Benthic Monitoring Report

for the period

Year 2012

subject location

The Open Ocean Mariculture Site

authorized by

U.S. Federal NPDES Permit HI 0021825

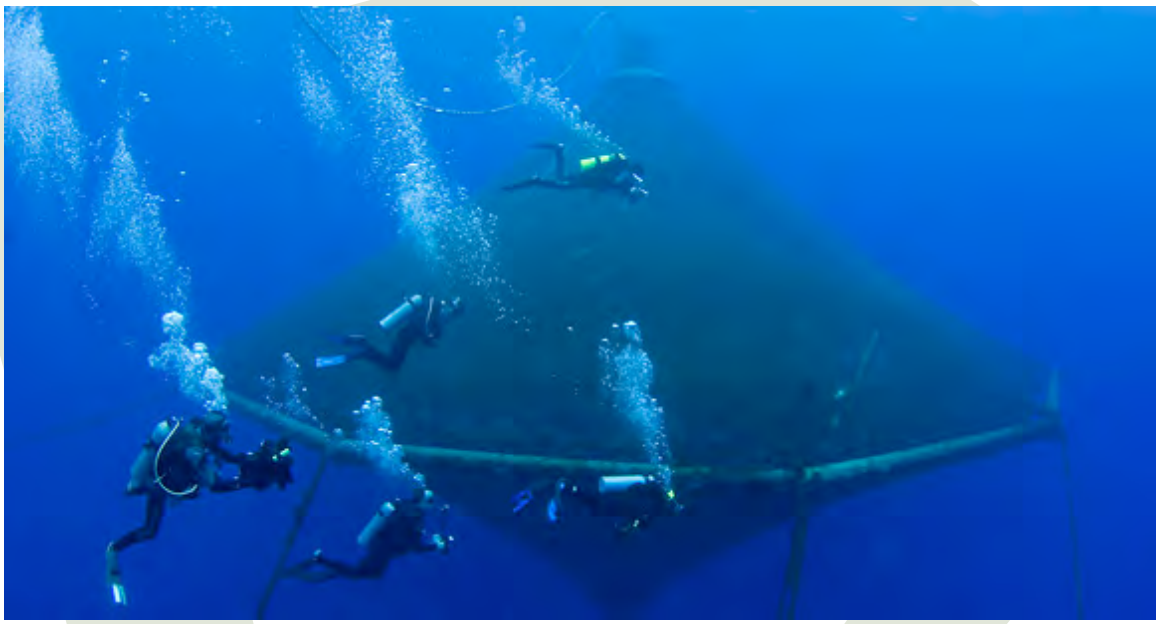
State of Hawaii CDUP HA-3497

operated by

Keahole Point Fish LLC

PLANB
CONSULTANCY, INC.

PO Box 578
Papaikou, HI 96781
808-854-4057
www.planbconsult.net



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Main Office: 6288 Belmont Way, West Linn, OR 97068 503.699.9893

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Benthic Monitoring Report
For
Keahole Point Fish LLC

Samples Collected At The Offshore Farm Site On:

September 25th, 2012

By

PlanB Consultancy

Chief Scientist: John Burns

This report details the 2012 annual benthic monitoring for the Keahole Point Fish farm site in Kona off Unualoha Point on the Big Island. All samples were collected with a ponar grab sampler lowered to the benthic substrate. The grab sampler was deployed and retrieved off of a boat with an electric winch. Upon retrieval the samples were transferred from the ponar grab sampler and placed in a receptacle along with the seawater collected with the sample.

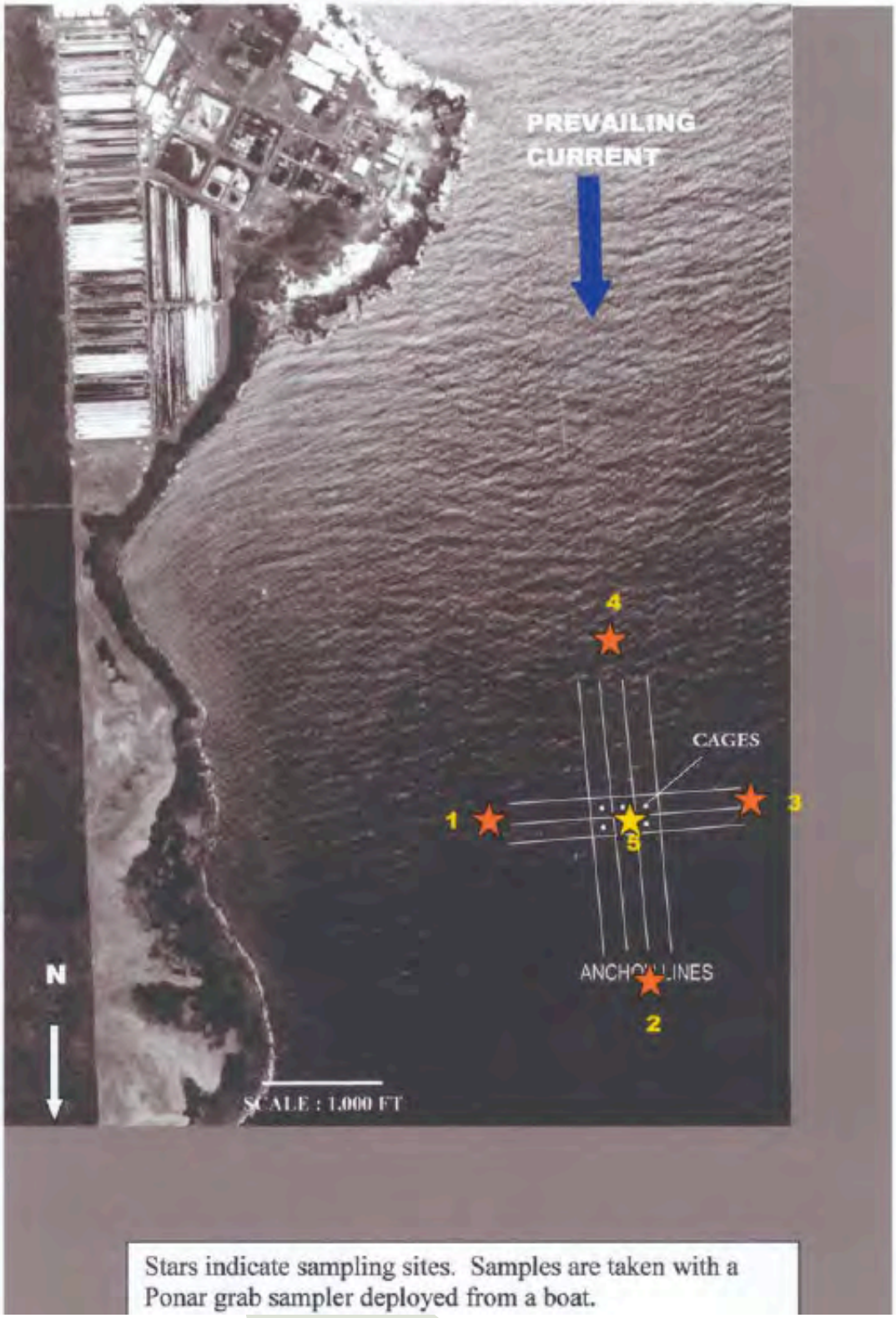
The following parameters were assessed immediately for each sample:

- *General appearance*
- *Macro fauna*
- *Macro algae*
- *Oxidation/Reduction Potential (ORP) readings*
- *Odor (presence of H_2S)*

Sub-samples were collected from each sample in order to analyze the following parameters:

- *Total organic carbon (TOC)*
- *Benthic sand characterization*
- *Micromollusk characterization*

AERIAL PHOTOGRAPH OF KEAHOLE POINT AREA, AND KONA BLUE FARM SITE, INDICATES THE BENTHIC SAMPLING SITES.



Stars indicate sampling sites. Samples are taken with a Ponar grab sampler deployed from a boat.

General *In-Situ* Sampling Observations and Data Description

North Anchor	**9:25am**
Appearance:	Light Brown
Macro Fauna:	None
Macro Algae:	*Cladophora laetevirens*
ORP:	218.4
Odor:	None

South Anchor	**8:35am**
Appearance:	Light Brown
Macro Fauna:	1 worm (*Ptychoderidae)*
Macro Algae:	*Cladophora laetevirens, Halimeda kanaloana*
ORP:	219
Odor:	None

West Anchor	**9:02am**
Appearance:	Light Brown
Macro Fauna:	2 Juvenile shrimp
Macro Algae:	*Halimeda kanaloana*
ORP:	222.1
Odor:	None

East Anchor	**9:46am**
Appearance:	Brown
Macro Fauna:	None
Macro Algae:	*Cladophora laetevirens*
ORP:	224.4
Odor:	Slight scent of sulfur

Under Cage	**10:02am**
Appearance:	Brown
Macro Fauna:	None
Macro Algae:	*Cladophora laetevirens*
ORP:	224.4
Odor:	None

Benthic Sand Characterization

Intro/Methods

Sediments play an important role in the structure of benthic communities because of grain size preferences by various organisms. Sediment characteristics can provide useful information about source materials, the depositional environment (amount of energy in waves and currents), and other physical and chemical factors.

Sub-samples taken from each surveyed location were washed with fresh water to remove salt and then sun-dried. Sand grain size analysis was conducted using a set of 7 US Standard sieves (5,10,35,60,120,230, and Dust). Samples were processed through the sieves using a motorized shaker to adequately separate sand grains based on physical size. An electronic balance was used to measure the mass of each sample proportion isolated in the individual sieves.

Data/Results

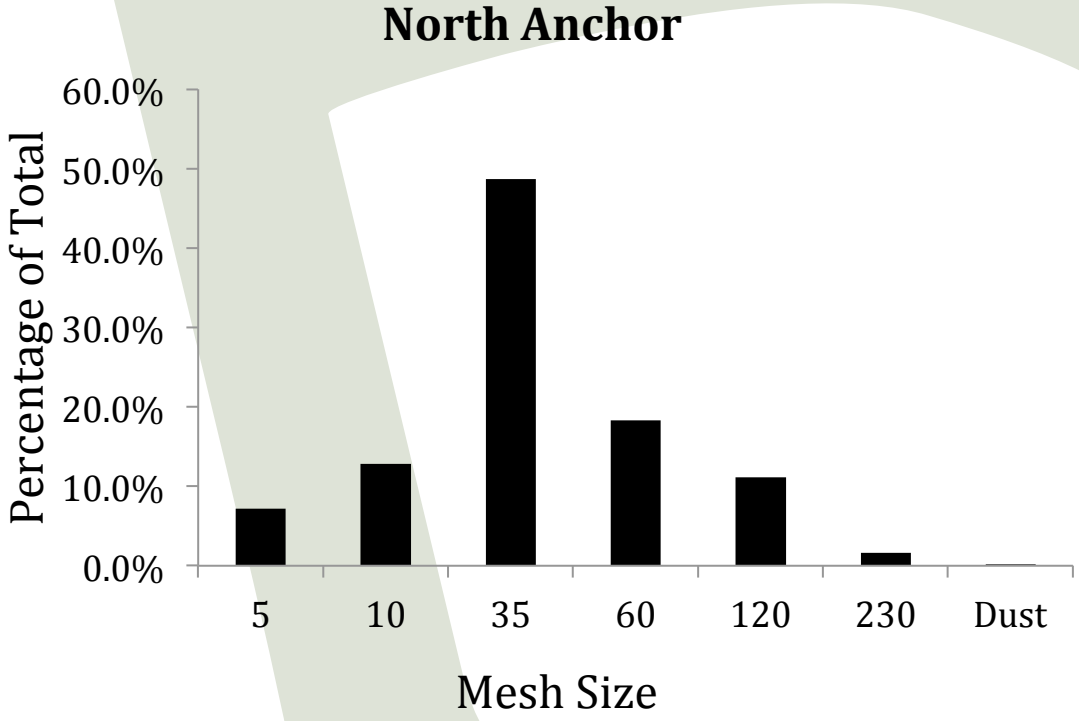
North Anchor		
Mesh Size	Retained Weight (grams)	Percentage of Total
5	18.15	7.20%
10	32.30	12.81%
35	122.8	48.69%
60	46.25	18.34%
120	28.05	11.12%
230	4.20	1.67%
Dust	0.45	0.18%
TOTAL	252.20	
South Anchor		
Mesh Size	Retained Weight (grams)	Percentage of Total
5	10.65	4.36%

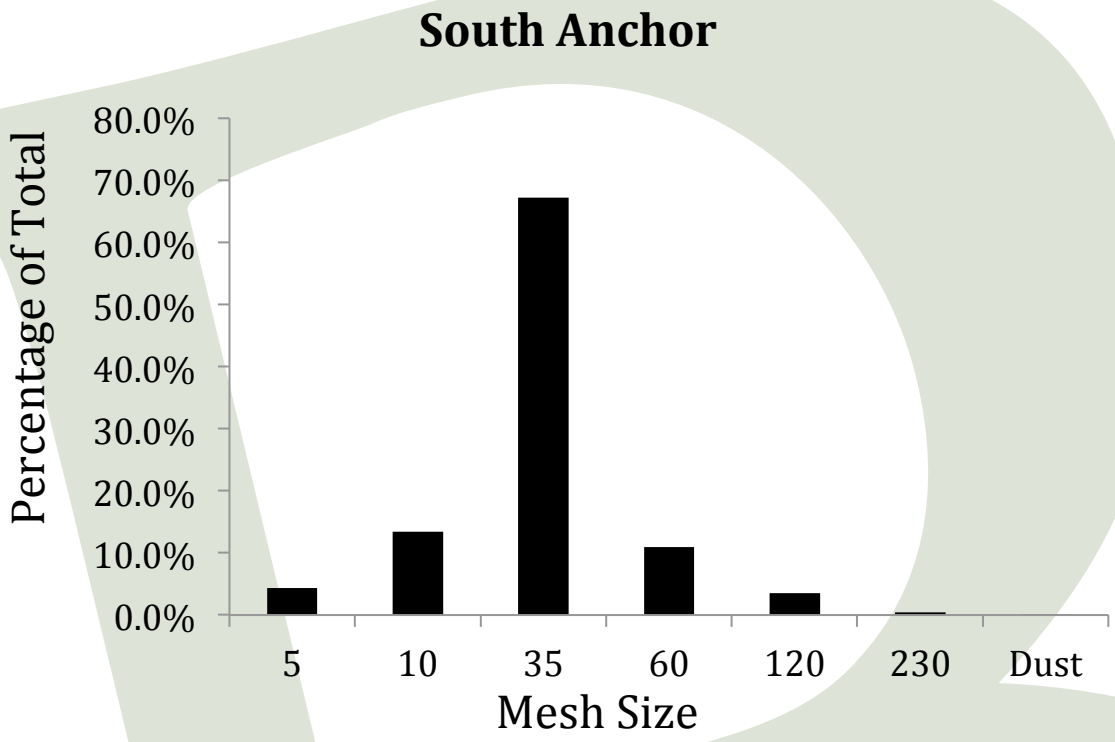
10	32.65	13.38%
35	164.10	67.23%
60	26.75	10.96%
120	8.60	3.52%
230	1.15	0.47%
Dust	0.20	0.08%
TOTAL	244.10	

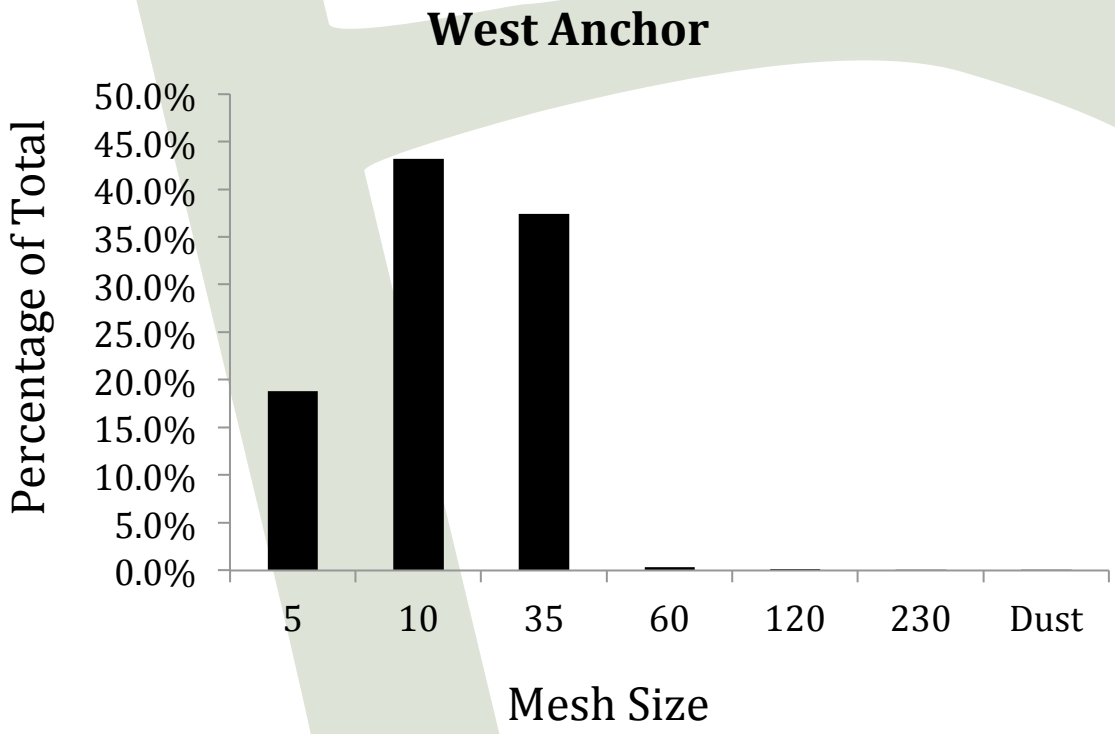
West Anchor		
Mesh Size	Retained Weight (grams)	Percentage of Total
5	33.30	18.80%
10	76.55	43.22%
35	66.25	37.41%
60	0.65	0.37%
120	0.20	0.11%
230	0.10	0.06%
Dust	0.05	0.03%
TOTAL	177.10	

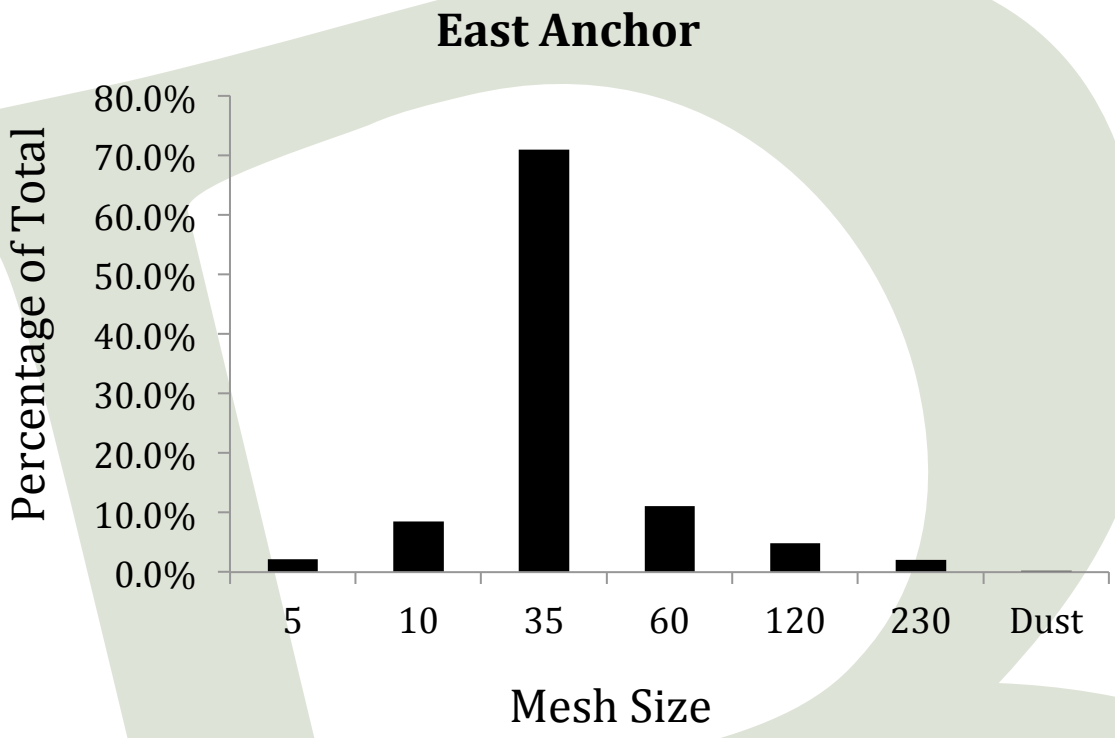
East Anchor		
Mesh Size	Retained Weight (grams)	Percentage of Total
5	6.00	2.17%
10	23.65	8.55%
35	196.35	70.96%
60	30.75	11.11%
120	13.55	4.90%
230	5.85	2.11%
Dust	0.55	0.20%
TOTAL	276.70	

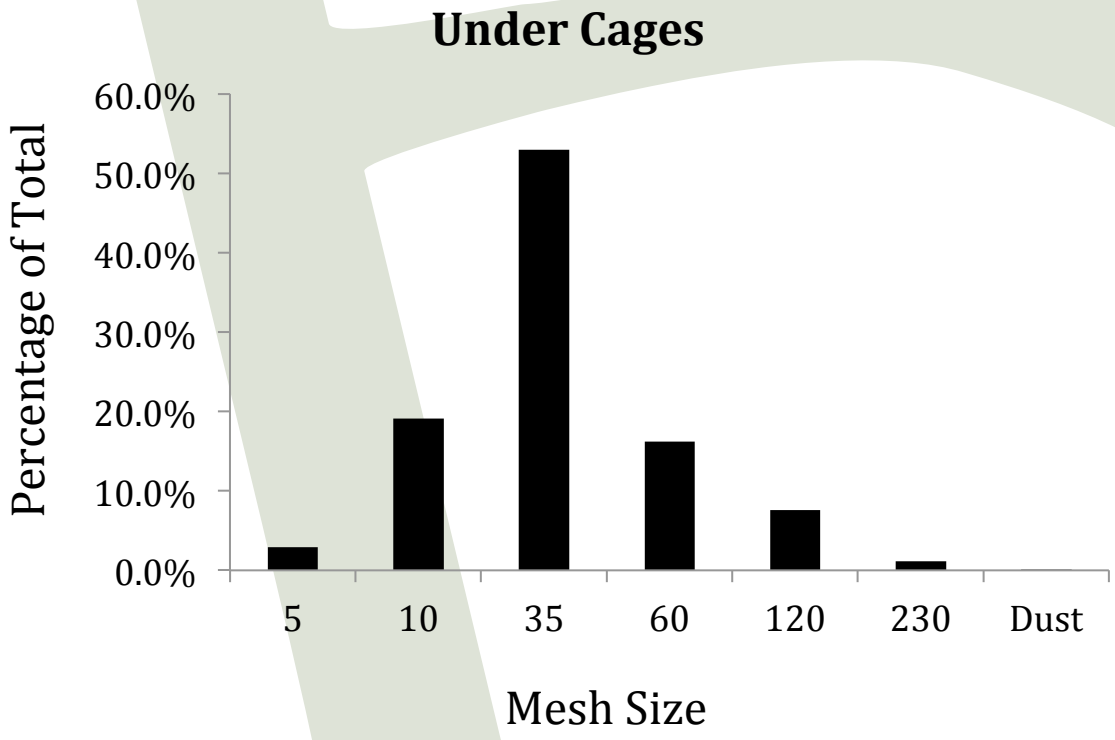
Under Cages		
Mesh Size	Retained Weight (grams)	Percentage of Total
5	7.45	2.95%
10	48.30	19.10%
35	133.85	52.93%
60	41.05	16.23%
120	19.15	7.57%
230	2.80	1.11%
Dust	0.30	0.12%
TOTAL	252.90	




South Anchor
Percentage of Total
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
5
10
35
60
120
230
Dust
Mesh Size


West Anchor
Percentage of Total
50.0%
45.0%
40.0%
35.0%
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
5
10
35
60
120
230
Dust
Mesh Size


East Anchor
Percentage of Total
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
5
10
35
60
120
230
Dust
Mesh Size


Under Cages
Percentage of Total
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
5
10
35
60
120
230
Dust
Mesh Size

Summary

The compositions of the substrate samples were similar to samples of previous years (Figure 1). All samples were composed of primarily course sand, with minimal silt. There is no evidence of live coral or hard substrate from the collected samples, and this is to be expected considering the depth of the benthic environment at this site (~60m). There was minimal macro fauna apparent in any of the samples. *Cladophora laetevirens* was present in all samples except at the West Anchor, and *Halimeda kanaloana* was present in the South and West Anchor samples. Comparing these findings to those from previous years suggests this site has exhibited a similar benthic sand composition over time, thus no apparent effects induced by the fish cages is apparent. Currents in this area are known to run at speeds of up to 2 knots in various directions. The disruptive hydrology likely impedes settlement of detritus and facilitates the consistent benthic composition that has been observed in the annual benthic monitoring of this area. It is likely that any changes in composition observed between years are due to disturbances caused by the natural hydrological characteristics at this site.

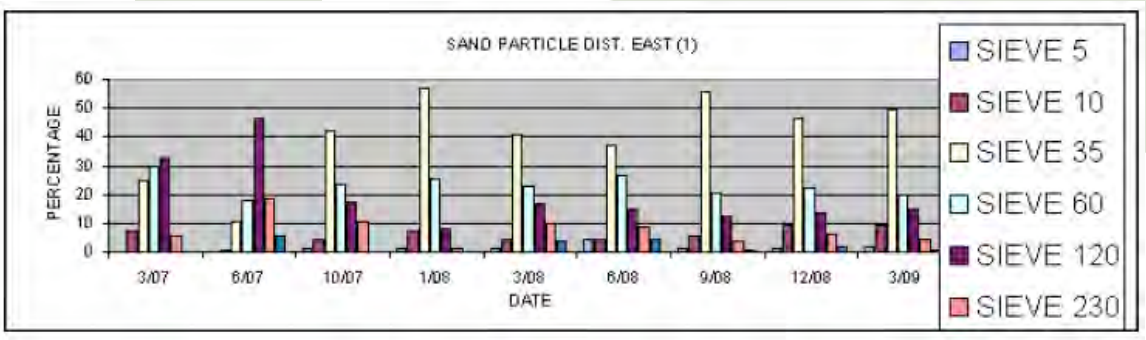


Figure 1. Previous years sand characterization at the East Anchor site. Not the similar composition to the samples collected this year.

Chemical Analysis

Intro/Methods

Chemical analysis was performed on all collected samples. Sub-samples were properly stored and analyzed for Total Organic Carbon (TOC) at the UH-Hilo EPSCoR Analystical Laboratory. Oxidation/Reduction Potential (ORP) was measured immediately with an ORP meter upon sample retrieval in the boat.

Measuring the amount of TOC can provide information on the amount of material in a sample that may be derived from decaying vegetation, bacterial growth, and metabolic activities of living organisms or chemicals. Levels of TOC can be indicative of contaminants from discharge and therefore provides an important measure of the potential effects of industrial discharge on the environment and human health. TOC is a highly sensitive, non-specific measurement of all organics present in a sample. A low value of TOC can confirm the absence of potentially harmful organic chemicals in water exposed to any form of industrial discharge.

ORP provides an indirect method to evaluate the level of biological activity in a substrate sample. This analytical technique also provides a measure of chemical exchange between the substrate and the water column. Low ORP values indicate a high amount of biological activity and an insufficient exchange for maintaining aerobic conditions. Readings below the value of 0 indicate anaerobic conditions. Anaerobic conditions typically occur when high levels of biological activity remove oxygen faster than it can be restored, thus creating an anaerobic environment. Aerobic and anaerobic conditions will determine the types of organisms that can inhabit the substrate and can cause a shift in the composition of the fauna and flora. Introduction of excess organic materials (fish feces, uneaten feed, or large amounts of bio-fouling material from cages) can be deposited on the substrate and result in anaerobic conditions. ORP therefore enables monitoring of the aerobic state of the substrate below the cages in order to ensure the fish farm is not affecting the biological composition of the sea floor.

Data/Results

Site	ORP Value
North Anchor	218.40
South Anchor	219.00
West Anchor	221.10
East Anchor	224.40
Under Cages	224.40

Site	TOC Value
North Anchor	0.10
South Anchor	0.14
West Anchor	0.12
East Anchor	0.11
Under Cages	0.09

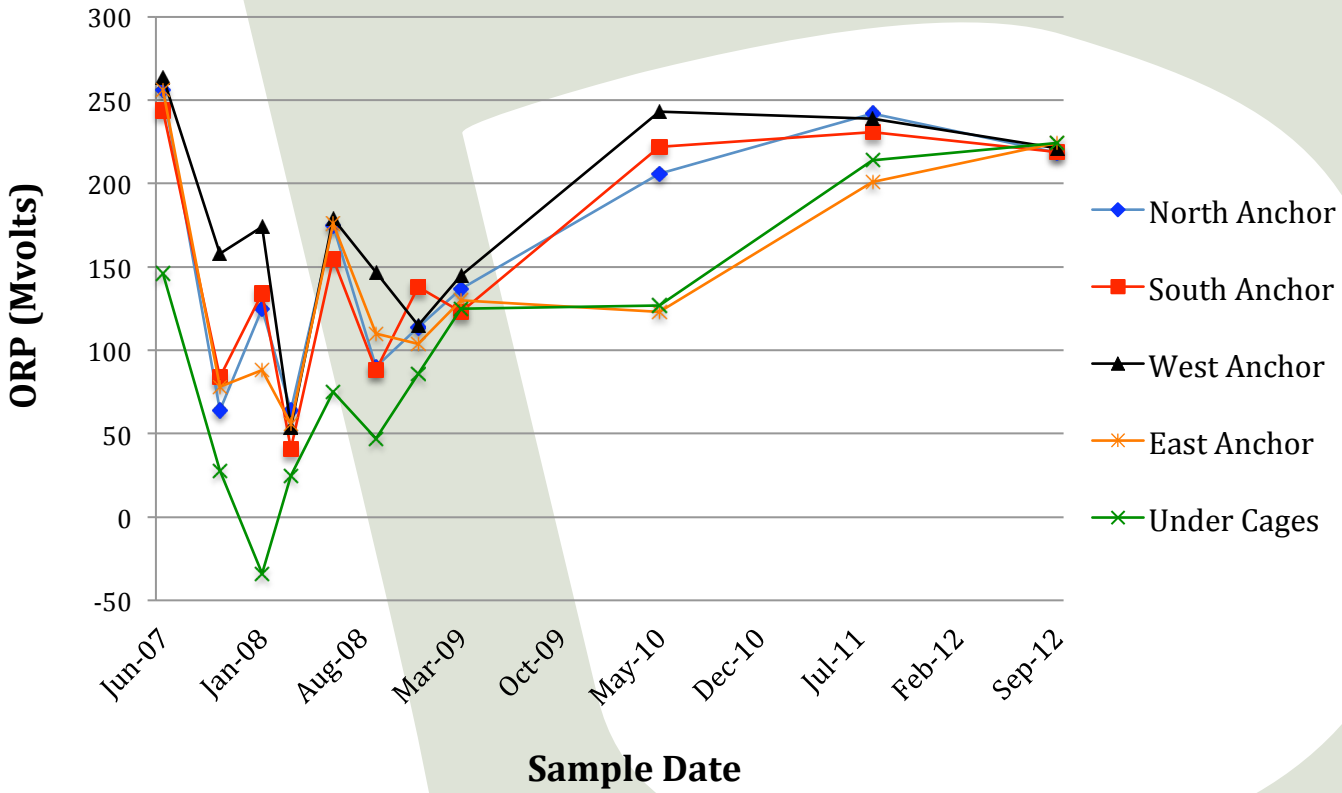


Figure 2. Temporal comparisons of ORP values measure at each monitored site.

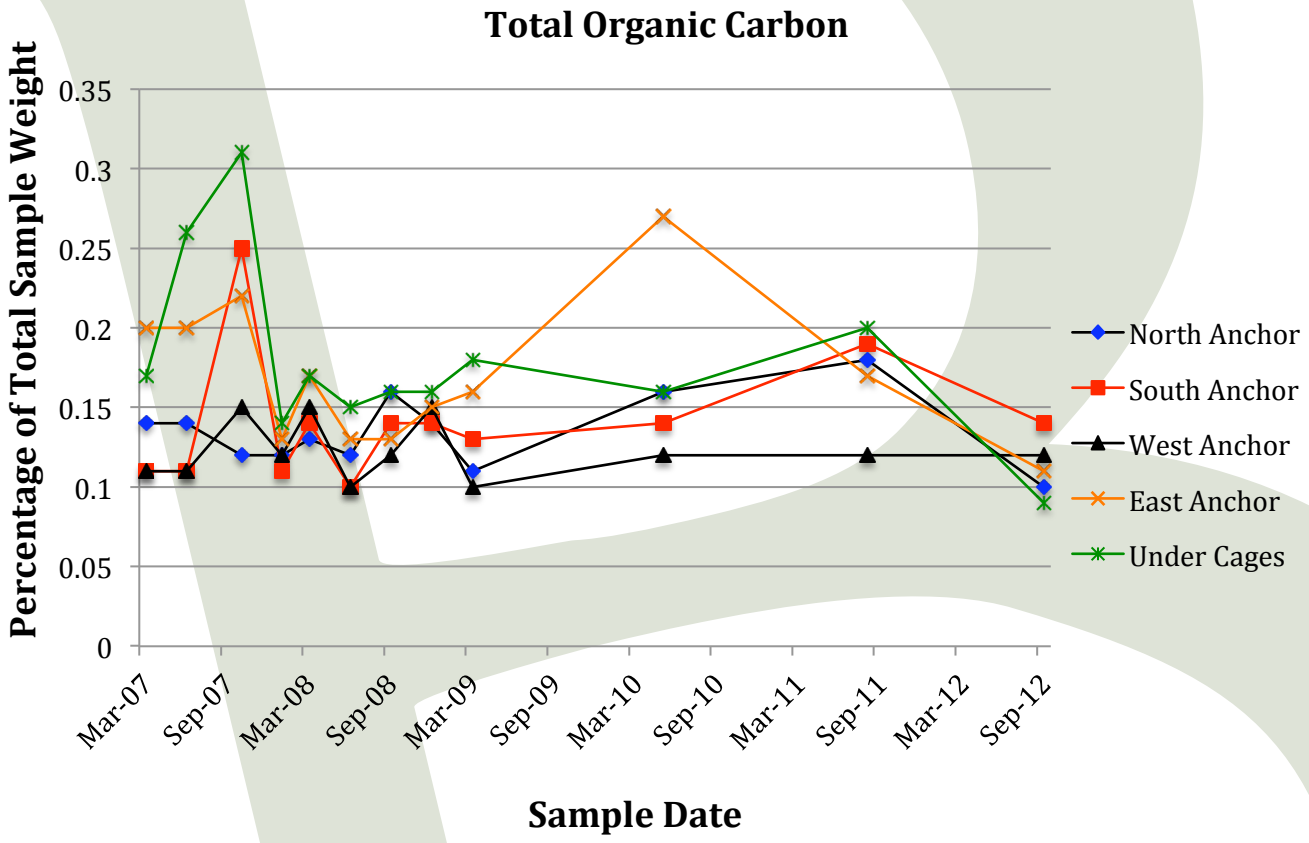


Figure 3. Temporal comparisons of TOC values measure at each monitored site.

Summary

ORP readings taken over the last two years have consistently yielded values over 100 Millivolts (Figure 2). Despite high variability and apparently one case of anoxic conditions, among measurements taken between 2007 and 2009, there appears to be no current evidence of anoxic conditions in the substrate below any of the monitored stations. This is reflected in the color, presence of macro algae and micromolluscs, and lack of odor from the samples monitored this year. These findings provide evidence that the benthic substrate below the cages is aerobic and there appears to be no influence of fish-cage discharge on the oxidation-reduction potential of the benthic substrate. This is likely due in part to the hydrologic mixing induced by the strong currents that affect the benthic substrate in this area.

TOC values exhibited minimal variation between the samples analyzed. The past two years have shown considerably less variability in comparison to values obtained between 2007 and 2009 (Figure 3). As suggested in previous monitoring reports, this may be due to improvements in feeding technology and processes. Due to the high environmental variability at this site, in large part due to strong variable currents, it is difficult to pinpoint one specific variable that may primarily affect the observed TOC values. Ultimately, the values of the past two years fall below 0.20. These low values show no evidence of contaminants from discharge and are not considered problematic.

Micromollusc Distribution Report for Keahole Point Fish
Marta deMaintenon, UH Hilo Marine Science
December 2012

Methods

Sand samples were taken from five stations (East, North, South, West and Center or Cage). Each sample (one per station) was rinsed in fresh water, dried, and 15ml subsamples were taken. The subsamples were picked for mollusk shells using an Olympus SZX12 dissecting stereomicroscope.

Fresh shells were picked from each sample, identified and counted. Bivalve halves were counted as whole individuals. Since it is not possible to identify shells that are truly freshly dead vs. dead for some time, the samples should be considered time-averaged. Identifications were made using Kay (1979) and Severns (2011). Kay (1979) provides some information on habitat and ecology, and more was derived from Beesley et al. (1998).

Micromolluscs

A total of 1497 individuals were found belonging to 92 taxa (Figure M1). Most were identified to species but some could not be (for instance a number of juveniles that are easily recognizable as triphorids, but not developed enough to identify to species; and many other unidentifiable juveniles), so undoubtedly more than 92 species were represented. This is more than previous years based on Kawamoto & Grasso (2011); however the discrepancy should be considered more likely due to a different researcher doing the counting, rather than to an actual change in overall diversity and abundance. I may have considered more specimens as being 'fresh' than previous specialists. West had fewer molluscs than the other four stations and North and South had the highest abundances. The low numbers seen at West may have been due to the sediments sampled, which in the case of this particular sample, appeared coarser than the samples from the other four stations.

The number of species sampled cross the five stations paralleled the pattern seen in abundance (Figure M2). West again had fewest (28), perhaps associated with the lower abundance. East appeared to have more species than might be expected relative to abundance, with 48 species sampled.

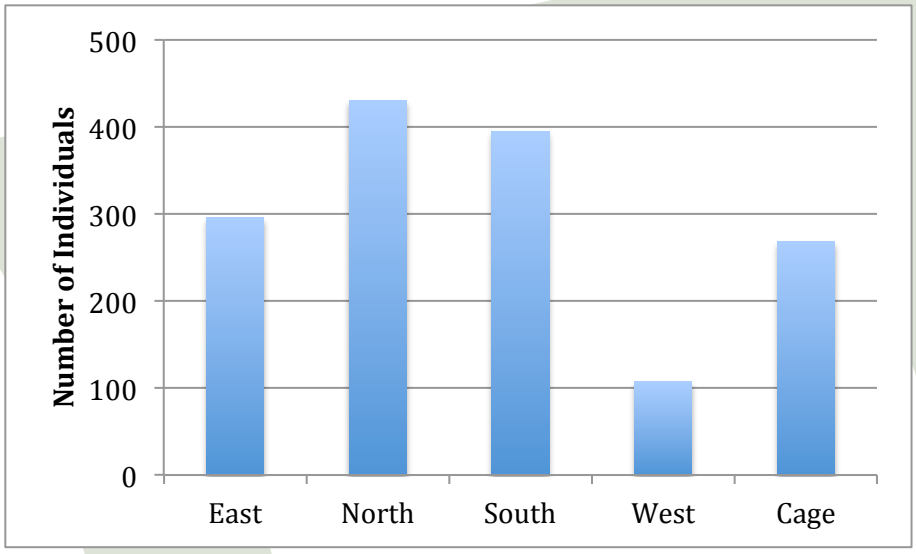


Figure M1. Mollusc abundance at each of the five stations for 2012. Total abundance was 1497 individuals.

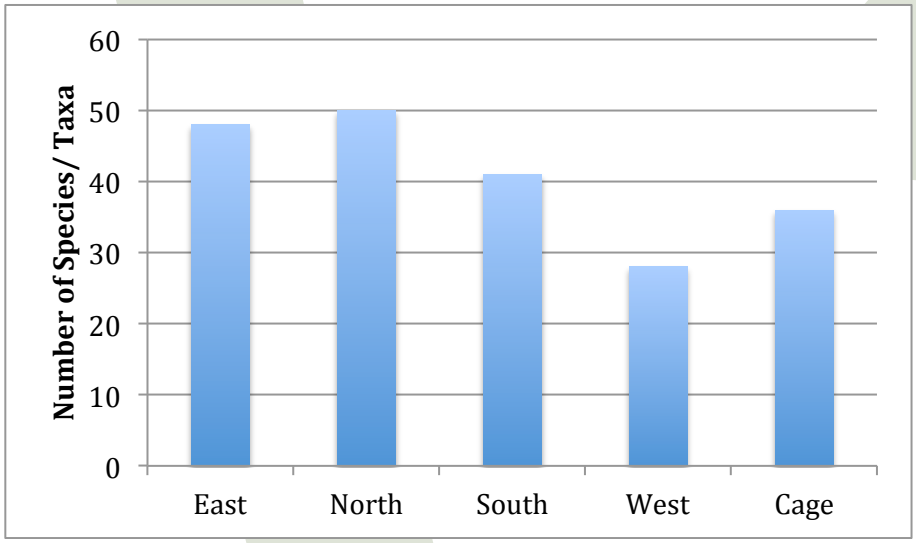


Figure M2. Mollusc diversity at each of the five stations for 2012. Total number of taxa recorded was over 92 species.

Gastropods were more abundant than bivalves by far; gastropods accounted for 86.9% to 97.0% of the individuals in the samples (Figure M3). No polyplacophorans or scaphopods were seen. West had the largest proportion of bivalves, though that was the sample with least abundance overall. So the number of bivalves counted was consistent with the other four samples, but the number of gastropods was fewer.

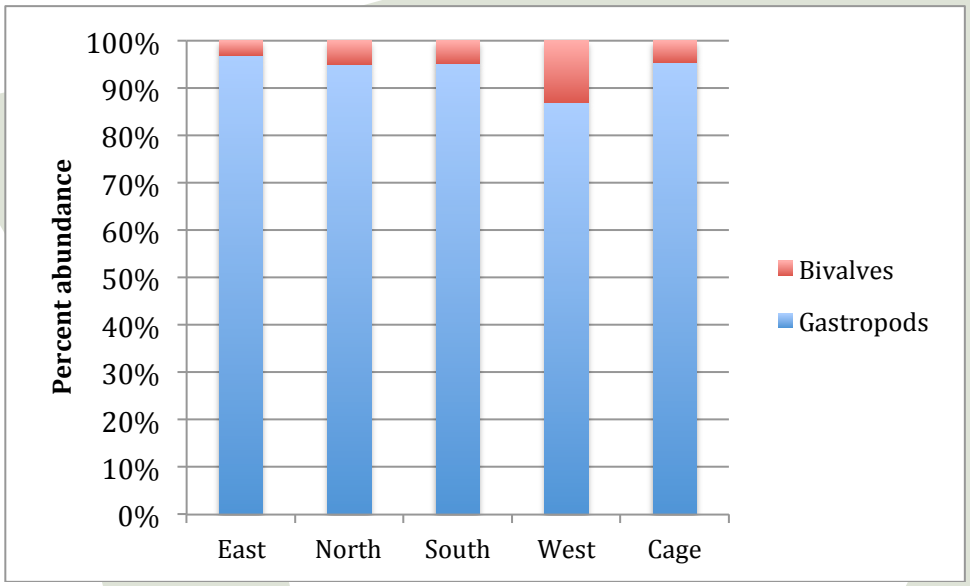


Figure M3. Proportion of gastropods vs. bivalves at each of the five sampling stations for 2012.

Numbers from this year were compared to those from last year; reports from previous years were not available. The number of individuals sampled (Figure M4) shows a similar pattern this year relative to last year, with North and South having high abundances and West low. The number of taxa sampled (Figure M5) varies more qualitatively from last year, with East and North relatively higher in species richness and West lower. Generally speaking, counts from this year recorded higher diversity and abundance than last year, but again this may reflect changing the researcher doing the count rather than a change at the site. Future years' data may help to determine whether patterns of diversity and abundance have changed at the site.

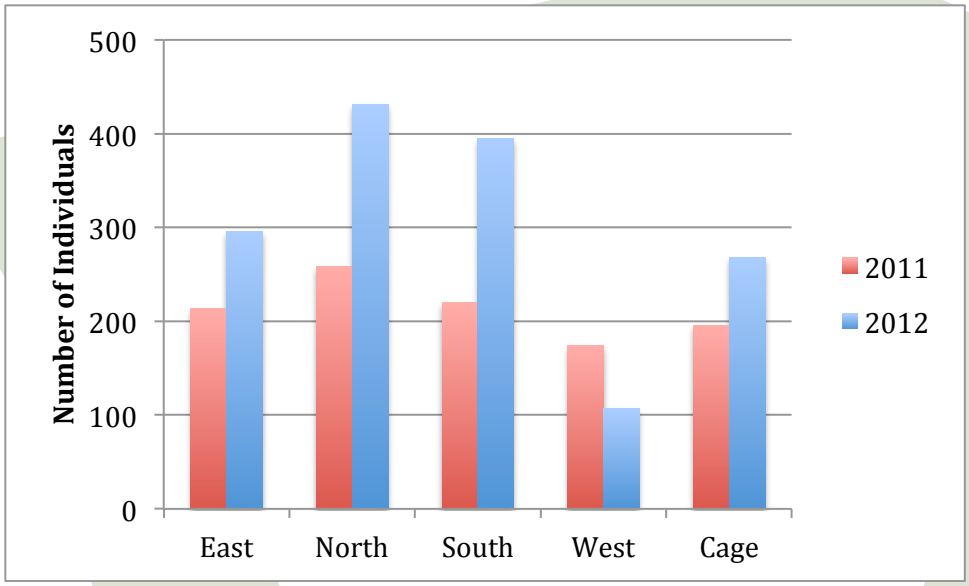


Figure M4. Number of individual molluscs sampled at each station this year relative to last year.

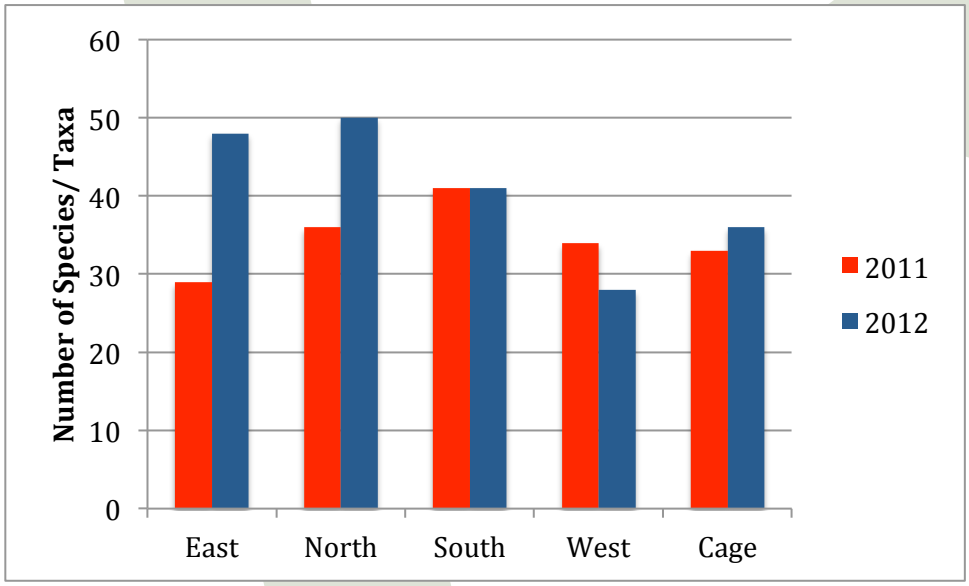


Figure M5. Number of molluscan taxa sampled at each station this year relative to last year.

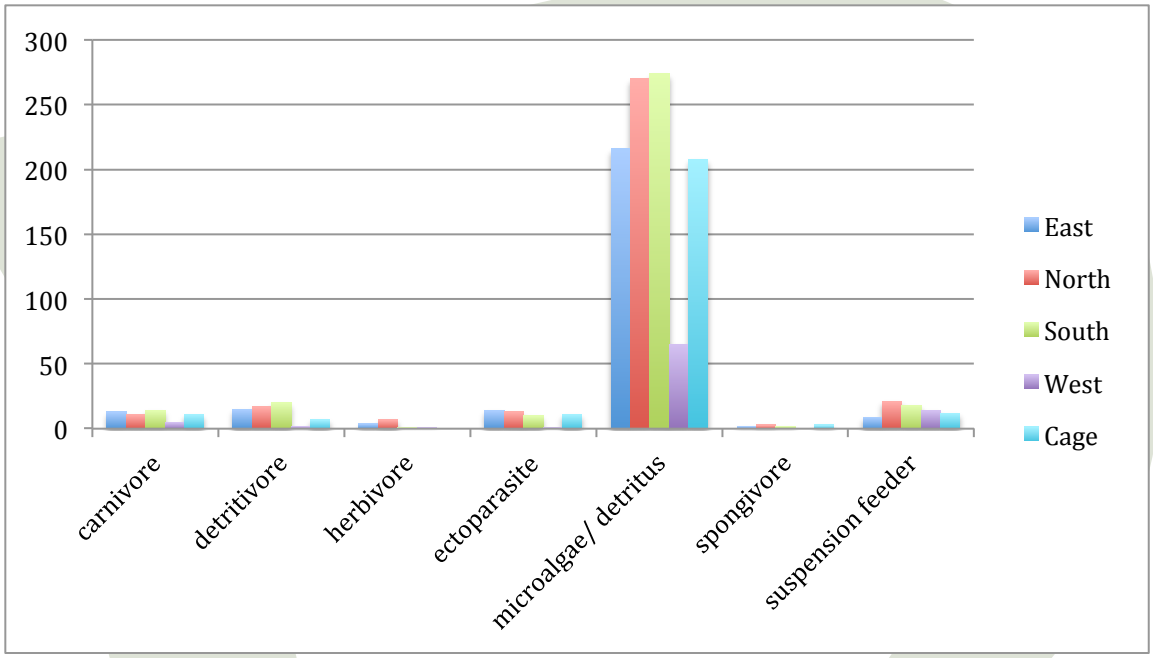


Figure M6. Abundance of molluscs in specific trophic groups at each site in 2012.

The trophic groups represented among the molluscs (Figure M6) were dominated by species that feed on microalgae (including diatoms) and detritus. Cerithiids and rissoids were the most abundant members of this group and were present at all sites, though somewhat fewer at West (where diversity and abundance were lower overall). The three most common species overall (Table M1: cerithiid *Argyropeza leucocephala*, rissoid *Mellitestea scopulorum* and dialid *Diala semistriata*) all belong to this trophic group. Two of the other most common taxa encountered were also rissoids with similar ecologies, *Parashiela* sp. and *Pusillina marmorata*.

East	North	South	West	Cage
Mellitestea scopulorum	*Mellitestea scopulorum*	*Argyropeza leucocephala*	*Argyropeza leucocephala*	*Mellitestea scopulorum*
Argyropeza leucocephala	*Argyropeza leucocephala*	*Mellitestea scopulorum*	*Diala semistriata*	*Argyropeza leucocephala*
Diala semistriata	*Diala semistriata*	*Diala semistriata*	*Rissoina pulchella*	*Pusillina marmorata*
Scaliola sp.	*Parashiela* sp.	*Parashiela* sp.	*Tricolia variabilis*	*Diala semistriata*
Parashiela sp.				

& *'Cerithidium' actinium*	*Pusillina marmorata*	*Pusillina marmorata*	*Mellitestea scopulorum*	*Parashiela* sp.

Table M1. The five most common molluscan species/ taxa at each station for 2012.

Carnivores included naticids, which feed on molluscs; conids (now including what used to be turrids), which feed on worms, molluscs, and other mobile invertebrates and fish; marginellids, which feed on sessile invertebrates; and architectonicids and epitoniids, which feed on cnidarians. Carnivores are typically represented by a higher diversity and lower numbers of each species. Obligate herbivores included the bubble shells of the family Haminoeidae, present in low abundance at all stations except under the cage. Obligate detritivores included *Scaliola*, present at all stations, and *Finella* (an indicator species characteristic of anaerobic conditions). The latter was present only at East. Triphorids (spongivores) were present at all stations except West.

Habitat comparisons were not recorded for this year's sample, however the fauna was almost entirely epifaunal. Bivalves in the sample included some infaunal taxa (lucinids, semelids and tellinids), and some epifaunal species mostly mytilids). Infaunal gastropods included a very few naticids (no more than two per site).

Overall, the data indicate a diverse and abundant molluscan fauna, with predominantly epifaunal gastropods displaying a variety of trophic levels. Microherbivores and detritivores were most abundant, with an array of carnivores and symbionts, indicating a diverse ecosystem with no apparent ill effect from the offshore aquaculture systems.

Sources cited:

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Severns, M. 2011. *Seashells of the Hawaiian Islands – The Sea Shells.* Conchbooks, Hackenheim, Germany. 564 pp.

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Environmental Division

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Phone • (808) 854-4057
E-mail: jburns@planbconsult.net • Website: www.planbconsult.net

BENTHIC SAMPLE CHAIN OF CUSTODY FORM

Company: KEAHOLE PT FISH Telephone # 808-217-4076 Fax #:
Contact: STEVE BARNES Client Project Number: PBE-KP-B-2012
Relinquished by: JOHN BURNS Date: 10/10/12 Time: 9:30AM
Written Report To: KEAHOLE PT FISH
Project Name: 2012 ANNUAL BENTHIC MONITORING
Turn-Around (Circle One): Same Day 24 Hour 2 - 5 Day 1 - 4 Weeks (Months) Rush After Hour Rush

For Laboratory Use Only

Project # PB-12-PB-KPF-BM Method: DISSECTING SCOPE
Samples Received by: DR. MARTA DEMANTENON Date: 10/10/12 Time: 9:30AM

Client Sample Number	Date	Time	Sample Type	Containers	Requested Analyses	Sampled By
1-NORTH	9/25/12	9:25	SHELLS	3x15mL ALIQUOTS	I.D. SHELLS	JB/LM
2-SOUTH	↓	8:35	↓	↓	↓	↓
3-WEST		9:02				
4-EAST		9:46				
5-UNDER	↓	10:02	↓	↓	↓	↓

Results Transmitted/Date: [signature] Fax/Phone By: _____
22 Dec 12

PLAN B CONSULTANCY, INC.
Environmental Division

PO Box 578 • Papaikou, HI 96781
Phone • (808) 854-4057
E-mail: jburns@planbconsult.net • Website: www.planbconsult.net

BENTHIC SAMPLE CHAIN OF CUSTODY FORM

Company: Keahole Pt Fish Telephone # 808-217-4076 Fax #:
Contact: Steve Barnes Client Project Number: PBE-KP-B-2012
Relinquished by: John Burns Date: 10/10/12 Time: 9:30AM
Written Report To: Keahole Pt Fish
Project Name: 2012 Annual Benthic Monitoring
Turn-Around (Circle One): Same Day 24 Hour 2 - 5 Day (1 - 4 Weeks) ~~Months~~ Rush After Hour Rush

For Laboratory Use Only

Project # PB - Method:
Samples Received by: Lucas Mead Date: 10/10/12 Time: 9:30AM

Client Sample Number	Date	Time	Sample Type	Containers	Requested Analyses	Sampled By
1-West	9/25/12	9:02	Sediment	1x50mL	TOC	JB/LM
2-North	9/25/12	9:25	↓	↓	↓	↓
3-South	9/25/12	8:35				
4-East	9/25/12	9:46				
5-Under	9/25/12	10:02				

Results Transmitted/Date: 11/1/12 Fax/Phone By: