria whitmaei (Holwit)	Ophiocomoa species (Ophio)	Ophodesomoa spectabilis (Ophspec)	Spirobranchus giganteus (Spigig)	Sponge (Sponge)	Spirastrealla vagabunda	Palythoa tuberculosa
18	50	2		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	50	4		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	50	6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	50	7		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	50	8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
18	50	16		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	50	24		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	50	28		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
18	50	33		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	50	34		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	35	5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	35	7		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	35	8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	35	16		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	35	17		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	35	23		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	35	31		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	35	37		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	35	38		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	35	39		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
18	15	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	15	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	15	4		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	15	7		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	15	11		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	15	13		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	15	16		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	15	23		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	15	24		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	15	27		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Site	Depth	Location	Sub-Categories	Algae	Asptax Asparagopsis taxiformis (Asptax)	Caurac Caulerpa racemosa (Caurac)	Caulser Caulerpa serrulata (Caulser)	Caulsert Caulerpa sertularioides (Caulsert)	Codara Codium arabicum (Codara)	CCA Crustose Coralline (CCA)	BG Cyanophyta (BG)	Dasyir Dasya iridescens (Dasyir)	Dichmar Dichotomaria marginata (Dichmar)	Dictcav Dictyospaeria cavernosa (Dictcav)	Dictver Dictyosphaeria versluysii (Dictver)	Dicty Dictyota species (Dicty)	Gibhaw Gismithia hawaiiensis (Gibhaw)	Halop Halimeda opuntia (Halop)	Lobvar Lobophora variegata (Lobvar)	Marflab Martensia flabelliformis (Marflab)	Marfrag Martensia fragilis (Marfrag)	Neoman Neomeris annulata (Neoman)	Padina Padina species (Padina)	Porhor Portieria hornemanii (Porhor)	Prewel Predaea weldii (Prewel)	Sarg Sargassum (Sarg)	Turbor Turbinaria ornata (Turbor)	Turf Turf (Turf)	venven Ventricaria ventricosa (venven)	green algae
18	50	2			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0
18	50	4			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0
18	50	6			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0
18	50	7			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	0	0
18	50	8			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0
18	50	16			0	0	0	0	0	15	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	5	0	0
18	50	24			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0
18	50	28			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39	0	0
18	50	33			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0
18	50	34			0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	38	0	0
18	35	5			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0
18	35	7			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0
18	35	8			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	0	0
18	35	16			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	0	0
18	35	17			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0
18	35	23			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0
18	35	31			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	0	0
18	35	37			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0
18	35	38			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	38	0	0
18	35	39			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	44	0	0
18	15	0			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0
18	15	1			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0
18	15	4			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0
18	15	7			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0
18	15	11			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0
18	15	13			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0
18	15	16			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	0	0
18	15	23			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	55	0	0
18	15	24			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0
18	15	27			0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0

					cypag	cypoc	Funscu	Leppur	lepinc	Moncap	Monfla	Monpat	Monsp	Pavdue	Pavvar	Pocdam	Poceyd	Poclig	Pocmea	Porcom	Porev	Porlob		Tubcoc			Basalt		Limest	Quad	Sand
Site	Depth	Location	Sub-Categories	Coral	Cyphastrea agassizi (cypag)	Cyphastrea ocellina (cypoc)	Fungia scutaria (Funscu)	Leptastrea purpurea (Leppur)	Leptoseris incrustans (lepinc)	Montipora capitata (Moncap)	Montipora flabellata (Monfla)	Montipora patula (Monpat)	Montipora species (Monsp)	Pavona duerdeni (Pavdue)	Pavona varians (Pavvar)	Pocillopora damicornis (Pocdam)	Pocillopora eydouxi (Poceyd)	Pocillopora ligulata (Poclig)	Pocillopra meandrina (Pocmea)	Porites compressa (Porcom)	Porites evermanni (Porev)	Porites lobata (Porlob)	Porites rus	Tubastrea coccinea (Tubcoc)	Sarcothelia edmondsoni	Inorganics	Basalt (Basalt)	Rubble	Limestone (Limest)	Quad (Quad)	Sand (Sand)
NPPE	50	2		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	10	0	30	0	0	0	0	0	0	0	0	0
NPPE	50	5		0	0	0	0	0	0	10	0	10	0	0	0	0	0	0	20	30	0	10	0	0	0	0	0	0	0	0	0
NPPE	50	9		0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	10	20	0	25	0	0	0	0	0	0	0	0	0
NPPE	50	11		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	10	65	0	0	0	0	0	0	0	0	0
NPPE	50	12		0	0	0	0	0	0	10	0	5	0	0	0	0	0	0	10	30	0	20	0	0	0	0	0	0	0	0	0
NPPE	50	15		0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	35	0	15	0	0	0	0	0	0	0	0	0
NPPE	50	16		0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	40	0	30	0	0	0	0	0	0	0	0	0
NPPE	50	20		0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	10	0	0	45	0	0	0	0	0	0	0	0	0
NPPE	50	27		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	45	0	25	0	0	0	0	0	0	0	0	0
NPPE	50	28		0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	10	0	45	0	0	0	0	0	0	0	0	0
NPPE	35	2		0	0	0	0	0	0	0	0	30	0	0	0	0	0	0	15	0	0	40	0	0	0	0	0	0	0	0	5
NPPE	35	17		0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	20	10	0	30	0	0	0	0	0	0	0	0	0
NPPE	35	18		0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	20	5	0	35	0	0	0	0	0	0	0	0	0
NPPE	35	22		0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	10	20	0	35	0	0	0	0	0	0	0	0	0
NPPE	35	23		0	0	0	0	0	0	10	0	5	0	0	0	0	0	0	15	25	0	10	0	0	0	0	0	0	0	0	0
NPPE	35	27		0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	10	0	0	45	0	0	0	0	0	0	0	0	0
NPPE	35	31		0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	15	5	0	30	0	0	0	0	0	0	0	0	0
NPPE	35	34		0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	15	10	0	40	0	0	0	0	0	0	0	0	0
NPPE	35	40		0	0	0	0	0	0	0	0	25	0	0	0	0	15	0	15	0	5	25	0	0	0	0	0	0	0	0	0
NPPE	35	50		0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	10	25	0	30	0	0	0	0	0	0	0	0	0
NPPE	15	6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	20	0	0	0	0	0	0	0	0	0
NPPE	15	12		0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	35	0	0	30	0	0	0	0	0	0	0	0	0
NPPE	15	13		0	0	0	0	0	0	2	0	5	0	0	0	0	0	0	20	0	0	30	0	0	0	0	0	0	0	0	0
NPPE	15	17		0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	5	0	0	30	10	0	0	0	0	10	0	0	0
NPPE	15	21		0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	15	0	0	35	0	0	0	0	0	0	0	0	0
NPPE	15	23		0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	25	0	0	40	0	0	0	0	0	0	0	0	0
NPPE	15	25		0	0	0	0	0	0	0	0	50	0	0	0	0	0	0	20	0	0	10	0	0	0	0	0	0	0	0	0
NPPE	15	41		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	25	0	0	0	0	0	0	0	0	0
NPPE	15	42		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0	10	0	0	0	0	0	0	0	0	0
NPPE	15	43		0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0

Site	Depth	Location	Sub-Categories	Inverts	Acanthaster planci (Acanpla)	Actinopyga mauritiana (Actmaur)	Actionopyga obesa (Actobe)	Chondrocidaris gigantea (Chongig)	Colobocentrotus atratus (Coloat)	Diadema paucispinum (Diapau)	Echinometra mathaei (Echmat)	Echinometra oblonga (Echobl)	Echinothrix species (Echinot)	Heterocentrotus mammillatus (Hemam)	Holothuria atra (Holatr)	Holothuria whitmaei (Holwit)	Ophiocomoa species (Ophio)	Ophodesomoa spectabilis (Ophspec)	Spirobranchus giganteus (Spigig)	Sponge (Sponge)	Spirastrealla vagabunda	Palythoa tuberculosa
					Acanpla	Actmaur	Actobe	Chongig	Coloat	Diapau	Echmat	Echobl	Echinot	Hemam	Holatr	Holwit	Ophio	Ophspec	Spigig	Sponge	Sponge	
NPPE	50	2		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	50	5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	50	9		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	50	11		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	50	12		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	50	15		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	50	16		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	50	20		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	50	27		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	50	28		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	35	2		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	35	17		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	35	18		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	35	22		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	35	23		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	35	27		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	35	31		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	35	34		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	35	40		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	35	50		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	15	6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	15	12		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	15	13		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	15	17		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
NPPE	15	21		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	15	23		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	15	25		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	15	41		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	15	42		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NPPE	15	43		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

					Asptax	Caurac	Caulser	Caulsert	Codara	CCA	BG	Dasyir	Dichmar	Dictcav	Dictver	Dicty	Gibhaw	Halop	Lobvar	Marflab	Marfrag	Neoman	Padina	Porhor	Prewel	Sarg	Turbor	Turf	venven	
Site	Depth	Location	Sub-Categories	Algae	Asparagopsis taxiformis (Asptax)	Caulerpa racemosa (Caurac)	Caulerpa serrulata (Caulser)	Caulerpa sertularioides (Caulsert)	Codium arabicum (Codara)	Crustose Coralline (CCA)	Cyanophyta (BG)	Dasya iridescens (Dasyir)	Dichotomaria marginata (Dichmar)	Dictyospaeria cavernosa (Dictcav)	Dictyosphaeria versluysii (Dictver)	Dictyota species (Dicty)	Gismithia hawaiiensis (Gibhaw)	Halimeda opuntia (Halop)	Lobophora variegata (Lobvar)	Martensia flabelliformis (Marflab)	Martensia fragilis (Marfrag)	Neomeris annulata (Neoman)	Padina species (Padina)	Portieria hornemanii (Porhor)	Predaea weldii (Prewel)	Sargassum (Sarg)	Turbinaria ornata (Turbor)	Turf (Turf)	Ventricaria ventricosa (venven)	green algae
NPPE	50	2			0	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0
NPPE	50	5			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	0	1
NPPE	50	9			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0
NPPE	50	11			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0
NPPE	50	12			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0
NPPE	50	15			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0
NPPE	50	16			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0
NPPE	50	20			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0
NPPE	50	27			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0
NPPE	50	28			0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0
NPPE	35	2			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0
NPPE	35	17			0	0	0	0	0	10	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	9	0	0
NPPE	35	18			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	20	0	0
NPPE	35	22			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0
NPPE	35	23			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0
NPPE	35	27			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0
NPPE	35	31			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0
NPPE	35	34			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0
NPPE	35	40			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0
NPPE	35	50			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0
NPPE	15	6			0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	5
NPPE	15	12			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0
NPPE	15	13			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	0	5
NPPE	15	17			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0
NPPE	15	21			0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0
NPPE	15	23			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0
NPPE	15	25			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0
NPPE	15	41			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	55	0	0
NPPE	15	42			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0
NPPE	15	43			0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	0	0

					cypag	cypoc	Funscu	Leppur	lepinc	Moncap	Monfla	Monpat	Monsp	Pavdue	Pavvar	Pocdam	Poceyd	Poclig	Pocmea	Porcom	Porev	Porlob		Tubcoc			Basalt		Limest	Quad	Sand
Site	Depth	Location	Sub-Categories	Coral	Cyphastrea agassizi (cypag)	Cyphastrea ocellina (cypoc)	Fungia scutaria (Funscu)	Leptastrea purpurea (Leppur)	Leptoseris incrustans (lepinc)	Montipora capitata (Moncap)	Montipora flabellata (Monfla)	Montipora patula (Monpat)	Montipora species (Monsp)	Pavona duerdeni (Pavdue)	Pavona varians (Pavvar)	Pocillopora damicornis (Pocdam)	Pocillopora eydouxi (Poceyd)	Pocillopora ligulata (Poclig)	Pocillopra meandrina (Pocmea)	Porites compressa (Porcom)	Porites evermanni (Porev)	Porites lobata (Porlob)	Porites rus	Tubastrea coccinea (Tubcoc)	Sarcothelia edmondsoni	Inorganics	Basalt (Basalt)	Rubble	Limestone (Limest)	Quad (Quad)	Sand (Sand)
H-bay	50	5		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	60	0	0	0	0	0	0	0	0	0
H-bay	50	8		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	20	0	30	0	0	0	0	0	0	0	0	0
H-bay	50	10		0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	20	0	0	25
H-bay	50	18		0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	60	0	25	0	0	0	0	0	0	0	0	0
H-bay	50	23		0	0	0	0	0	0	2	0	0	0	0	20	0	0	0	0	60	0	10	0	0	0	0	0	0	0	0	0
H-bay	50	29		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	50	0	0	20
H-bay	50	30		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0	40
H-bay	50	33		0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	50	10	20	0	0	0	0	0	0	0	0	0
H-bay	50	38		0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	40	30	15	0	0	0	0	0	0	0	0	0
H-bay	50	42		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	15	0	0	0	0	0	25	0	0	25
H-bay	35	0		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	15	15	0	40	0	0	0	0	0	0	0	0	0
H-bay	35	4		0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	15	0	0	44	0	0	0	0	0	0	0	0	1
H-bay	35	11		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	5	30	0	24	0	0	0	0	0	0	0	0	0
H-bay	35	20		0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	20	0	0	20
H-bay	35	34		0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	25	0	0	25	0	0	0	0	0	0	0	0	0
H-bay	35	35		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	10	10	40	0	0	0	0	0	0	0	0	0
H-bay	35	37		0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	30	0	20	20	0	0	0	0	0	0	0	0	0
H-bay	35	44		0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	5	70	0	0	0	0	0	0	0	0	0
H-bay	35	46		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	70	0	0	0	0	0	0	0	0	0
H-bay	35	47		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	10	0	50	0	0	0	0	0	0	0	0	0
H-bay	15	1		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	10	0	0	20	0	0	0	0	0	0	0	0	20
H-bay	15	2		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	50	0	0	0	0	0	0	0	0	0
H-bay	15	3		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	15	0	0	10	0	0	0	0	0	0	0	0	14
H-bay	15	6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	30
H-bay	15	11		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	5
H-bay	15	13		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	10	0	0	0	0	0	0	0	0	0
H-bay	15	32		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	25	0	0	0	0	0	0	0	0	0
H-bay	15	35		0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	20	0	0	50	0	0	0	0	0	0	0	0	0
H-bay	15	38		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	10	10	0	0	0	0	0	0	0	0	0
H-bay	15	40		0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	30	0	15	15	0	0	0	0	0	0	0	0	5

Site	Depth	Location	Sub-Categories	Inverts	Acanpla Acanthaster planci (Acanpla)	Actmaur Actinopyga mauritiana (Actmaur)	Actobe Actionopyga obesa (Actobe)	Chongig Chondrocidaris gigantea (Chongig)	Coloat Colobocentrotus atratus (Coloat)	Diapau Diadema paucispinum (Diapau)	Echmat Echinometra mathaei (Echmat)	Echobl Echinometra oblonga (Echobl)	Echinot Echinothrix species (Echinot)	Hemam Heterocentrotus mammillatus (Hemam)	Holatr Holothuria atra (Holatr)	Holwit Holothuria whitmaei (Holwit)	Ophio Ophiocomoa species (Ophio)	Ophspec Ophodesomoa spectabilis (Ophspec)	Spigig Spirobranchus giganteus (Spigig)	Sponge Sponge (Sponge)	Sponge Spirastrealla vagabunda	Palythoa tuberculosa
H-bay	50	5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	50	8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	50	10		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	50	18		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	50	23		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	50	29		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	50	30		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	50	33		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	50	38		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	50	42		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	35	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	35	4		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	35	11		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	35	20		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	35	34		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	35	35		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	35	37		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	35	44		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	35	46		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	35	47		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	15	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	15	2		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	15	3		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	15	6		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	15	11		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	15	13		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	15	32		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	15	35		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	15	38		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-bay	15	40		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Sub-Categories

Algae

Site	Depth	Location	Asptax	Caurac	Caulser	Caulsert	Codara	CCA	BG	Dasyir	Dichmar	Dictcav	Dictver	Dicty	Gibhaw	Halop	Lobvar	Marflab	Marfrag	Neoman	Padina	Porhor	Prewel	Sarg	Turbor	Turf	venven	
			Asparagopsis taxiformis (Asptax)	Caulerpa racemosa (Caurac)	Caulerpa serrulata (Caulser)	Caulerpa sertularioides (Caulsert)	Codium arabicum (Codara)	Crustose Coralline (CCA)	Cyanophyta (BG)	Dasya iridescens (Dasyir)	Dichotomaria marginata (Dichmar)	Dictyospaeria cavernosa (Dictcav)	Dictyosphaeria versluysii (Dictver)	Dictyota species (Dicty)	Gismithia hawaiiensis (Gibhaw)	Halimeda opuntia (Halop)	Lobophora variegata (Lobvar)	Martensia flabelliformis (Marflab)	Martensia fragilis (Marfrag)	Neomeris annulata (Neoman)	Padina species (Padina)	Portieria hornemanii (Porhor)	Predaea weldii (Prewel)	Sargassum (Sarg)	Turbinaria ornata (Turbor)	Turf (Turf)	Ventricaria ventricosa (venven)	green algae
H-bay	50	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39	0	0
H-bay	50	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	49	0	0
H-bay	50	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	48	0	0
H-bay	50	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0
H-bay	50	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0
H-bay	50	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	0	0
H-bay	50	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0
H-bay	50	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0
H-bay	50	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0
H-bay	50	42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0
H-bay	35	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	0	0
H-bay	35	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0
H-bay	35	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0
H-bay	35	20	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	0	0
H-bay	35	34	0	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0
H-bay	35	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0
H-bay	35	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0
H-bay	35	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	19	0	0
H-bay	35	46	0	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0
H-bay	35	47	0	0	0	0	0	10	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0
H-bay	15	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	49	0	0
H-bay	15	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0
H-bay	15	3	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0
H-bay	15	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	0	0
H-bay	15	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	85	0	0
H-bay	15	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80	0	0
H-bay	15	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	0	0
H-bay	15	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	0	0
H-bay	15	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	55	0	0
H-bay	15	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0

Site	Depth	Location	Sub-Categories	Coral	Cyphastrea agassizi (cypag)	Cyphastrea ocellina (cypoc)	Fungia scutaria (Funscu)	Leptastrea purpurea (Leppur)	Leptoseris incrustans (lepinc)	Montipora capitata (Moncap)	Montipora flabellata (Monfla)	Montipora patula (Monpat)	Montipora species (Monsp)	Pavona duerdeni (Pavdue)	Pavona varians (Pavvar)	Pocillopora damicornis (Pocdam)	Pocillopora eydouxi (Poceyd)	Pocillopora ligulata (Poclig)	Pocillopra meandrina (Pocmea)	Porites compressa (Porcom)	Porites evermanni (Porev)	Porites lobata (Porlob)	Porites rus	Tubastrea coccinea (Tubcoc)	Sarcothelia edmondsoni	Inorganics	Basalt (Basalt)	Rubble	Limestone (Limest)	Quad (Quad)	Sand (Sand)
					cypag	cypoc	Funscu	Leppur	lepinc	Moncap	Monfla	Monpat	Monsp	Pavdue	Pavvar	Pocdam	Poceyd	Poclig	Pocmea	Porcom	Porev	Porlob		Tubcoc			Basalt		Limest	Quad	Sand
Wawa	50	1		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	20	0	0	5	0	0	0	0	0	0	0	0	54
Wawa	50	8		0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0	5	0	0	0	0	10	0	0	0	46
Wawa	50	12		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	5	0	0	0	0	0	0	0	0	59
Wawa	50	14		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	15	0	0	0	0	0	0	0	0	20
Wawa	50	16		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	45	0	0	0	0	0	0	0	0	20
Wawa	50	17		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	15	0	0	0	15
Wawa	50	23		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	30
Wawa	50	28		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	10	0	0	0	0	0	0	0	0	40
Wawa	50	30		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	10	0	0	15	0	0	0	0	0	0	0	0	40
Wawa	50	38		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	44
Wawa	35	5		0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	12	0	0	11	0	0	0	0	0	0	0	0	25
Wawa	35	10		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	35
Wawa	35	16		0	0	0	0	0	0	20	0	5	0	0	0	0	0	0	10	0	0	20	0	0	0	0	0	0	0	0	20
Wawa	35	21		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Wawa	35	27		0	0	0	0	0	0	5	0	5	0	0	0	0	0	0	25	0	0	5	0	0	0	0	0	0	0	0	20
Wawa	35	29		0	0	0	0	0	0	10	0	5	0	0	0	0	0	0	10	0	0	25	0	0	0	0	0	0	0	0	15
Wawa	35	38		0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	10	0	0	15	0	0	0	0	0	0	0	0	30
Wawa	35	44		0	0	0	0	0	0	5	0	3	0	0	0	0	0	0	3	0	0	35	0	0	0	0	0	0	0	0	10
Wawa	35	45		0	0	0	0	0	0	8	0	8	0	0	0	0	0	0	15	8	0	35	0	0	0	0	0	0	0	0	10
Wawa	35	48		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	5	0	0	63
Wawa	15	2		0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	4	0	0	7	0	0	0	0	0	40	0	0	0
Wawa	15	5		0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	15	0	0	25	0	0	0	0	0	10	0	0	20
Wawa	15	8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	15	0	0	5	0	0	0	0	0	0
Wawa	15	9		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	10	0	0	3	0	0	0	0	0	35
Wawa	15	10		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	10
Wawa	15	11		0	0	0	0	15	0	0	0	5	0	0	0	0	0	0	20	0	0	10	0	0	5	0	0	0	0	0	0
Wawa	15	21		0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	25	0	0	20	0	0	0	0	0	0	0	0	0
Wawa	15	28		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	25	0	0	0	0	0	0	0	0	0
Wawa	15	32		0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	5	0	0	5	0	0	5	0	0	0	0	0	0
Wawa	15	43		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	10

Site	Depth	Location	Sub-Categories	Inverts	Acanpla Acanthaster planci (Acanpla)	Actmaur Actinopyga mauritiana (Actmaur)	Actobe Actionopyga obesa (Actobe)	Chongig Chondrocidaris gigantea (Chongig)	Coloat Colobocentrotus atratus (Coloat)	Diapau Diadema paucispinum (Diapau)	Echmat Echinometra mathaei (Echmat)	Echobl Echinometra oblonga (Echobl)	Echinot Echinothrix species (Echinot)	Hemam Heterocentrotus mammillatus (Hemam)	Holatr Holothuria atra (Holatr)	Holwit Holothuria whitmaei (Holwit)	Ophio Ophiocomoa species (Ophio)	Ophspec Ophodesomoa spectabilis (Ophspec)	Spigig Spirobranchus giganteus (Spigig)	Sponge Sponge (Sponge)	Sponge Spirastrealla vagabunda	Palythoa tuberculosa
Wawa	50	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	50	8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	50	12		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	50	14		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	50	16		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	50	17		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	50	23		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	50	28		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	50	30		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	50	38		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Wawa	35	5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Wawa	35	10		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Wawa	35	16		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Wawa	35	21		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	35	27		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
Wawa	35	29		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	35	38		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Wawa	35	44		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	35	45		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	35	48		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	15	2		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	15	5		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	15	8		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	15	9		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	15	10		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	15	11		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	15	21		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	15	28		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	15	32		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	15	43		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Site	Depth	Location	Sub-Categories	Algae	Asptax	Caurac	Caulser	Caulsert	Codara	CCA	BG	Dasyir	Dichmar	Dictcav	Dictver	Dicty	Gibhaw	Halop	Lobvar	Marflab	Marfrag	Neoman	Padina	Porhor	Prewel	Sarg	Turbor	Turf	venven	
					Asparagopsis taxiformis (Asptax)	Caulerpa racemosa (Caurac)	Caulerpa serrulata (Caulser)	Caulerpa sertularioides (Caulsert)	Codium arabicum (Codara)	Crustose Coralline (CCA)	Cyanophyta (BG)	Dasya iridescens (Dasyir)	Dichotomaria marginata (Dichmar)	Dictyospaeria cavernosa (Dictcav)	Dictyosphaeria versluysii (Dictver)	Dictyota species (Dicty)	Gismithia hawaiiensis (Gibhaw)	Halimeda opuntia (Halop)	Lobophora variegata (Lobvar)	Martensia flabelliformis (Marflab)	Martensia fragilis (Marfrag)	Neomeris annulata (Neoman)	Padina species (Padina)	Portieria hornemanii (Porhor)	Predaea weldii (Prewel)	Sargassum (Sarg)	Turbinaria ornata (Turbor)	Turf (Turf)	Ventricaria ventricosa (venven)	green algae
Wawa	50	1			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0
Wawa	50	8			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0
Wawa	50	12			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0
Wawa	50	14			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0
Wawa	50	16			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0
Wawa	50	17			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	65	0	0
Wawa	50	23			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	67	0	0
Wawa	50	28			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0
Wawa	50	30			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34	0	0
Wawa	50	38			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	48	0	0
Wawa	35	5			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41	0	0
Wawa	35	10			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	53	0	0
Wawa	35	16			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	0	0
Wawa	35	21			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wawa	35	27			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32	0	0
Wawa	35	29			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0
Wawa	35	38			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	0	0
Wawa	35	44			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39	0	0
Wawa	35	45			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0
Wawa	35	48			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0
Wawa	15	2			0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	0	0
Wawa	15	5			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0
Wawa	15	8			0	0	0	0	0	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0
Wawa	15	9			0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0
Wawa	15	10			0	0	0	0	0	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0
Wawa	15	11			0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0
Wawa	15	21			0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0
Wawa	15	28			0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0
Wawa	15	32			0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	0	0
Wawa	15	43			0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	75	0	0

Appendix B

Fish Biota Data Charts

WHALE Environmental Services LLC
www.whalees.com
P.O. Box 455, KAHUKU, HI 96731 808-294-9254

12 Pipe North **6/23/2015** **12:40**

50'

Species	Individuals	Size (cm)
A. nigrofuscus	2	8
A. nigrofuscus	4	9
A. nigrofuscus	1	11
A. nigrofuscus	1	13
C.strigosus	1	4
C.strigosus	1	5
C.strigosus	3	7
C.strigosus	3	8
C.strigosus	4	9
C.strigosus	2	10
C.strigosus	1	11
P.johnstonianus	1	7
P.johnstonianus	1	8
G.varius	1	12
G.varius	1	14
G.varius	1	18
C. ornatissimus	1	9
C. ornatissimus	1	12
S. bursa	1	18
C. sordidus	1	15
C. sordidus	1	17
C. sordidus	1	32
P.octotania	1	8
C. hanui	2	6
C. hanui	2	7
T.duperrey	1	8
Z.flavescens	1	5
Z.flavescens	1	9
Z.flavescens	1	12
Z.flavescens	1	13
Z.flavescens	1	14
Z.flavescens	1	15
C.multicinctus	5	8
C.multicinctus	2	11
P. arcatus	1	13
F. flavissimus	1	12
F. flavissimus	1	13
N. literatus	1	12
N. literatus	1	13
N. literatus	1	29
N. literatus	1	33
C.agilis	21	4
C.agilis	33	5
C.agilis	13	6
C.agilis	3	7
H. polylepis	8	14
H. polylepis	10	16
C. vanderbilti	5	4
P. spilosoma	1	11
P. tetrataenia	1	4
P. tetrataenia	1	6
H. ornatissimus	1	9
P. forsteri	1	18
Totals	158	11.58
	# of fish	average size

35'

Species	Individuals	Size (cm)
A. nigrofuscus	1	8
A. nigrofuscus	1	10
A. nigrofuscus	2	12
A. nigrofuscus	1	13
A. nigrofuscus	5	14
A. nigrofuscus	2	16
A. nigrofuscus	1	17
C. jactator	2	6
C. jactator	1	7
C. multicinctus	2	14
C. sordidus	1	19
C. sordidus	1	20
C. strigosus	1	6
C. strigosus	1	7
C. strigosus	1	11
C. strigosus	2	12
C. strigosus	3	13
C. strigosus	2	14
C. strigosus	6	15
C. strigosus	2	16
C. strigosus	2	17
C. strigosus	1	18
C. strigosus	1	19
C. vanderbilti	16	2
C. vanderbilti	60	3
C. vanderbilti	43	4
C. vanderbilti	15	5
F. flavissimus	1	19
F. flavissimus	1	22
P. arcatus	1	7
P. arcatus	1	9
P. arcatus	1	1
T. duperrey	1	5
T. duperrey	1	7
T. duperrey	2	8
T. duperrey	1	11
T. duperrey	1	12
T. duperrey	1	13
Z. flavescens	1	13
Z. flavescens	6	14
Z. flavescens	1	15
Z. flavescens	1	16
A. scriptus	1	44
P. tetrataenia	1	7
P. forsteri	1	17
C. unimaculatus	1	15
C. unimaculatus	1	16
A. olivaceus	1	31
S. bursa	1	19
	204	13.31
	# of fish	average size

15'

Species	Individuals	Size (cm)
A. nigrofuscus	1	7
A. nigrofuscus	2	8
A. nigrofuscus	4	9
A. nigrofuscus	5	10
A. nigrofuscus	5	11
A. nigrofuscus	5	12
A. nigrofuscus	3	13
A. nigrofuscus	3	14
C. multicinctus	1	8
C. multicinctus	1	9
C. sordidus	2	14
C. sordidus	1	17
C. sordidus	1	18
C. sordidus	1	22
C. strigosus	2	7
C. strigosus	2	8
C. strigosus	2	9
C. strigosus	5	10
C. strigosus	5	11
C. strigosus	7	12
C. strigosus	5	13
C. strigosus	11	14
C. strigosus	7	15
C. strigosus	5	16
C. strigosus	2	17
C. vanderbilti	5	2
C. vanderbilti	42	3
C. vanderbilti	29	4
P. multifasciatus	1	18
T. duperrey	1	5
T. duperrey	1	6
T. duperrey	1	8
T. duperrey	1	13
T. duperrey	2	14
Z. flavescens	2	9
Z. flavescens	2	10
Z. flavescens	2	11
Z. flavescens	2	12
Z. flavescens	4	13
Z. flavescens	5	14
Z. flavescens	1	15
Z. flavescens	2	16
Z. flavescens	1	17
P. tetrataenia	1	7
C. quadrimaculatus	1	14
A. achilles	1	9
A. achilles	1	11
A. nigricans	1	13
A. nigricans	2	15
A. nigricans	1	16
A. nigricans	1	19
C. gaimard	1	20
C. amboinensis	1	11
	203	12.10
	# of fish	average size

12 Pipe South 6/23/2015 15:00

50'

Species	Individuals	Size (cm)
A. nigrofuscus	1	7
A. nigrofuscus	2	8
A. nigrofuscus	10	9
A. nigrofuscus	4	10
A. nigrofuscus	5	11
A. nigrofuscus	3	12
A. nigrofuscus	4	13
C. agilis	72	4
C. agilis	84	5
C. agilis	51	6
C. multicinctus	1	6
C. multicinctus	1	8
C. sordidus	1	34
C. strigosus	2	5
C. strigosus	3	9
C. strigosus	6	11
C. strigosus	1	13
C. vanderbilti	60	2
C. vanderbilti	85	3
C. vanderbilti	62	4
F. flavissimus	1	9
F. flavissimus	1	10
G. varius	1	8
G. varius	1	11
L. phthirophagus	1	8
P. johnstonianus	1	7
P. johnstonianus	2	8
P. johnstonianus	1	9
P. arcatus	2	7
P. arcatus	1	11
P. multifasciatus	1	16
P. multifasciatus	1	18
P. octotania	1	7
P. octotania	1	11
S. bursa	1	16
S. bursa	1	20
T. duperrey	1	8
T. duperrey	1	9
T. duperrey	1	13
Z. flavescens	2	7
Z. flavescens	3	8
Z. flavescens	5	9
Z. flavescens	3	10
Z. flavescens	2	12
Z. flavescens	2	13
Z. flavescens	3	14
Z. flavescens	2	17
P. spilosoma	1	9
P. tetrataenia	1	7
P. forsteri	1	18
C. gaimard	1	18
C. argus	1	27
C. argus	1	26
C. kleinii	2	9
C. kleinii	2	9
Totals	509	11.13
	# of fish	average size

35'

Species	Individuals	Size (cm)
A. nigrofuscus	2	7
A. nigrofuscus	3	8
A. nigrofuscus	2	9
A. nigrofuscus	3	10
A. nigrofuscus	6	11
A. nigrofuscus	3	12
A. nigrofuscus	1	13
C. jactator	1	5
C. jactator	2	6
C. jactator	1	7
C. jactator	1	8
C. multicinctus	2	8
C. multicinctus	1	9
C. ornatissimus	1	17
C. sordidus	1	32
C. strigosus	3	7
C. strigosus	3	8
C. strigosus	1	9
C. strigosus	2	10
C. vanderbilti	72	2
C. vanderbilti	73	3
C. vanderbilti	72	4
F. flavissimus	1	14
L. phthirophagus	1	7
L. phthirophagus	1	8
P. arcatus	2	7
P. arcatus	1	8
P. arcatus	2	9
P. arcatus	1	10
P. arcatus	1	11
P. johnstonianus	1	3
P. johnstonianus	2	7
P. johnstonianus	1	8
P. octotania	2	8
T. duperrey	1	8
T. duperrey	2	14
T. duperrey	1	17
T. duperrey	1	19
Z. cornutus	1	12
Z. cornutus	12	14
Z. flavescens	1	3
Z. flavescens	1	4
Z. flavescens	1	7
Z. flavescens	1	10
Z. flavescens	1	12
H. ornatissimus	1	9
P. spilosoma	1	10
C. quadrimaculatus	2	13
C. gaimard	1	5
C. gaimard	1	8
O. unifasciatus	1	28
C. unimaculatus	1	7
C. unimaculatus	1	9
C. unimaculatus	1	10
C. unimaculatus	1	10
F. longirostris	1	14
	306	10.15
	# of fish	average size

15'

Species	Individuals	Size (cm)
A. nigrofuscus	1	6
A. nigrofuscus	1	9
A. nigrofuscus	1	10
A. nigrofuscus	3	11
A. nigrofuscus	4	12
A. nigrofuscus	3	13
C. jactator	1	5
C. jactator	1	6
C. jactator	1	7
C. multicinctus	2	9
C. multicinctus	1	10
C. ornatissimus	1	16
C. sordidus	1	10
C. sordidus	1	12
C. sordidus	1	16
C. sordidus	2	18
C. sordidus	1	19
C. strigosus	1	7
C. strigosus	4	9
C. strigosus	4	11
C. strigosus	4	12
C. strigosus	3	14
C. strigosus	2	15
C. vanderbilti	13	2
C. vanderbilti	22	3
C. vanderbilti	10	4
C. vanderbilti	1	5
N. literatus	1	26
N. literatus	1	31
P. arcatus	1	8
P. arcatus	1	11
P. johnstonianus	1	5
P. johnstonianus	1	8
T. duperrey	2	5
T. duperrey	3	9
T. duperrey	3	10
T. duperrey	4	12
T. duperrey	1	14
T. duperrey	3	16
T. duperrey	1	17
Z. cornutus	1	15
Z. flavescens	1	4
Z. flavescens	4	12
Z. flavescens	5	13
Z. flavescens	4	14
Z. flavescens	4	15
Z. flavescens	4	16
Z. flavescens	3	17
A.chinensis	1	52
H. ornatissimus	1	14
C. ornatissimus	1	16
C. quadrimaculatus	1	11
C. quadrimaculatus	2	13
C. gaimard	1	33
C. gaimard	1	33
M. kuntee	3	16
C. lunula	1	9
C. lunula	1	12
A. Abdominalis	4	13
S. marginatus	1	7
S. marginatus	2	8
O. meleagris	1	7
	159	12.67
	# of fish	average size

NPPE	6/23/2015	10:50
50'		
Species	Individuals	Size (cm)
A.nigrofuscus	1	5
A.nigrofuscus	2	6
A.nigrofuscus	2	8
A.nigrofuscus	2	9
A.nigrofuscus	1	11
A.nigrofuscus	1	12
C.strigosus	1	6
C.strigosus	2	7
C.strigosus	3	8
C.strigosus	1	9
P.johnstonianus	2	6
P.johnstonianus	2	7
H. polylepis	10	13
H. polylepis	10	14
H. polylepis	15	15
H. polylepis	5	16
G.varius	1	9
G.varius	1	12
C.ornatissimus	1	16
C.ornatissimus	1	19
C. potteri	1	12
S. bursa	1	12
S. bursa	1	14
S. bursa	1	16
C. sordidus	1	14
P.octotania	1	11
C. hanui	1	4
C. hanui	1	5
C. hanui	2	7
T.duperrey	1	9
Z.flavescens	1	4
Z.flavescens	5	5
Z.flavescens	2	6
Z.flavescens	2	7
Z.flavescens	1	8
Z.flavescens	1	9
Z.flavescens	1	14
Z.flavescens	1	15
C.multicinctus	1	6
C.multicinctus	1	7
C.multicinctus	2	11
M. vidua	1	23
M. vidua	1	26
P. arcatus	1	11
Z. veliferum	1	11
F. flavissimus	1	16
F. flavissimus	1	17
N. literatus	2	12
N. literatus	1	18
C.agilis	40	4
C.agilis	97	5
C.agilis	55	6
Z. cornutus	1	14
A.chinensis	1	47
Totals	296	11.58
	# of fish	average size

35'		
Species	Individuals	Size (cm)
A.nigrofuscus	1	8
A.nigrofuscus	2	9
A.nigrofuscus	1	10
A.nigrofuscus	1	11
A.nigrofuscus	3	12
A.nigrofuscus	1	13
C.strigosus	2	6
C.strigosus	1	7
C.strigosus	4	8
C.strigosus	1	9
C.strigosus	1	10
C.strigosus	1	12
C.strigosus	1	13
P.johnstonianus	1	8
P.johnstonianus	1	9
C. jactator	1	6
C. jactator	1	7
C. quadrimaculatus	1	12
C. vanderbilti	1	12
C. potteri	1	9
C. sordidus	1	29
C. hanui	1	6
T.duperrey	1	6
T.duperrey	1	7
T.duperrey	1	14
T.duperrey	1	16
Z.flavescens	1	12
Z.flavescens	1	13
C. vanderbilti	12	2
C. vanderbilti	19	3
C. vanderbilti	20	4
C. vanderbilti	5	5
C.multicinctus	1	11
C.multicinctus	1	12
P. arcatus	1	7
P. arcatus	1	9
P. arcatus	1	13
P. arcatus	1	14
F. flavissimus	1	18
N. literatus	1	37
C. agilis	6	5
C.agilis	4	6
C.agilis	1	7
A.chinensis	1	43
	111	11.40
	# of fish	average size

15'		
Species	Individuals	Size (cm)
A.nigrofuscus	4	8
A.nigrofuscus	4	9
A.nigrofuscus	8	10
A.nigrofuscus	4	11
A.nigrofuscus	7	12
A.nigrofuscus	6	13
A.nigrofuscus	12	14
C.strigosus	3	8
C.strigosus	2	9
C.strigosus	2	10
G.varius	1	6
G.varius	2	7
G.varius	1	8
G.varius	1	10
G.varius	1	12
G.varius	1	13
C.ornatissimus	1	19
S. bursa	1	16
S. bursa	1	21
T.duperrey	2	6
T.duperrey	1	7
T.duperrey	1	8
T.duperrey	2	9
T.duperrey	1	10
T.duperrey	1	12
Z.flavescens	2	9
Z.flavescens	2	10
Z.flavescens	2	11
Z.flavescens	3	12
Z.flavescens	3	13
Z.flavescens	1	14
Z.flavescens	1	15
C.multicinctus	1	12
C.multicinctus	1	13
P. arcatus	1	6
P. arcatus	1	8
P. arcatus	1	9
C. vanderbilti	5	2
C. vanderbilti	14	3
C. vanderbilti	33	4
L. phthirophagus	1	5
C. sordidus	1	22
C. sordidus	1	28
C. jactator	1	6
P. multifasciatus	1	16
C.hawaiiensis	1	22
C.hawaiiensis	1	24
M. niger	1	19
M. niger	2	20
M. niger	5	22
M. niger	1	24
M. niger	2	25
H. ornatissimus	1	6
H. ornatissimus	1	9
P. ewaensis	1	5
P. ewaensis	1	6
C. ornatissimus	2	13
A. scriptus	1	42
A. scriptus	2	46
	168	13.26
	# of fish	average size

18	6/24/2015	8:00

50'

Species	Individuals	Size (cm)
A. nigrofuscus	6	4
A. nigrofuscus	6	5
A. nigrofuscus	14	7
A. nigrofuscus	14	8
A. nigrofuscus	6	9
A. nigrofuscus	5	11
A. nigrofuscus	5	13
C. jactator	1	5
C. multicinctus	1	6
C. multicinctus	1	8
C. multicinctus	3	9
C. multicinctus	1	11
C. sordidus	1	21
C. sordidus	1	30
C. strigosus	1	3
C. strigosus	2	4
C. strigosus	1	5
C. strigosus	2	6
C. strigosus	3	8
C. strigosus	3	10
C. strigosus	4	12
C. vanderbilti	44	2
C. vanderbilti	49	3
C. vanderbilti	45	4
F. flavissimus	1	11
F. flavissimus	1	13
G. varius	1	5
G. varius	1	7
L. phthirophagus	1	6
P. arcatus	5	5
P. arcatus	2	9
P. johnstonianus	2	7
P. johnstonianus	1	8
P. multifasciatus	1	16
P. octotania	1	6
P. octotania	1	7
P. octotania	2	8
P. octotania	1	9
S. bursa	1	17
T. duperrey	1	6
T. duperrey	1	11
T. duperrey	1	12
T. duperrey	1	18
Z. cornutus	1	15
Z. flavescens	1	4
Z. flavescens	1	5
Z. flavescens	1	7
Z. flavescens	1	9
P. tetrataenia	2	6
H. ornatissimus	1	9
H. ornatissimus	1	10
H. ornatissimus	1	13
C. gaimard	1	6
C. argus	1	34
C. agilis	6	5
C. agilis	1	6
A. chinensis	1	21
O. unifasciatus	1	26
C. potteri	1	8
A. olivaceus	1	30
A. olivaceus	1	33
C. ornatissimus	1	14
N. hexacanthus	23	36
P. evanidus	1	4
P. evanidus	1	6
P. evanidus	1	7
Totals	296	10.75
	# of fish	average size

35'

Species	Individuals	Size (cm)
A. nigrofuscus	1	4
A. nigrofuscus	7	5
A. nigrofuscus	4	6
A. nigrofuscus	5	7
A. nigrofuscus	7	8
A. nigrofuscus	6	9
A. nigrofuscus	9	10
A. nigrofuscus	9	11
A. nigrofuscus	7	12
A. nigrofuscus	5	13
C. multicinctus	1	3
C. multicinctus	2	7
C. multicinctus	1	8
C. multicinctus	3	9
C. multicinctus	1	10
C. strigosus	1	4
C. strigosus	2	5
C. strigosus	3	6
C. strigosus	3	7
C. strigosus	4	9
C. strigosus	6	11
C. strigosus	4	13
C. strigosus	2	14
C. vanderbilti	63	2
C. vanderbilti	64	3
C. vanderbilti	20	4
G. varius	1	11
P. arcatus	1	7
P. arcatus	1	10
P. arcatus	1	12
P. johnstonianus	1	8
P. multifasciatus	1	18
S. bursa	1	18
T. duperrey	1	7
T. duperrey	1	9
T. duperrey	3	10
T. duperrey	1	15
T. duperrey	1	18
T. duperrey	1	20
Z. cornutus	1	18
Z. flavescens	5	9
Z. flavescens	6	11
Z. flavescens	8	13
Z. flavescens	7	14
Z. flavescens	7	15
P. tetrataenia	1	4
P. tetrataenia	1	5
P. tetrataenia	1	6
P. tetrataenia	1	7
C. agilis	4	5
C. agilis	1	6
N. literatus	1	28
N. literatus	1	31
N. literatus	1	32
O. unifasciatus	1	26
C. ornatissimus	1	14
F. longirostris	1	10
P. evanidus	1	6
P. forsteri	1	17
C. quadrimaculatus	1	10
C. miliaris	2	11
H. tompsoni	2	20
H. tompsoni	1	24
H. tompsoni	2	26
H. tompsoni	1	28
	315	11.86
	# of fish	average size

15'

Species	Individuals	Size (cm)
A. nigrofuscus	5	7
A. nigrofuscus	8	9
A. nigrofuscus	7	11
A. nigrofuscus	8	12
A. nigrofuscus	3	14
A. nigrofuscus	3	15
A.chinensis	1	56
C. hawaiiensis	2	26
C. hawaiiensis	2	28
C. hawaiiensis	1	32
C. multicinctus	1	9
C. multicinctus	1	11
C. ornatissimus	1	17
C. sordidus	1	19
C. sordidus	1	22
C. sordidus	8	8
C. sordidus	7	9
C. strigosus	7	10
C. strigosus	7	12
C. strigosus	7	14
C. vanderbilti	35	2
C. vanderbilti	56	3
F. flavissimus	1	13
M. vidua	1	28
N. literatus	1	24
P. arcatus	1	12
S. bursa	1	21
S. bursa	1	6
S. bursa	2	7
T. duperrey	1	8
T. duperrey	1	13
T. duperrey	1	17
T. duperrey	3	12
Z. flavescens	5	13
Z. flavescens	6	14
Z. flavescens	5	15
Z. flavescens	5	16
Z. flavescens	2	17
Z. cornutus	1	17
Z. cornutus	1	18
M. niger	6	17
M. niger	6	19
M. niger	7	21
M. niger	7	23
M. niger	6	24
M. niger	1	25
M. niger	1	27
C. dumerilii	1	31
H. ornatissimus	1	5
P. forsteri	1	6
C. lunula	1	14
C. lunula	1	15
A. olivaceus	1	28
C. quadrimaculatus	1	17
A. Abdominalis	2	14
C. miliaris	2	13
C. miliaris	1	14
A. leucopareius	3	15
A. leucopareius	4	16
A. leucopareius	3	17
C. reticulatus	2	12
A. guttatus	1	17
A. blochii	1	27
K. cinerascens	1	36
	272	16.98
	# of fish	average size

Haona Bay **6/23/2015** **9:00**

50'

Species	Individuals	Size (cm)
A.nigrofuscus	1	8
A.nigrofuscus	1	10
A.nigrofuscus	1	11
A.nigrofuscus	2	12
C.potteri	1	11
C.agilis	7	2
C.agilis	13	3
C.agilis	8	4
C.agilis	15	5
C.agilis	20	6
C.hawaiiensis	1	13
C.strigosus	1	8
C.strigosus	1	12
C.strigosus	3	14
C.strigosus	1	15
D.albisella	6	8
D.albisella	1	9
D.albisella	3	10
D.albisella	1	11
D.albisella	1	12
G.varius	1	16
L. phthyrophagus	1	7
M.kuntee	41	14
M.kuntee	45	16
M.kuntee	45	18
N.literatus	1	11
N.literatus	1	12
O.unifaciatus	1	21
P.johnstonianus	1	7
P.johnstonianus	1	9
P.octotania	1	9
T.duperrey	1	18
Z.flavescens	1	3
Z.flavescens	2	4
Z.flavescens	1	5
Z.flavescens	1	7
Z.flavescens	3	8
Totals	236	10.25
	# of fish	average size

35'

Species	Individuals	Size (cm)
A.nigrofuscus	1	5
A.nigrofuscus	2	6
A.nigrofuscus	2	8
A.nigrofuscus	1	9
A.nigrofuscus	3	10
A.nigrofuscus	3	12
A.nigrofuscus	1	13
C. vanderbilti	1	8
C.agilis	3	3
C.agilis	4	4
C.agilis	12	5
C.agilis	11	6
C.multicinctus	2	10
C.quadrimaculatus	1	12
C.quadrimaculatus	1	13
C.strigosus	1	3
C.strigosus	1	5
C.strigosus	1	7
C.strigosus	5	8
C.strigosus	9	9
C.strigosus	2	10
C.strigosus	1	12
D.albisella	4	10
D.albisella	3	11
G.varius	1	11
H. ornatissimus	1	11
M.kuntee	6	15
M.kuntee	10	16
N.literatus	1	9
N.literatus	1	10
N.literatus	1	12
N.literatus	1	13
N.literatus	1	15
N.literatus	1	18
N. unicornus	1	15
O.unifaciatus	1	20
P.johnstonianus	1	6
P.johnstonianus	1	7
P. arcatus	2	6
P. arcatus	1	8
P. arcatus	1	9
P. multifasciatus	1	21
S. bursa	1	17
T.duperrey	2	16
T.duperrey	1	17
C. sordidus	3	12
C. sordidus	4	13
N. sammara	1	16
Z.flavescens	1	3
Z.flavescens	3	4
Z.flavescens	1	6
Z.flavescens	2	7
Z.flavescens	2	9
Z.flavescens	1	11
Z.flavescens	1	12
	131	10.44
	# of fish	average size

15'

Species	Individuals	Size (cm)
A.nigrofuscus	1	9
A.nigrofuscus	8	11
A.nigrofuscus	11	12
A.nigrofuscus	4	13
A.nigrofuscus	13	14
C. vanderbiliti	63	3
C. vanderbiliti	40	4
C. vanderbiliti	20	5
C.hawaiiensis	1	16
C.hawaiiensis	1	19
C.hawaiiensis	1	20
C.hawaiiensis	1	21
C.strigosus	18	3
C.strigosus	2	8
C.strigosus	8	9
C.strigosus	4	12
G.varius	1	9
G.varius	1	12
C.ornatissimus	1	16
P. multifasciatus	1	13
S. bursa	1	7
C. quadrimaculatus	2	13
C. sordidus	2	10
C. sordidus	4	12
C. sordidus	1	13
C. sordidus	1	15
C. sordidus	1	18
C. sordidus	1	28
T.duperrey	1	5
T.duperrey	1	6
T.duperrey	1	7
T.duperrey	2	9
T.duperrey	1	11
T.duperrey	2	12
Z.flavescens	3	12
Z.flavescens	1	13
Z.flavescens	5	14
Z.flavescens	1	15
Z.flavescens	1	16
C.multicinctus	1	10
C.multicinctus	1	11
C.multicinctus	2	12
A. leucopareius	3	16
M. vidua	1	22
P. arcatus	1	7
P. arcatus	1	12
F. flavissimus	2	15
C. carolinus	1	26
C. carolinus	1	17
	246	12.77
	# of fish	average size

Wawa	6/24/2015	10:00									
50'				35'				15'			
Species	**Individuals**	**Size (cm)**	**Length mm**	**Species**	**Individuals**	**Size (cm)**	**Length mm**	**Species**	**Individuals**	**Size (cm)**	**Length mm**
A. nigrofuscus	3	3	30	*A. nigrofuscus*	2	6	60	*A. nigrofuscus*	21	12	120
A. nigrofuscus	17	5	50	*A. nigrofuscus*	3	7	70	*A. nigrofuscus*	2	15	150
A. nigrofuscus	5	6	60	*A. nigrofuscus*	3	8	80	*C. strigosus*	1	5	50
A. nigrofuscus	1	7	70	*A. nigrofuscus*	2	9	90	*C. quadrimaculatus*	1	9	90
A. nigrofuscus	1	9	90	*A. nigrofuscus*	1	10	100	*A. leucopareius*	1	16	160
C. agilis	1	5	50	*C. strigosus*	1	6	60	*C. vanderbilti*	26	2	20
C. agilis	1	6	60	*C. strigosus*	2	7	70	*C. vanderbilti*	31	3	30
C. multicinctus	1	4	40	*C. strigosus*	1	8	80	*T. duperrey*	2	4	40
C. potteri	1	3	30	*C. vanderbilti*	24	2	20	*T. duperrey*	2	6	60
C. potteri	1	6	60	*C. vanderbilti*	22	3	30	*T. duperrey*	2	7	70
C. strigosus	6	3	30	*C. vanderbilti*	14	4	40	*T. duperrey*	1	8	80
C. strigosus	1	4	40	*P. arcatus*	1	7	70	*T. duperrey*	1	12	120
C. strigosus	2	5	50	*P. arcatus*	2	8	80	*Z. flavescens*	6	14	140
C. vanderbilti	128	2	20	*P. arcatus*	1	10	100	*H. ornatissimus*	1	10	100
C. vanderbilti	30	3	30	*T. duperrey*	1	8	80	*H. ornatissimus*	1	12	120
L. phthirophagus	1	5	50	*T. duperrey*	1	10	100	*C. hawaiiensis*	1	23	230
C. hanui	1	5	50	*T. duperrey*	3	12	120	*C. unimaculatus*	3	10	100
P. arcatus	1	6	60	*Z. flavescens*	1	8	80	*G. varius*	1	10	100
P. arcatus	2	7	70	*Z. flavescens*	1	9	90	*P. johnstonianus*	1	5	50
P. arcatus	2	8	80	*Z. flavescens*	1	12	120	*C. sordidus*	1	21	210
P. arcatus	1	9	90	*H. ornatissimus*	2	8	80	*C. sordidus*	1	24	240
P. arcatus	1	10	100	*H. ornatissimus*	2	10	100	*N. literatus*	4	24	240
P. arcatus	2	11	110	*A. olivaceus*	2	28	280	*N. literatus*	1	28	280
P. arcatus	1	12	120	*A. olivaceus*	1	31	310	*N. literatus*	1	30	300
P. octotania	1	5	50	*G. varius*	1	9	90	*N. literatus*	1	34	340
P. octotania	1	6	60	*Z. cornutus*	1	18	180	*N. literatus*	1	36	360
S. bursa	1	17	170	*P. forsteri*	1	11	110	*C. ornatissimus*	1	10	100
T. duperrey	1	10	100	*M. vidua*	1	26	260	*C. ornatissimus*	2	11	110
Z. flavescens	1	4	40	*C. jactator*	1	7	70	*C. ornatissimus*	2	12	120
Z. flavescens	1	5	50					*C. ornatissimus*	2	15	150
P. ewaensis	1	4	40					*M. niger*	1	28	280
P. tetrataenia	3	4	40					*C. multicinctus*	2	10	100
P. tetrataenia	1	5	50					*C. lunula*	1	13	130
H. ornatissimus	2	5	50					*P. ewaensis*	2	4	40
H. ornatissimus	1	7	70					*C. dumerilii*	1	30	300
A. olivaceus	1	24	240					*S. marginatus*	1	7	70
A. olivaceus	1	27	270					*R. rectangulus*	1	18	180
A. olivaceus	1	28	280								
P. evanidus	1	3	30								
P. evanidus	4	5	50								
P. evanidus	1	6	60								
P. evanidus	3	7	70								
B. albotaeniatus	1	5	50								
Totals	238	7.47	3210		3455	7.02	3020		131	12.51	5380
	# of fish	average size			# of fish	average size			# of fish	average size	

Appendix C

Coral Benthic PhotoQuadrants

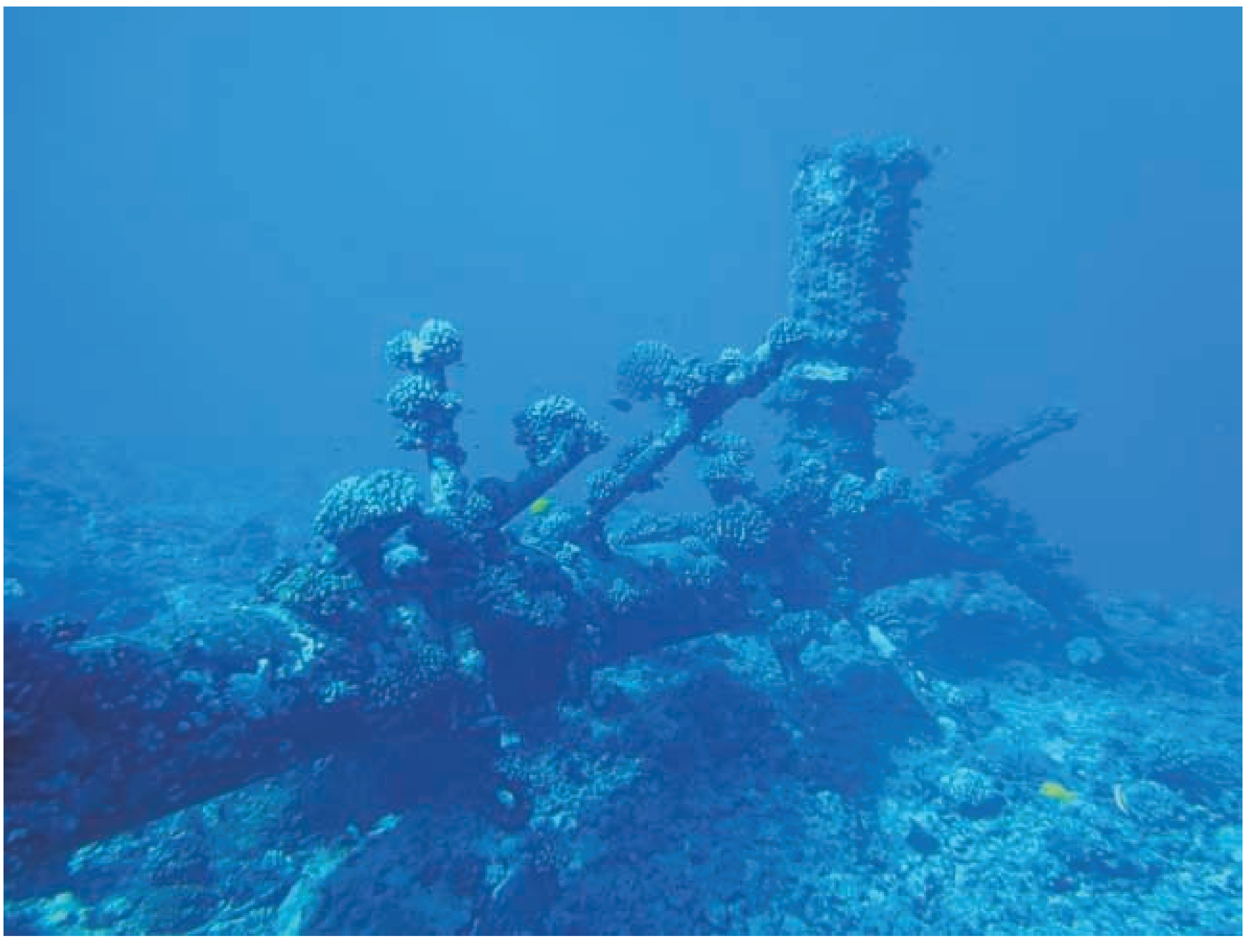
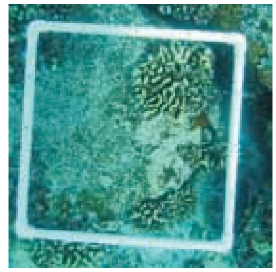
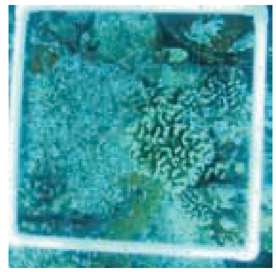
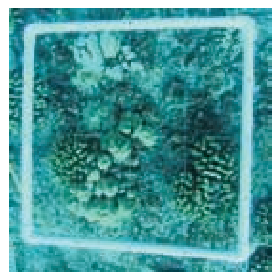
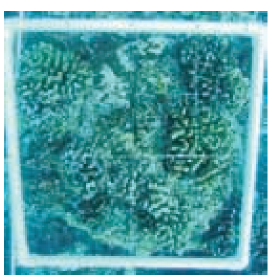


Photo-Quadrants 12" Pipe South - 15 feet



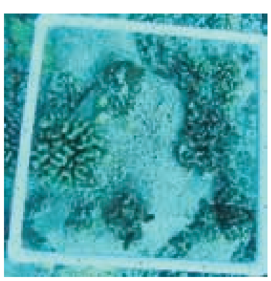
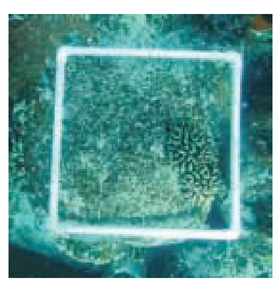



Photo-Quadrants 12" Pipe South - 35 feet

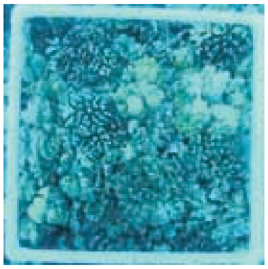
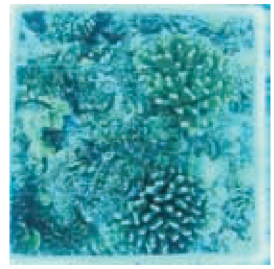
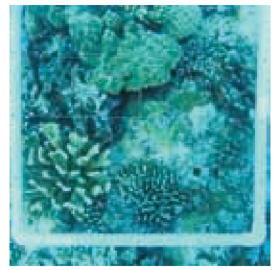
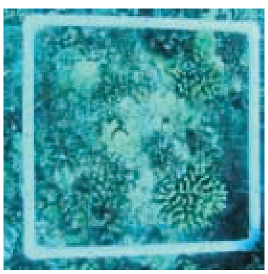
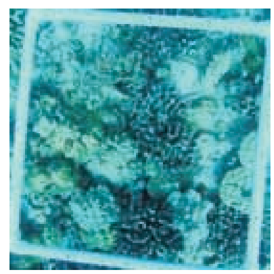
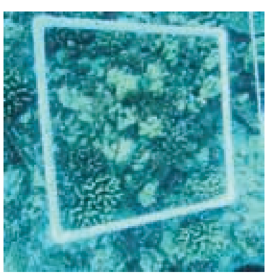
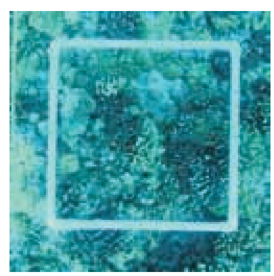
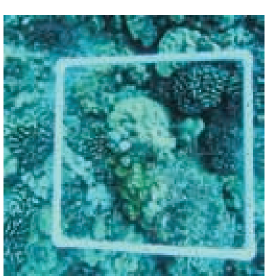
	
	
	
	
	

Photo-Quadrants 12" Pipe South - 50 feet

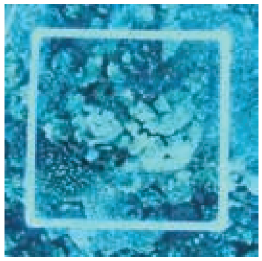
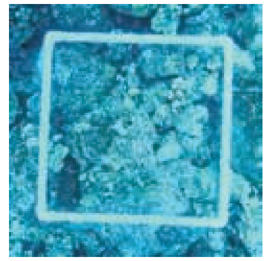
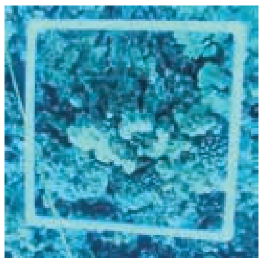
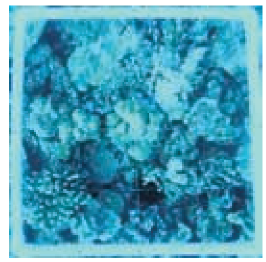
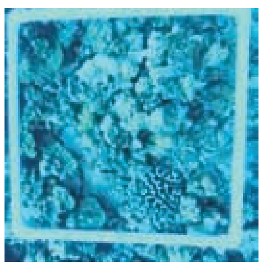
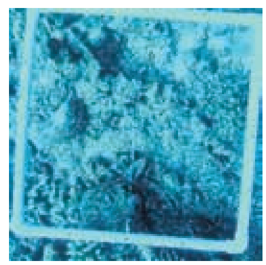
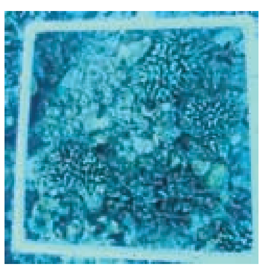
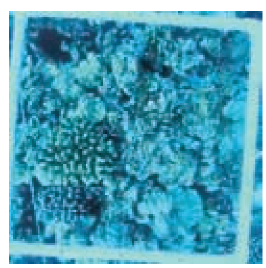
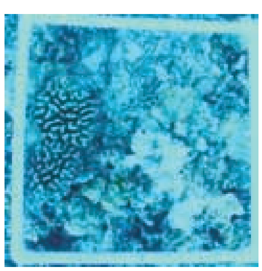
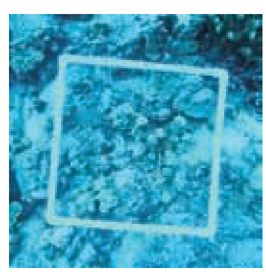
	
	
	
	
	

Photo-Quadrants

12" Pipe North - 15 feet

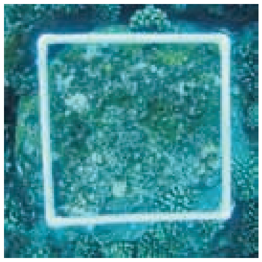
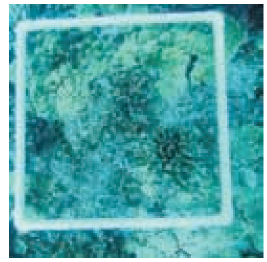
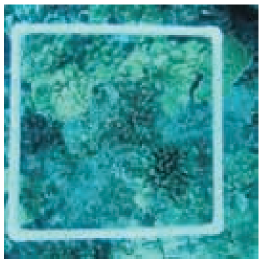
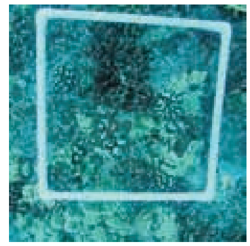
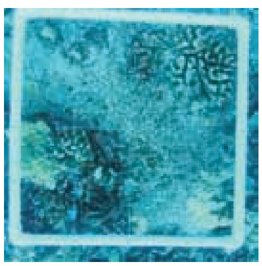
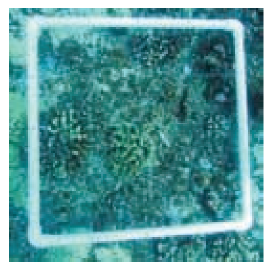
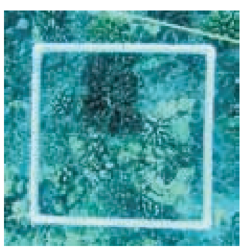
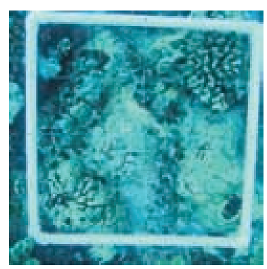
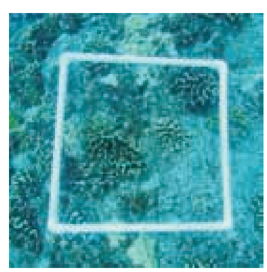
	
	
	
	
	

Photo-Quadrants 12” Pipe North - 35 feet

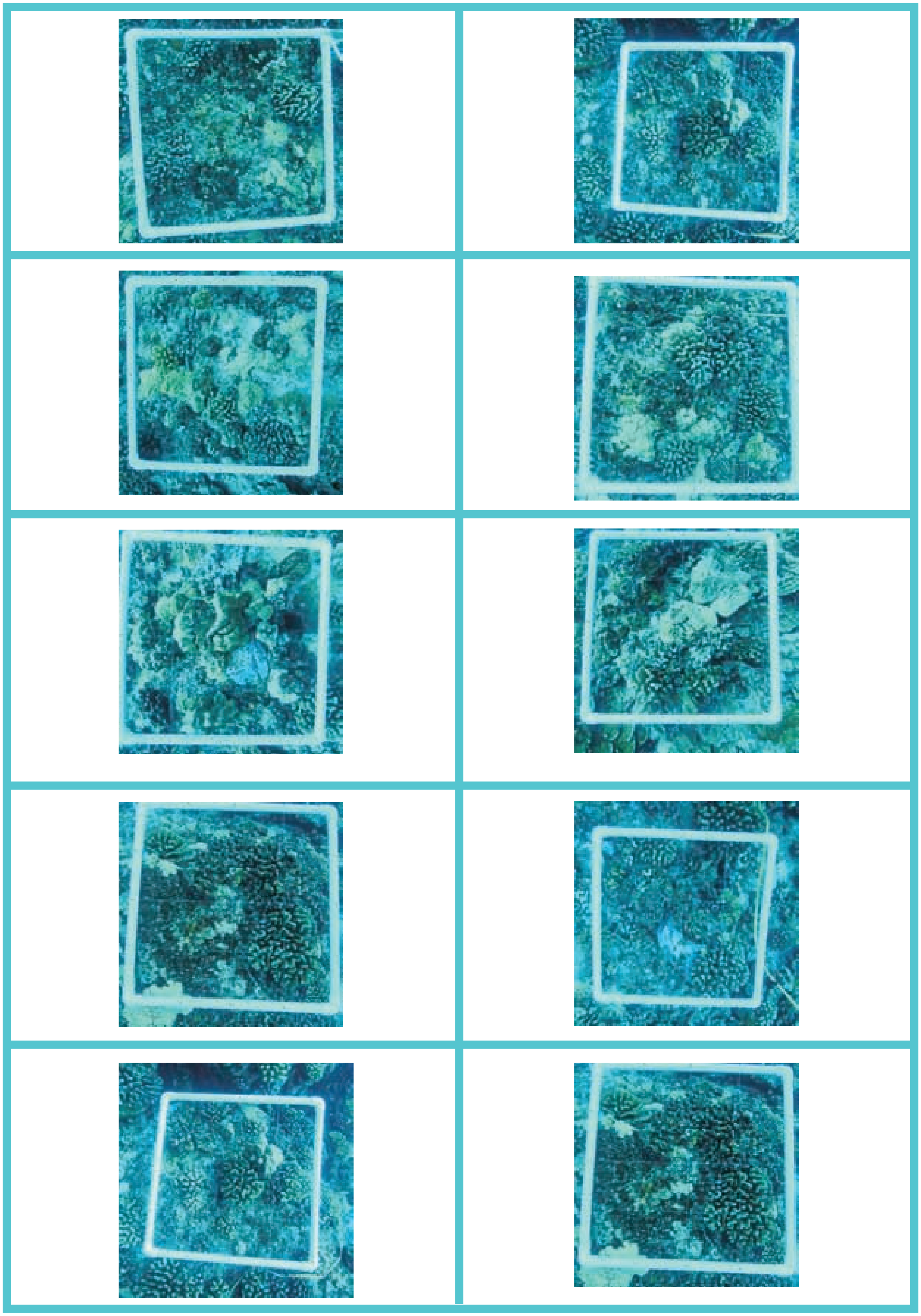


Photo-Quadrants 12” Pipe North - 50 feet

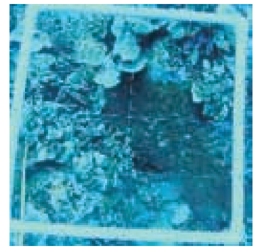
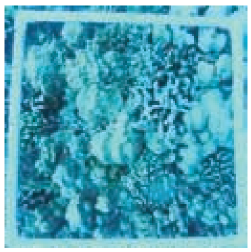
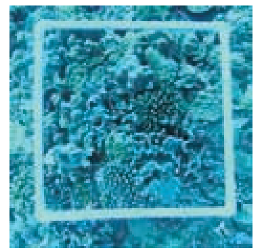
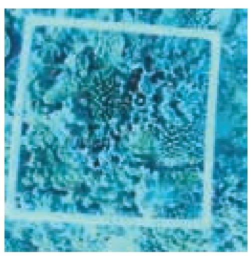
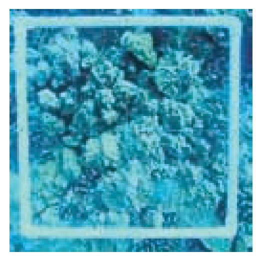
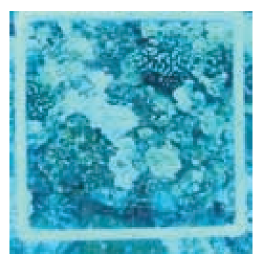
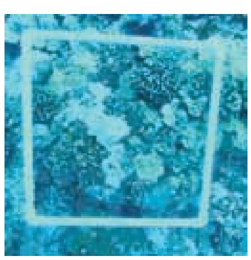
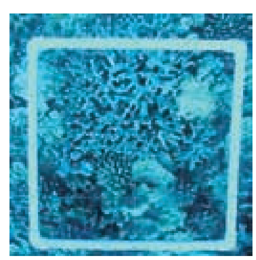
	
	
	
	
	

Photo-Quadrants 18" Pipe - 15 feet

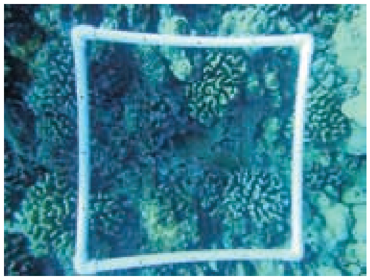
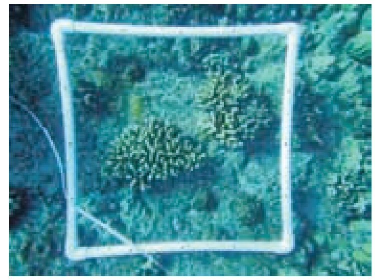
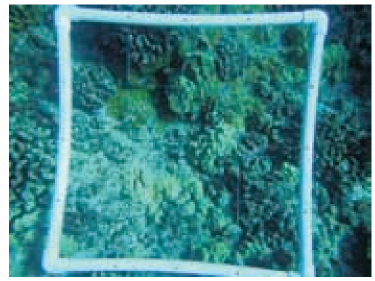
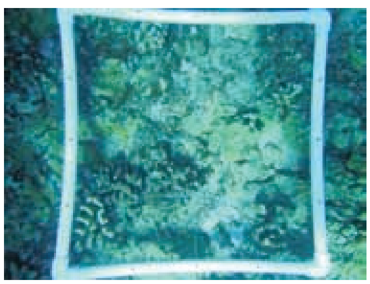
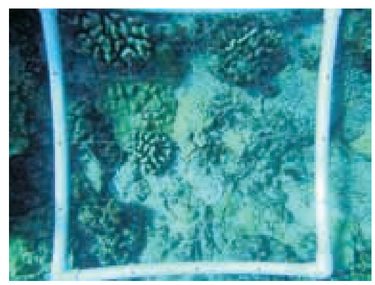
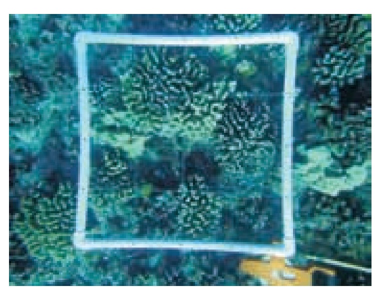
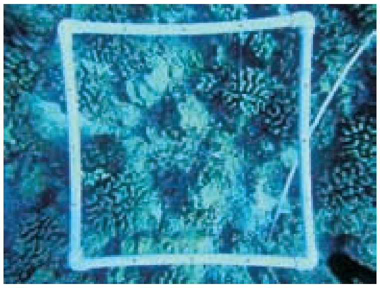
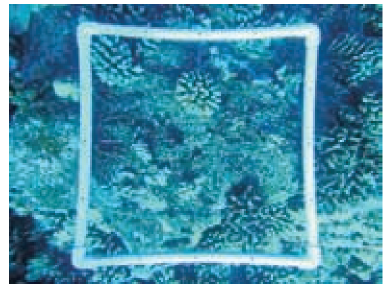
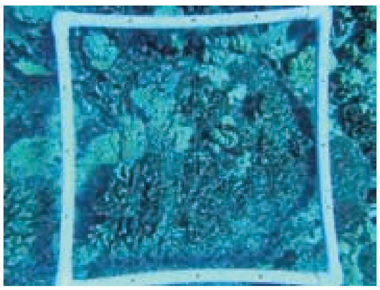
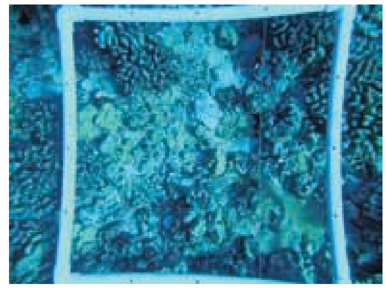
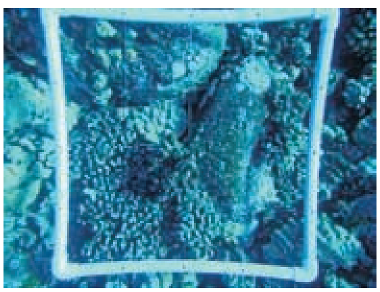
	
	
	
	
	

Photo-Quadrants 18” Pipe - 35 feet

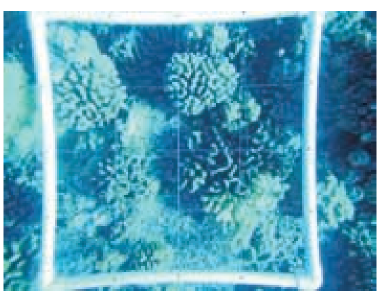
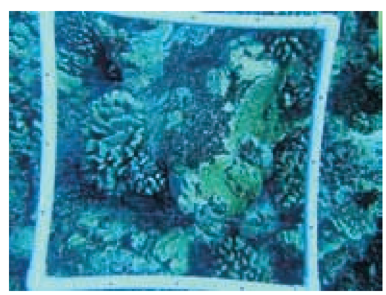
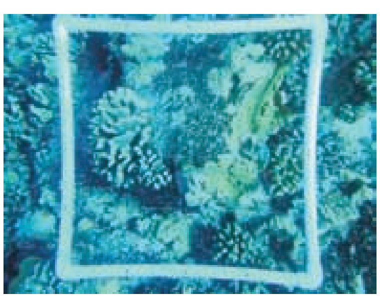
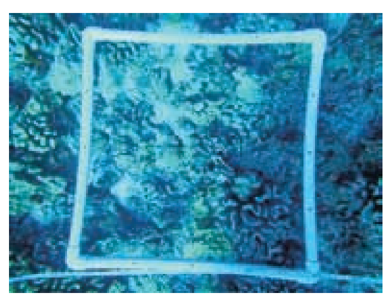
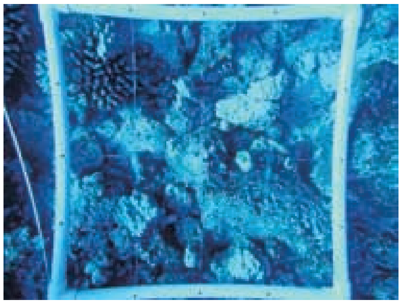
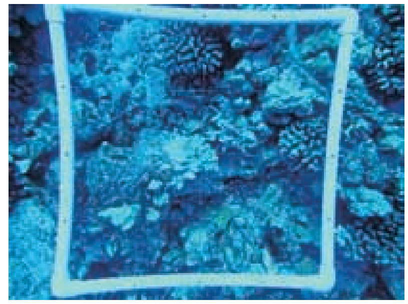
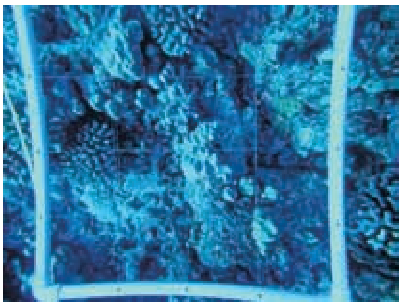
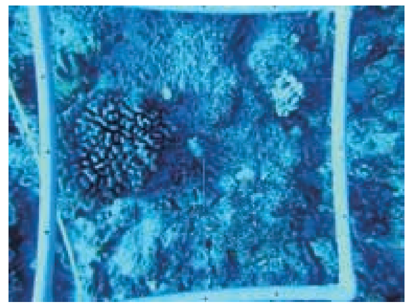
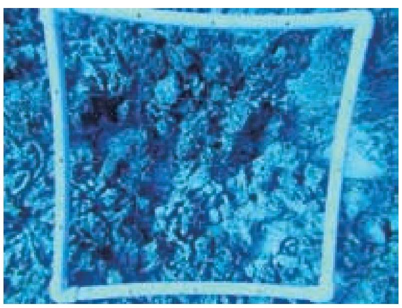
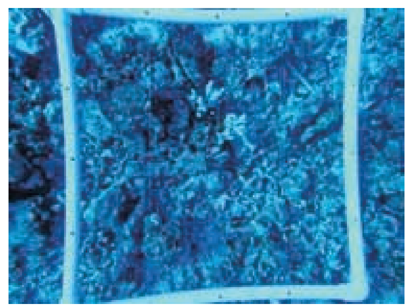





Photo-Quadrants 18" Pipe - 50 feet

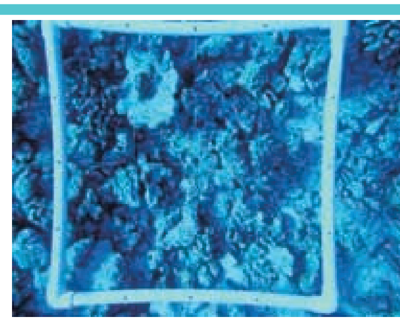
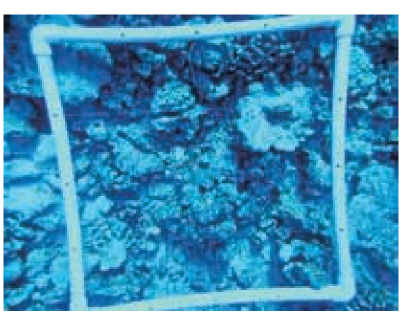
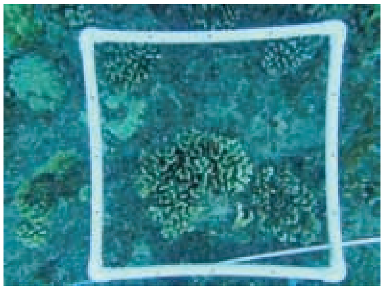
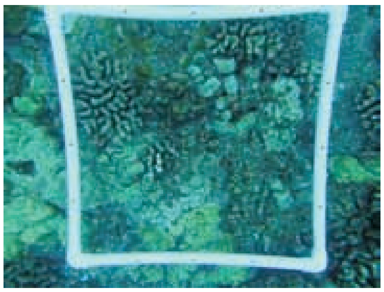
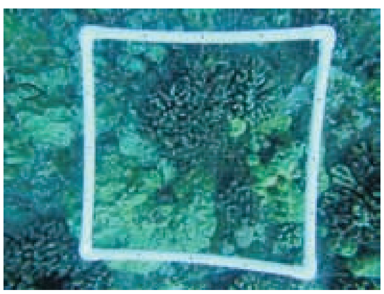
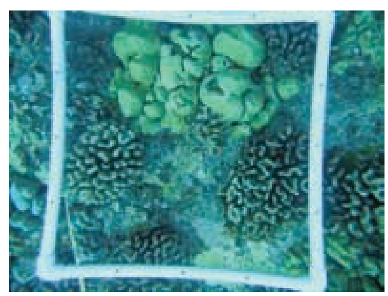




Photo-Quadrants NPPE - 15 feet







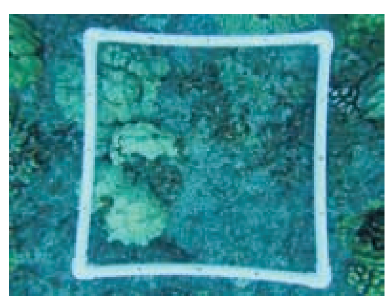


Photo-Quadrants NPPE - 35 feet

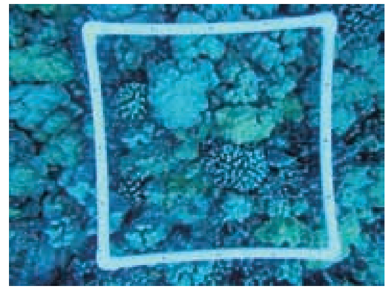
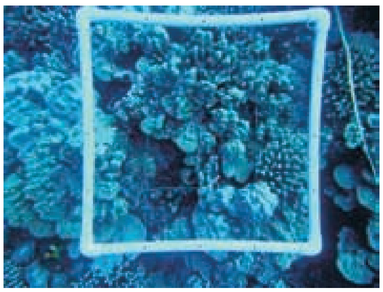
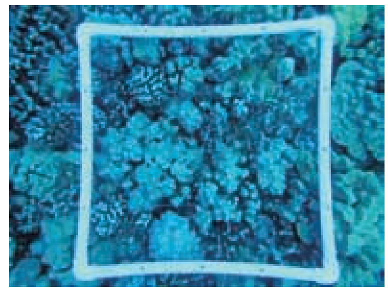
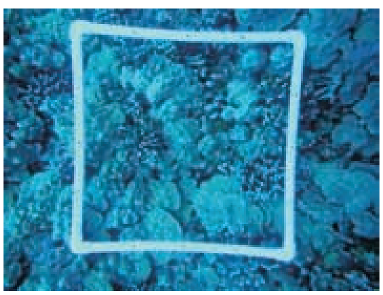
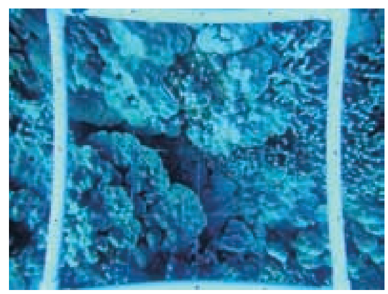
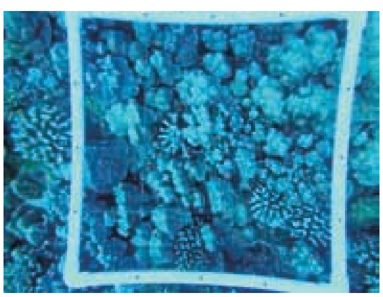
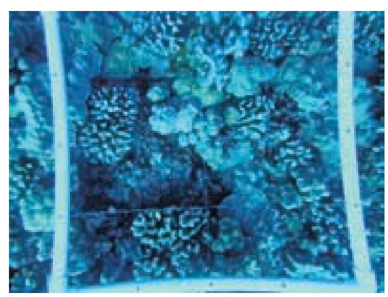
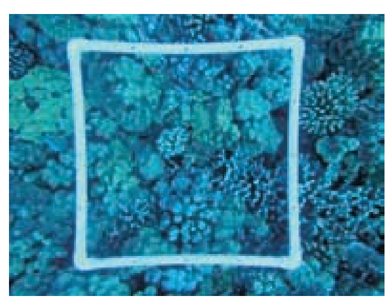
	
	
	
	
	

Photo-Quadrants NPPE - 50 feet

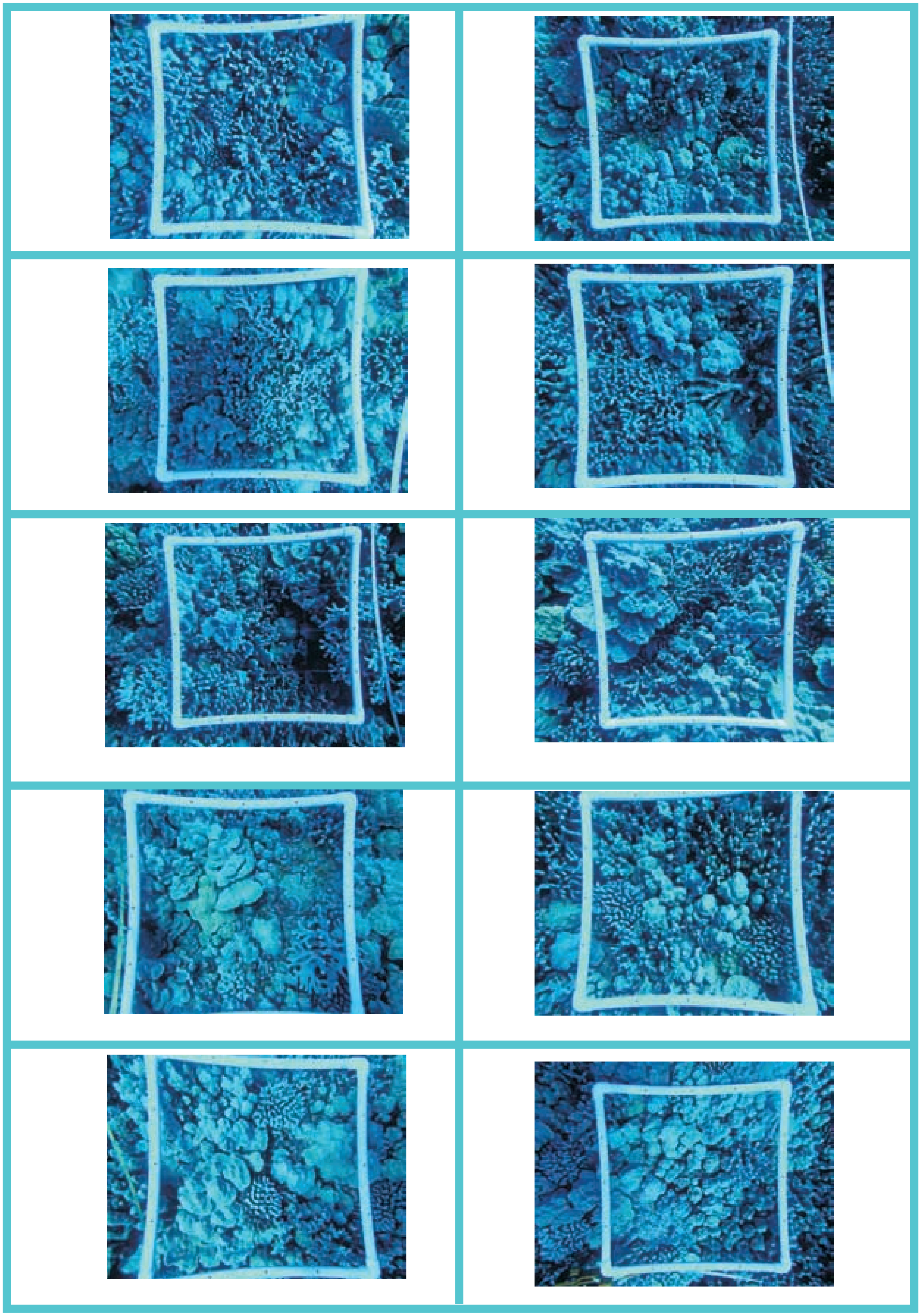


Photo-Quadrants Ho`ona Bay - 15 feet

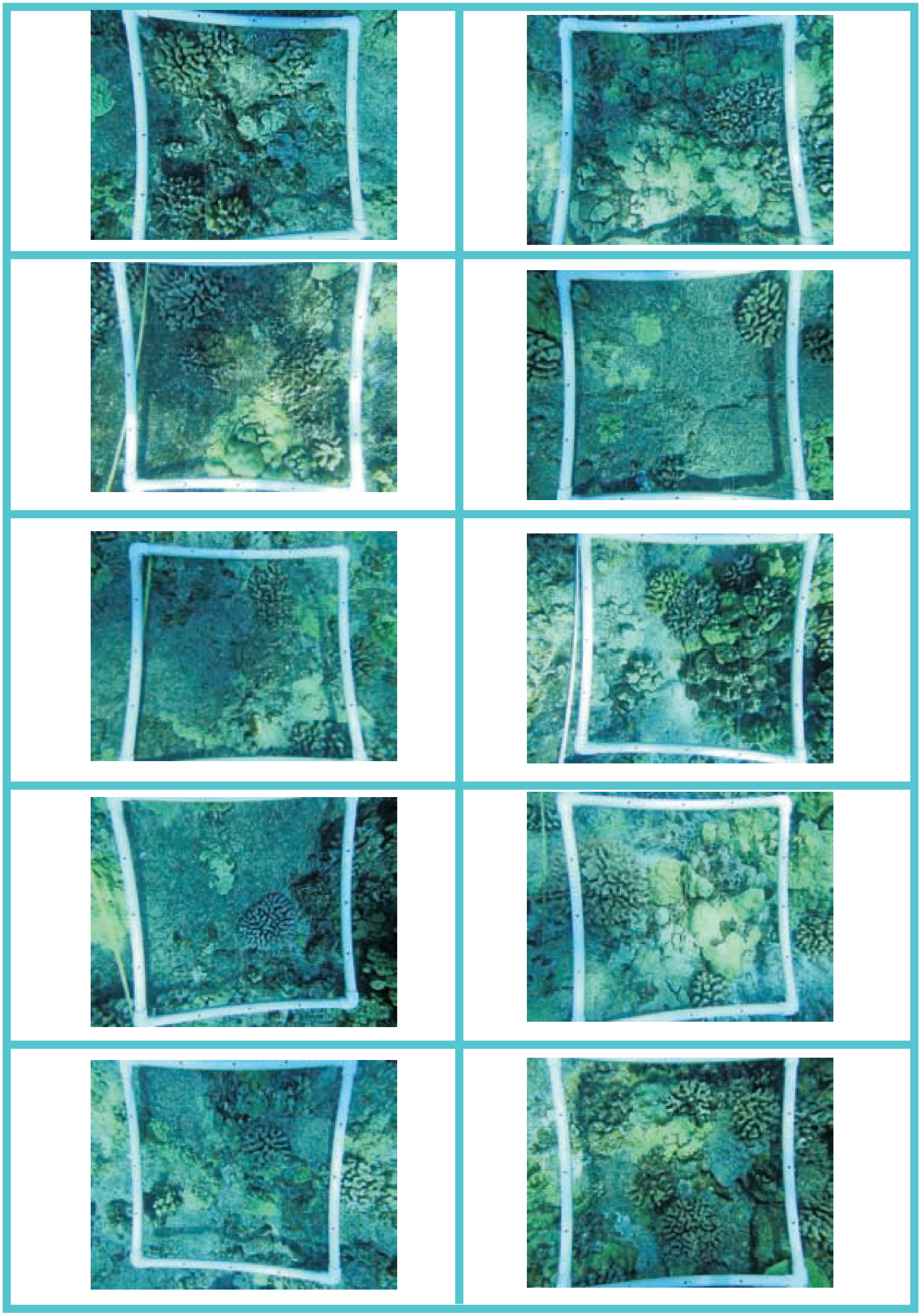


Photo-Quadrants   Ho`ona Bay - 35 feet

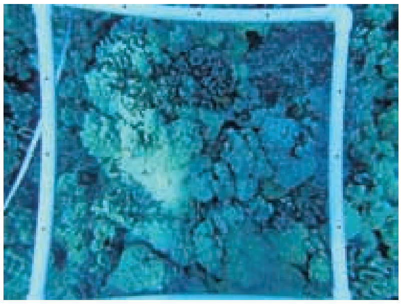
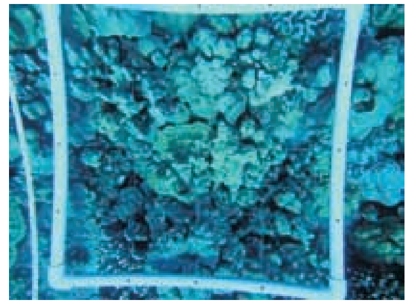
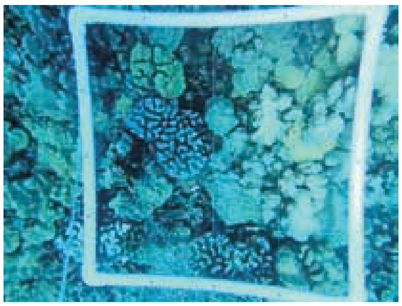
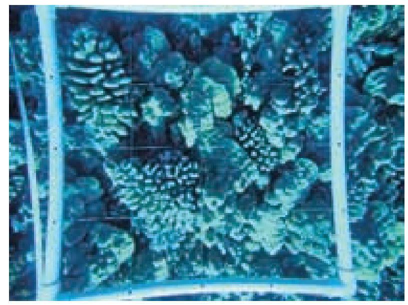
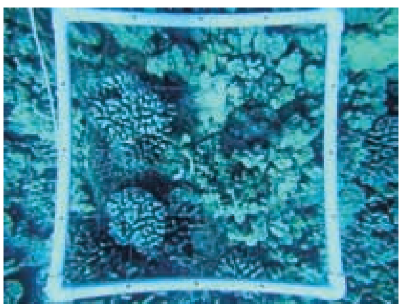
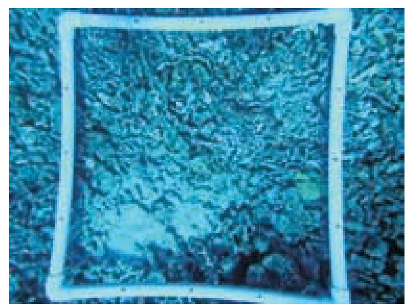
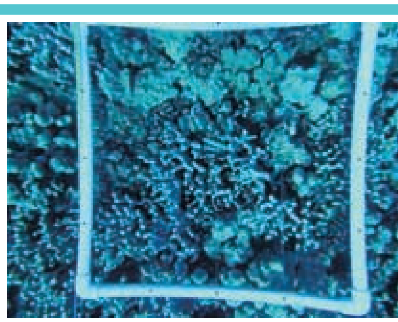
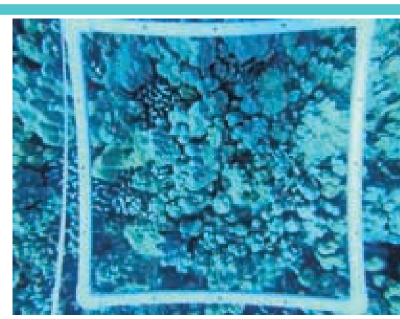
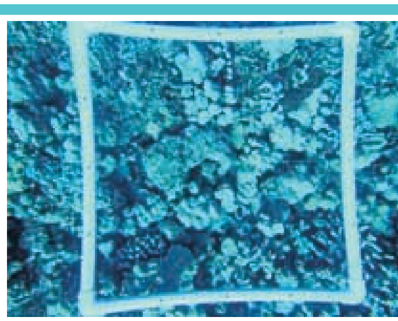
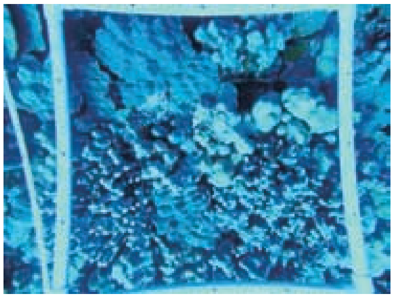
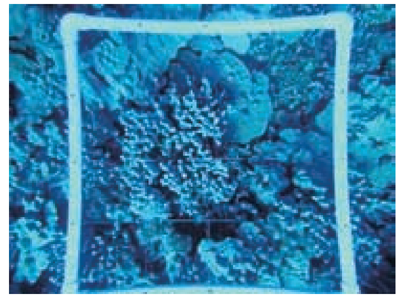
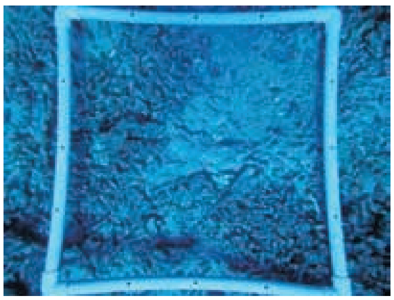
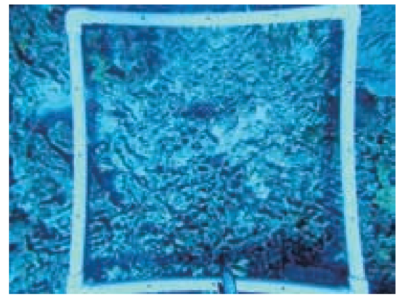
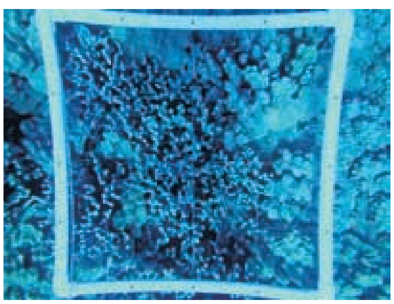
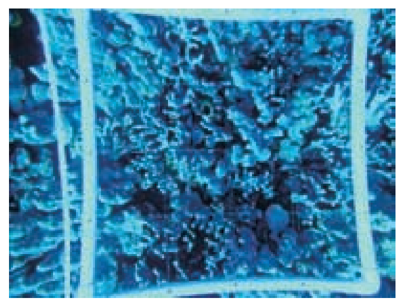
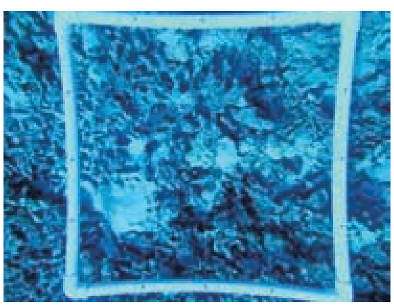
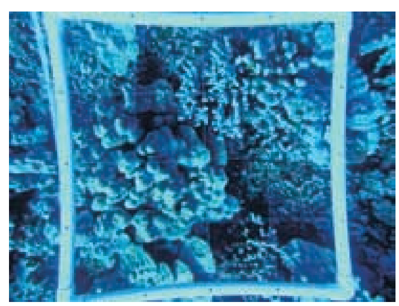











Photo-Quadrants

Ho`ona Bay - 50 feet

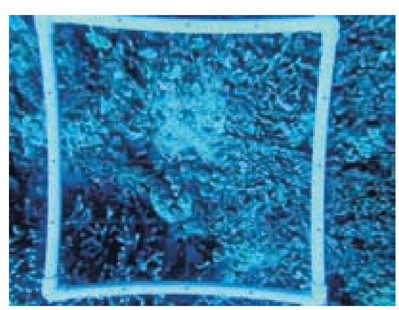


Photo-Quadrants Wawaloli - 15 feet

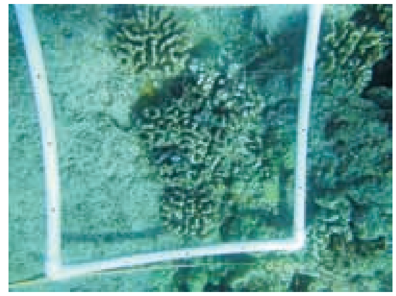
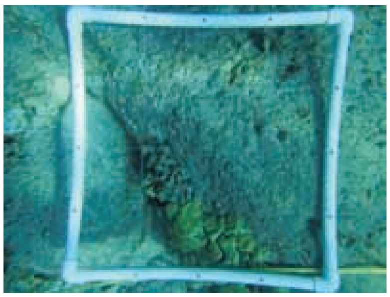









Photo-Quadrants Wawaloli - 35 feet

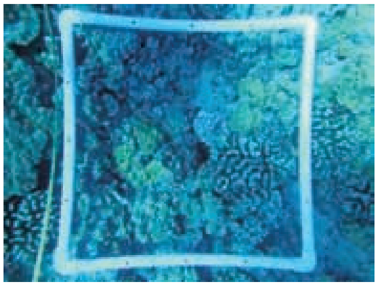
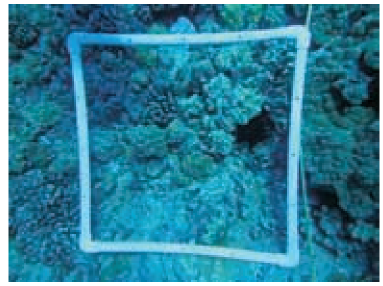
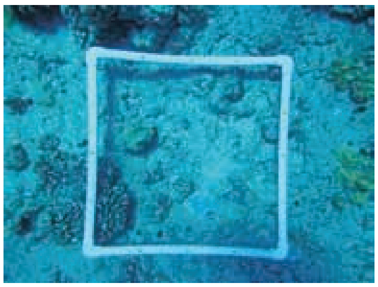
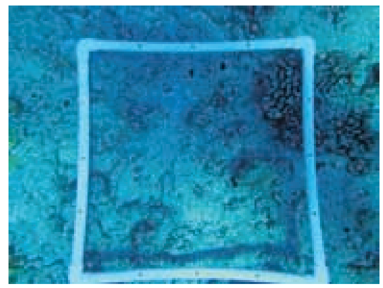
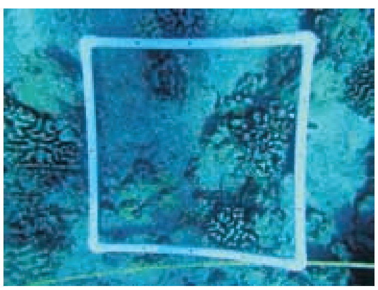
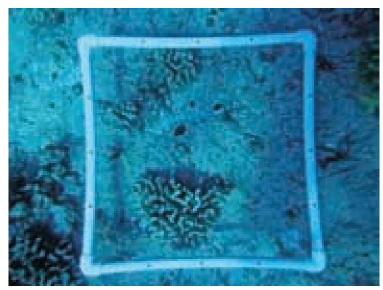
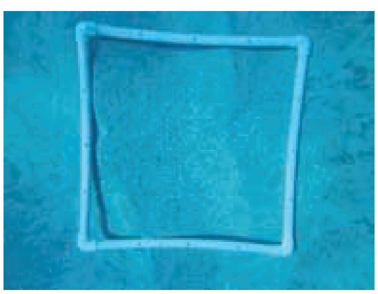
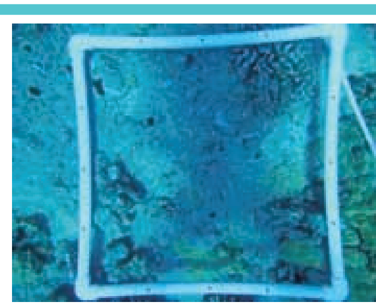
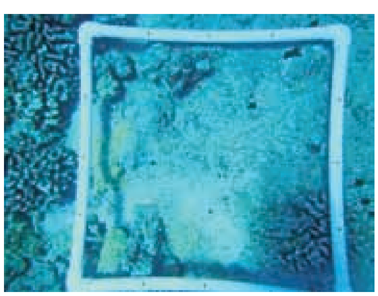
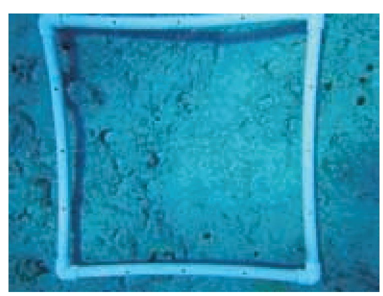











Photo-Quadrants Wawaloli - 50 feet