CIP GENERATION PROJECT

2014 COMMUNITY BENEFITS PROGRAM

REEF FISH MONITORING PROJECT

YEAR 7 RESULTS

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EXECUTIVE SUMMARY

The development of an electrical generating facility at Campbell Industrial Park (CIP) Barbers Point was the impetus to initiate a quarterly environmental monitoring program to follow changes, if any, in coral reef fish communities in the Barbers Point - Kahe Point area. This document is the seventh annual report for this effort covering the period from December 2007 through December 2014 with a focus on the surveys completed in 2014. On a quarterly basis, this study monitors the status of coral reef fish communities at sixteen permanently marked sites offshore of Barbers Point on the southeast to Nanakuli Beach Park about 7.9 km to the northwest. These monitoring stations are all in waters from 5 to 12 m in depth and thus are subject to impact from high surf events.

Because of Hawaiian Electric's construction/operation of the generating station at Kahe Point as well as the developments at West Beach and Barbers Point Harbor, long-term marine environmental data covering the status of fish and coral communities are available commencing from the mid-1970's up to present. The most comprehensive of those efforts occurred with the Hawaiian Electric Environmental program in support of the Kahe Generating facility at Kahe Point. The Hawaiian Electric monitoring program documented changes that occurred to marine communities following three major storm events: the January 1980 event, Hurricane Iwa in November 1982 and Hurricane Iniki in September 1992 all of which severely impacted coral reef communities in the area. These studies demonstrated the impact of those storm events and not the operation of the Kahe facility as the major source of impact to marine communities of the Kahe area.

In the present study there were no statistically-significant changes in the mean number of fish species, mean number of individual fish censused or in the mean standing crop per transect among the twenty-eight 2007-2014 survey periods, thus demonstrating stability in these communities. All species of fishes censused in the present study have been assigned to one of five feeding guilds (or trophic categories): herbivores (species feeding on algae), planktivores (species that feed on zooplankton up in the water column), omnivores (species that feed on both algae and small animals), coral feeders which are a specialized group feeding on coral tissue or mucous, and carnivores which are species feeding on smaller fishes and invertebrates living on the coral reef. Of the 149 species of fishes encountered in the twenty-eight 2007-2014 surveys, twenty-five species are herbivores, fifteen are planktivores, seven are omnivores, eight are coral feeders and 94 are carnivores. Fifteen of the sixteen monitored locations are established on natural substratum where 87% of the fish standing crop is comprised of herbivores and carnivores. However, at one station established on the Kahe Generating Station warm-water discharge (Station 16), herbivores are largely replaced by planktivores but carnivores remain important as elsewhere. The reasons for this shift in dominance is due to the thermally-elevated discharge creating a unidirectional current that discharges particulate materials. The steel and armor rock covering the discharge pipe also provides a high degree of shelter space at this station.

This study was undertaken to follow changes in coral reef fish communities as part of the environmental monitoring program related to the development of the CIP electrical generation facility. The data collected in the first year represent the preconstruction baseline (December 2007 - December 2008), while data collected in the second year represents the construction phase (January - September 2009) and the data collected in the third through seventh years (2010-2014) represent the operational phase of the plant. The sixteen stations geographically fall into four groups along the 7.9 km of coastline; on the southeast are four stations offshore of the generation plant at Campbell Industrial Park (Station nos. 1-4), three stations seaward of Ko'Olina Resort (nos. 5-7), five stations fronting the Kahe generation facility (nos. 8-12), three stations north of Kahe Point (13-15) and the Kahe Station discharge pipe (no. 16). Statistical analysis of the fish community parameters measured in this study (i.e., number of species, number of individuals and standing crop) on natural substratum found that the diversity of fish species,

the number of individual fish as well as the standing crop to be significantly greatest at the three Ko'Olina stations over those in the other three groups over the 2007-2014 survey period. These three measures were least at the four stations offshore of Campbell Industrial Park and the seven Kahe stations. These differences are attributed to better benthic community development offshore of Ko'Olina than elsewhere. The above analysis excluded data from Station 16 (the Kahe discharge pipe) because it is a man-made structure and not comprised of natural substratum as present at all other stations. However, to better understand the differences among the sixteen stations, the three fish community measures (mean number of species per transect, mean number of individuals per transect and mean estimated biomass per transect) were statistically examined comparing all stations. Two findings emerge: (1) the Kahe discharge pipe station had a clearly-separable significantly greater mean number of species, individuals and standing crop present over all other stations and (2) the means for all parameters from all other stations were not statistically separable except for one station (number 11) where the number of fish species was significantly less than all other stations which is due to the short transect length used at this site (i.e., 10.5 m) versus 50 m at all other sites. Thus the development in the fish communities at the fifteen stations situated on natural substratum monitored in this study pales relative to that found at the man-made Kahe discharge pipe.

Seven of the permanently marked monitoring stations in this study have been used in earlier Hawaiian Electric studies and the methods used herein are similar, allowing comparative analysis of the data. Comparing earlier fish community data (1976-1984) to present (2007-2014) data finds that there are no statistically significant differences in the annual mean number of fish species or annual mean number of individual fish censused per transect despite the imposition of three major storm events in 1980, 1982 and 1992 suggesting that the fish communities have to some extent recovered from these disturbances. These documented storm events impacted marine communities offshore of the Barbers Point and Kahe Point areas. These impacts were probably greatest on the coral communities which are the source of much of the natural local topographical relief creating shelter for fishes. If disturbance to the coral community occurs frequently and corals are known to be slow-growing, they are unable to contribute much to the local topography upon which many fish species depend thus keeping the fish community at an earlier point in community succession. The early studies demonstrated the large impact that these storms had at the time on corals as well as the movement of sand away from the Kahe area leaving much near-barren limestone that is present today and is scoured by small wave events keeping benthic community development to a minimum. This has resulted in a relatively poor development of the fish communities at many of the Kahe sample sites which continues to today. Where topographical relief and benthic communities are well-developed, the fish communities are likewise better developed. Given the long-term data set spanning 38 years and the apparent lack of strong significant changes occurring to fish communities with the three early storm events which is probably related to some level of recovery, suggests that the variation seen in the measures of the fish community used in this study will continue to fluctuate at a similar magnitude in future monitoring events as this program moves forward. Furthermore, the analysis of the 2007-2014 data suggest that benthic community development/topographic complexity creating shelter for fishes remain the overriding factors determining the degree of development in fish communities at the stations monitored in this study. Since these factors were heavily impacted by the early storm events many years ago (as documented by Hawaiian Electric), the present findings will probably continue much the same in future years of this study.

INTRODUCTION

1. Purpose

Hawaiian Electric has constructed a new generating station on vacant portions of its existing Barbers Point Tank Farm in Campbell Industrial Park (CIP) on the island of O'ahu. This generating facility was constructed in light of the fact that there is an urgent need for new generating capacity on the island. Initially, the generating station would consist of a single 110 megawatt (MW) Siemans-Westinghouse combustion turbine (CT) and two single 2 MW capacity black-start diesel engine generators. The system was designed to be fueled primarily by biofuels which assists in fulfilling the State's goals of energy security and sustainability. However, alternative fuels (e.g., diesel, naphtha, etc.) may be used if biofuels are unavailable. The facility is designed to accept a second generating unit and could be constructed if and when it is needed to meet system requirements. It was expected that the generation system could be used to help meet peak load periods on the island's system which normally occur between 5:00 pm and 9:00 pm on weekdays.

The single CT generation unit utilizes approximately 600 gallons per minute (gpm) of water which is used for water injection into the CT for air pollution control, equipment cooling, plant washdown, landscape irrigation and domestic use by operating personnel. Disposal of used water is via injection wells on the facility site. Thus, unlike the nearby Kahe Generating Station (KGS) where seawater is used for cooling in the plant and discharged back into the marine environment, the CIP plant does not discharge cooling water into the nearby ocean thus precluding or significantly reducing the potential for environmental impacts to occur in the marine environment.

As part of the environmental monitoring program for the CIP Generating Station, it was suggested that a coral reef fish monitoring program be put in place to track the changes, if any, that may occur with fish populations offshore of the plant at Barbers Point. Data were initially collected in 2008 representing the preconstruction baseline, in 2009 representing the "construction period" of the generating facility and in 2010 representing the commencement of the operational phase of the plant and continuing through 2014. The 2008 information was presented in Brock (2009), the "during construction" information was given in Brock (2010) and data collected since the commencement of plant operations in 2010 are given in Brock (2011), for 2011 in Brock (2012), 2012 in Brock (2013), 2013 in Brock (2014) and the continuing operational phase data for 2014 are presented herein.

Since Hawaiian Electric had this type of monitoring plan in place for the offshore area of its Kahe power plant in the 1970's and 1980's, the present study has included a reassessment of some of those locations which provide information on the changes that have occurred to fish communities in the Barbers Point - Kahe Point area over the last 30 years. This study addresses the question, "What are the changes in the coral reef fish community structure that occur through time in the Barbers Point - Kahe Point area?" Community structure is defined as the diversity of species, their abundance and biomass as well as their place in the food web of the coral reef.

This document addresses this question and represents the seventh annual report since monitoring began for the CIP Generating Station and the fifth annual report since it began operating. This report includes a comparative assessment to baseline and during plant construction periods.

2. Natural Events and Impacts to Hawai'i's Coral Reefs

It is a common belief that coral reefs and their fish communities exist in stable environments which have resulted in the high diversity of species that is often seen in these systems. More recent data has shown that the environment in which coral reefs exist is dynamic, i.e., undergoing constant change, thus the organisms are subjected to a variety of stresses, resulting in shifts in community structure and abundance of species (Grassle 1973, Connell 1978, Dollar and Tribble 1993). Indeed, the concept that "intermediate levels of disturbance" may result in higher diversity has been demonstrated in a number of studies of coral communities (Connell 1978, Dollar 1982, Grigg 1983). Benign environments result in final successional stages of coral community development with low species diversity where one or just a few species dominate. This decrease in species diversity is found also with the coral-associated fish communities. Stability in coral species populations has been recently viewed as ever-changing in time and space, where species diverge by genetic drift due to isolation or converge by hybridization, producing constant change which has been described as reticulate evolution (Veron 1995).

Stochastic (i.e., random) processes create a nonequilibrium situation in coral reef communities. A major causal mechanism of stochastic events is the occurrence of occasional storms, which have been shown to be the single most important factor influencing the structure, diversity, and abundance of coral communities in Hawai'i (Dollar 1982, Grigg 1983, Dollar and Tribble 1993). Coral reefs have been described as "temporally varying mosaics" (Bak and Luckhurst 1980) in which the coral community undergoes a continual cycle of disturbance or removal and recovery or renewal. The effects of severe disturbance that drive this cycle have been documented for specific reef areas. The removal or destructive phase due to large storm events has been recorded in the Caribbean (Ball *et al*. 1967, Perkins and Enos 1968, Stoddart 1969, 1974, Woodley *et al.* 1981) and in the Pacific (Blumenstock *et al.* 1961, Cooper 1966, Dollar 1982, Dollar and Tribble 1993, Done *et al.* 1991, Harmelin-Vivien and Laboute 1986, Maragos *et al.* 1973, Ogg and Koslow 1978).

Following the impact of large storm events that disrupt the coral and fish communities is a period of regrowth. This period has received less study because the recovery of most coral communities is a slow process and because having pre-storm study sites where post-storm sampling can be done is rare (Dollar and Tribble 1993). Corals are relatively slow-growing and long-lived, thus the successional processes on most reefs take place on a scale of years to decades (Grigg and Maragos 1974).

In exposed locations in Hawai'i, storm waves keep coral communities at an early point in succession (Dollar 1982, Grigg 1983, Dollar and Tribble 1993). Under such situations, coral colonies never attain any significant size and growth forms are usually prostrate, thus reducing their exposure to wave energy. Since much of the development in the associated fish community

is related to the topographical complexity of the substratum (Risk 1972) and much of this complexity is directly due to the growth of corals, fish community development is usually reduced where coral communities are poorly developed and shelter space is lacking. Besides topographical complexity providing shelter habitat for fishes, the highly variable shelter created by coral communities serves a wide range of invertebrate and algal communities which may be forage for many fish species. Thus the development of coral reef fish communities is often directly linked to the degree of development of coral communities and factors that negatively affect the coral community frequently will have a similar negative impact to the fish community.

In general, many corals in Hawai'i have relatively slow growth rates, and many species produce annual growth bands much like the large conifers of temperate forests (Knutson *et al.* 1972). The large hemispherical colonies of *Porites lobata* do this, accreting about a centimeter per year in radial diameter. In Hawai'i, *P. lobata* colonies may attain diameters in excess of 4 m, thus large colonies may be more than 150 years in age. Under these circumstances, significant storm events do not have to occur with much frequency to have a strong influence on the successional state and development of coral communities where this species occurs.

Since 1980, three major storm events have created large surf that have caused impacts to Hawai'i's reefs over levels that normally occur. The January 1980 storm brought waves which attained heights of at least 6 m, from a south-southwest direction to the islands (Dollar 1982) thus impacting the Barbers Point - Kahe Point region. The next major storm event was Hurricane Iwa, which struck the islands in November 1982. Again, storm waves which attained estimated heights of 9 m, impacted the south and west shores of all islands (Coles and Fukuda 1984). The most recent major storm event was Hurricane Iniki, which passed over Kauai on 11 September 1992 with sustained winds up to 144 miles per hour (mph). It also created large surf that again impacted the south and west shores of O'ahu with storm generated surf arriving from a south-southeast (SSE) direction. On the south shore of O'ahu, wave heights were estimated to reach 8 m (Brock, personal observations).

3. Hawaiian Electric's Environmental Monitoring Program: A Synopsis of Impacts Associated with the Construction and Operation of the Kahe Generating Station (1970's-1980's)

As part of the National Pollutant Discharge Elimination System (NPDES) permit conditions allowing the discharge of thermally-elevated cooling water into the marine environment at Kahe Point, Hawaiian Electric was required to monitor the status of the coral, algae and fish communities in the offshore waters fronting and in the vicinity of the plant. The findings from these early monitoring efforts provide an excellent overview of the environmental changes that occurred in the Kahe Point area prior to the three storm events in 1980, 1982 and 1992 and after the January 1980 and November 1982 events. Studies on coral coverage showed a significant decrease of 7% from 1973 to 1975 and an additional 13% from 1975 to 1977. These decreases were correlated with proximity to the Kahe plant discharge but the analyses did not determine whether the disturbance associated with outfall construction or plant operation were definitive factors producing the mortality. In contrast to the increased mortality, settlement and growth of

coral recruits increased with proximity to the outfall after the plant began operating, which suggests that outfall construction rather than plant operation was the major factor in producing the mortality. Fish populations throughout the study area showed no changes except on the marginal reefs to the northeast of the outfall where both the numbers of species and individuals censused decreased following the commencement of outfall operations. However, the number of intertidal species on the rocky shoreline increased in the areas of thermal impingement (Coles *et al.* 1985a).

In 1978 the analysis of all reef fish population data collected since the beginning of the offshore outfall operation in December 1976 indicated that fish populations were being displaced from the immediate vicinity of the outfall (Coles 1979). The impact caused by the January 1980 "Kona" storm that generated extreme surf on the south and western shores of the islands, however, was much greater than the changes observed from 1976 to 1978. The Kahe study area was heavily impacted by waves at that time. Subsequent survey work found that the 1980 storm was responsible for reductions in coral coverage, fish populations and the redistribution of beach sand that were all much greater than the subtle changes which had occurred in these parameters over the previous seven years (Coles *et al.* 1981).

During 1981, the generating capacity of the Kahe Station was increased by the addition of Unit 6 to a total of 651 MW which increased the cooling water flow to 846 million gallons per day (mgd), a 33% increase above the flow rate for Units 1 to 5. With this change came a reduction in the surface plume area to about one-half while the area of benthic thermal impingement nearly doubled, but was restricted primarily to offshore sand areas. A result of these changes was a moderation in coral coverage declines observed previously but coral reef fish populations continued to decline probably in response to the decrease in reef habitat produced by the 1980 storm (Coles *et al.* 1982).

In November 1982, Hurricane Iwa struck the Hawaiian Islands with most of the damage occurring on Kauai. On O'ahu, damage was greatest along the northwest coastline which included the Kahe Point area. Waves and winds were substantially greater than seen in the January 1980 event with waves heights estimated at 30 feet (Noda 1983). As described in Coles *et al.* (1985a, page 16):

"Surprisingly, coral communities in shallow water areas appeared relatively undisturbed by hurricane wave turbulence. However, reefs further offshore at depths of 20 feet or more appeared to have been substantially destroyed by the force of breaking waves. Measurements of reef coral coverage and fish populations just prior to the hurricane had indicated stable populations compared to the previous year, indicating that damage had resulted from the catastrophic forces released by the hurricane. A further observation of interest was that sand along the reef front had been swept away by the hurricane's waves, exposing reef pavement and rubble that had been buried by up to five feet of sand.

The 1983 monitoring investigations verified the preliminary conclusions that had been determined shortly after Hurricane Iwa occurred. Quantitative estimates indicated substantial

reductions in coral, algal and fish communities corresponding to locations where hurricane wave forces had been greatest. Due to removal of sand from shallow areas and the extreme cutting back of beaches that had occurred during the hurricane, sand entrainment through the Kahe Station was substantially less in 1983 than during previous years. A study of coral recolonization in the area indicated a positive influence of the Kahe outfall in the re-establishing of reef corals on denuded reef surfaces."

Coles and Fukuda (1984) noted the net significant decrease in coverage of 18.7% between 1979-1980 due to the January 1980 storm as measured at the Kahe permanent monitoring stations. Hurricane Iwa contributed a further significant decline of coral offshore of the Kahe facility; in 1982-83 the net change in coral coverage decreased 5.4%. The greater decline in coverage with the 1980 storm relative to Hurricane Iwa was probably related to two facts: (1) since the wave energy of the January 1980 event was less that the 1982 hurricane, the impact of that energy was probably released at shallower depths where coral coverage had been high and (2) Hurricane Iwa occurred just two years after the January 1980 storm event leaving little time for significant coral recovery to occur.

4. The Impact of Hurricane Iniki

As noted above, Hurricane Iniki struck the Hawaiian Islands in September 1992 with high waves impacting the south and west shores of all islands. Fifty-four days after Hurricane Iniki, a qualitative survey was carried out to determine the extent of damage to coral communities in the vicinity of the KGS (Brock 1992a). Fourteen of the more than 38 permanently marked monitoring stations were visited. With respect to coral damage, two general findings emerged: (1) that damage due to storm waves to corals was minimal and was primarily restricted to the cauliflower coral *Pocillopora meandrina.* The reasons for this restricted damage was related to the branching nature of this species as well as the fact that this coral frequently colonizes the tops of high points on hard bottom (i.e., limestone ridges and boulders). In these locations, cauliflower corals have relatively greater exposure to wave energy impinging on the bottom than would coral colonies situated down in depressions. The second finding was that the greatest damage to corals occurred at those stations situated in areas with greatest exposure to wave forces impinging from the SSE direction which was consistent with the direction of Hurricane Iniki's storm waves. Finally, the field survey noted that a considerable amount of sand was removed by the storm at some stations with a net result of a greater amount of hard substratum previously covered by sand was now exposed and available for benthic recruitment. Only one station examined in the study showed evidence of net deposition of loose materials (i.e., coral rubble and broken live pieces) while at all other stations, sand, broken live corals and rubble were not present and assumed to have been advected to deeper water seaward and outside of the study area (Brock 1992a). These findings were similar to those noted in Mamala Bay, southeast of Kahe study area (Brock 1996).

As noted above, Hawaiian Electric carried out environmental surveys following the January 1980 storm and Hurricane Iwa in 1982. Several key observations emerge in comparing the findings following the 1980 storm to those from the post-Hurricane Iniki study: (1) the January

1980 event had a much greater impact to the Kahe coral communities relative to Hurricane Iniki; (2) it caused considerable deposition of sand at many stations which in some cases caused burial of corals; and (3) it was responsible for significant abrasion of many corals which was not obvious following Hurricane Iniki. The finger coral, *Porites compressa*, was present at many of monitoring stations in 1980 and by the time of the post-Iniki survey, this species contributed little to the coverage estimates at sampled stations. Because of its relatively delicate skeletal structure, *P. compressa* is prone to damage by storm surge (Dollar 1982) and the storms since 1980 have probably contributed to the decline of this species at many Kahe Point locations (Brock 1992a).

The energy from the high amplitude, short period waves generated by all three storm events (January 1980, November 1982 and September 1992) was dissipated in deeper water thus coral communities in these deeper areas were potentially exposed to greater impacts (see Dollar 1982, Walsh 1983). As noted by Coles and Fukuda (1984), fully 90 percent of the coral coverage offshore of the Kahe generating facility was at depths of 10 m or more prior to the January storm. These deeper water coral communities apparently received much of the damage in 1980 and again in 1982 with much of that damage occurring to the finger coral, *Porites compressa*. Brock (1992b) examined marine communities southeast of the Barbers Point Deep Draft Harbor two weeks after Hurricane Iniki and found considerable damage to corals below 13 m and the damage was greatest in areas exposed to a SSE swell. Coral communities inshore of this or those protected from a direct SSE swell direction, appeared to have suffered little impact. Brock's observations included the disappearance of a large amount of loose coral rubble in the 12 to 22 m depth range where rubble that had accumulated intermittently along the base of a submarine cliff. Individual estimated volumes were in excess of 2,000 cubic meters (m^3) over linear distances of 30-50 m and this material was not found within diving depths (here from shore to 30 m).

As noted by Brock (1992a, page 5):

"The two storms preceding Hurricane Iniki produced opposite impacts subtidally with respect to the movement of sand offshore of the Kahe facility. The January 1980 storm resulted in the deposition of sand over many reef areas, thus burying or scouring benthic communities. In contrast, Hurricane Iwa resulted in 3 to 5 feet of sand being removed along the seaward edge of the reef exposing coral reef framework that had been formerly covered. Coles and Fukuda (1983) noted '...sand which had been deposited by the Kahe outfall and swept on to the reefs by previous storms was completely removed from along the entire reef front. The substratum available in the area is now similar to the conditions when marine monitoring began in 1973...'. It appears that Hurricane Iniki also removed sand from the area seaward of the forereef but to a much lesser extent than in the November 1982 event (i.e., up to 0.75 m in 1992 versus up to 1.5 m in 1982); perhaps the sand had not returned before the 11 September 1992 storm."

Three strong storms commencing in January 1980 and ending 12 years later with Hurricane Iniki documented change to the bottom communities in the Barbers Point - Kahe Point area. These changes also created a negative impact to the resident fish communities which has been

documented elsewhere in Hawai'i (Walsh 1983). The findings from these past studies, therefore, indicate that knowledge of the past environmental history can lead to a better understanding of the biological resources present in the area today. This environmental history provides the basis for the present study.

METHODS

The fish communities at sixteen permanently marked sites are monitored on a quarterly schedule. These sixteen sites are located in the Barbers Point to Nanakuli area on the west coast of O'ahu (see below). The monitoring of fish communities is carried out using a visual census method. The sampling protocol occurs in the following sequence: on arrival at a given station, the individual conducting the visual fish census enters the water and carries out the visual census over a 50 m long by 4 m wide corridor run parallel to shore. (Station 16, which is located on the Kahe facility's discharge pipe, runs perpendicular to shore and station 11 is only 10.5 m in length). All fishes within this area to the water's surface are counted. Data collected include the species, numbers of individuals and an estimate of the length of each individual fish counted. The length data are later converted to standing crop estimates using linear regression techniques. The diver equipped with SCUBA, transect line, slate and pencil enters the water, counts and notes all fishes in the prescribed area (method modified from Brock 1954). The 50 m transect line is paid out as the census progresses, thereby avoiding any previous underwater activity in the area which could frighten wary fishes. The length data are used in making estimates of biomass for each species present coupling the length data with species-specific regression coefficients (Ricker, 1975, Brock and Norris 1989).

Fish abundance and diversity are often related to small-scale topographical relief over short linear distances. A long transect may bisect a number of topographical features (e.g., cross coral mounds, sand flats and algal beds), thus sampling more than one community and obscuring distinctive features of individual communities. To alleviate this problem, a relatively short transect (50 m in length) has proven adequate in sampling many Hawaiian benthic communities. In addition, the transect length used by Coles *et* al. (1985a) was also 50 m thus making the present counts collected under this program comparable to the earlier data collected by Hawaiian Electric. However as noted above, Station 11 which was originally established by Hawaiian Electric in the 1970's is only 10.5 m in length.

Besides frightening wary fishes, other problems with the visual census technique include the underestimation of cryptic species such as moray eels (family Muraenidae) and nocturnal species, e.g., squirrelfishes (family Holocentridae), aweoweos or bigeyes (family Priacanthidae), etc. This problem is compounded in areas of high relief and coral coverage affording numerous shelter sites. Species lists and abundance estimates are more accurate for areas of low relief, although some fishes with cryptic habits or protective coloration (e.g., the nohus, family Scorpaenidae; the flatfishes, family Bothidae) might still be missed. Obviously, the effectiveness of the visual census technique is reduced in turbid water and species of fishes which move quickly and/or are very numerous may be difficult to count and to estimate individual sizes. Additionally, bias related to the experience of the diver conducting counts

should be considered in making any comparison between surveys. In spite of these drawbacks, the visual census technique probably provides the most accurate nondestructive method available for the assessment of diurnally-active fishes (Brock 1982).

In the analysis of the data, all fishes encountered were classified as to their primary foraging behavior as a means to better understand the trophic relationships in the fish communities. These functional groups are carnivores which includes all fishes feeding on other coral reef animals (fish and invertebrates) greater than zooplankton in size, planktivores which are species that feed primarily on zooplankton and detritus in the watercolumn, herbivores which are species feeding primarily on algae, omnivores which are usually small species that feed on a combination of algae and benthic animals and the coral feeders which are a specialized group of fishes that feed on coral polyps and mucous. The determination of which species were in each feeding guild utilized the findings of Hiatt and Strasburg (1960), Hobson (1974), Brock *et al*. (1979) and Randall (2007). Primarily nonparametric statistical procedures are used thus avoiding the requirements for normality in the data, etc. that are necessary in parametric statistical analyses.

RESULTS AND DISCUSSION

1. Station Locations

To assess the status of coral reef fish communities in the Kahe-Barbers Point area, sixteen permanently marked stations were established. These stations are spread along 7.9 km (4.9 miles) of coastline fronting the CIP Generating Station at Barbers Point on the southeast to the south boundary of the Nanakuli Beach Park on the northwest and their approximate positions are shown in Figure 1 and more precise locations (latitude/longitude) are given in Table 1. Eight stations were established in 2008, prior to the pre-construction monitoring event and the rest are stations established for the Hawaiian Electric environmental monitoring program in the 1970's. Four stations are located offshore of Campbell Industrial Park at Barbers Point in waters from 7 to about 10 m in depth. These stations (Station nos. 1 - 4, Table 1) monitor the status of fish communities in closest proximity to the CIP Generation site and are located to the southeast of the Barbers Point Harbor entrance channel. Two stations are located northwest of the Barbers Point Harbor entrance channel fronting the Ko'Olina Resort and Paradise Cove area (Station nos. 5 and 6, Table 1). Again the water depths at these two stations is from 7 to 9 m. Coles *et al.* (1985) monitored fish community structure at seven stations fronting and adjacent to the KGS. These seven stations are also monitored in the present study (here numbered as Station nos. 7 through 13 in Table 1) to obtain information on the status of these fish communities today and to compare the fish community structure today to what was present at these same locations more than 30 years ago. These stations are in water ranging from 5 m to 12 m in depth.

The previous Hawaiian Electric environmental monitoring program also monitored a control station offshore of Nanakuli (Coles *et al.* 1985a) which has also been added to the stations monitored under the present program (here Station 14, Table 1). A second control station (Station 15, Table 1) approximately 70 m north of Station 14 has been established for the present

monitoring program. Finally Station 16 was established on the Kahe discharge pipe directly offshore of the generating facility in water from 5 to 7 m in depth.

As noted above, the locations of all stations are shown in Figure 1. The "start point" for each station is marked using 90 cm long nylon cable ties and small subsurface floats that are tied to the substratum in proximity to the start point for each transect. Because of high public use by dive tour operators and individuals SCUBA diving from shore fronting the KGS, Stations 7 - 12 as well as Station 16 have not been marked but rely on prominent natural points on the local substratum. Past experience in permanently marking biological monitoring stations in "high use" areas results in divers removing materials of anthropogenic origin thus destroying and negating this method for relocation of stations. Low-cost modern global positioning systems (GPS) can put the diver/monitor within a few feet of any known point. The GPS waypoints for each of the 16 stations sampled in this study are given in Table 1.

2. The 2007-2008 (Preconstruction) Data

During the preconstruction period, fish transect data were collected on five occasions commencing on 27 December 2007. In 2008, transect work was carried out on 4 April, 30 May, 19 August and on 25 November. As noted above, sixteen stations were routinely sampled in this study and these early data are presented in Brock (2009). In the first survey, twelve of the sixteen stations were sampled; missing were Stations 4 (East 4), 5 and 6 (Ko'Olina 1 and 2) and 16 (Hawaiian Electric discharge pipe). The second survey carried out on 4 April only missed one site, Station 16 (the Hawaiian Electric discharge pipe) and by the third survey on 30 May 2008 all sixteen sites were sampled. The Hawaiian Electric thermally-elevated discharge (Station 16) was added as a monitoring station because of the well-developed fish community present at that location. Because station 16 is unusual with a highly developed community on a man-made structure, it is treated separately in many of the analyses below. In total, 122 species of fishes were censused in these first five surveys and these are given in Brock (2009).

3. The 2009 During Construction Data

In 2009 field surveys were conducted on 19 March, 11 May and 21 July. When the fourth quarter 2009 period commenced, weather deteriorated with a series of fronts that started in October 2009 and carried though unabated April 2010. Locally, these weather fronts brought surf as did weather fronts occurring elsewhere in the Pacific which affected the south, west, northwest and north coastline of O'ahu. Surf from these directions impinge on some or all of the sample sites precluding field sampling during these periods. The result was that the fourth quarter 2009 field survey was not completed. Thus the analysis below includes data from the first three quarters of 2009 which represent the during construction period for the new generation facility at Campbell Industrial Park.

4. The 2010 through 2014 Operational Phase Data

In 2010 field surveys were carried out on 29 March, 14 May, 12 August and 29 October

representing the first year of operations of the new generating facility at Campbell Industrial Park. Although the data collection phases have been split into "preconstruction", "during construction" and operational periods, it should be noted that the CIP Generating Station is situated well inland of the ocean and its operation has no direct input to the sea. The 2011 surveys were carried out on 25 February, 16 June, 29 July and 23 November, the 2012 surveys were completed on 2 May, 23 May, 23 July and 2 November 2012, the 2013 surveys were conducted on 3 May, 14 June, 20 September and 18 December 2013. Inclement weather (surf and strong wind) precluded the timely collection of data for the first quarter of 2012, 2013 and 2014. The surveys were carried out once the weather became favorable. In 2014, surveys were completed on 8 May, 6 June, 26 September 2014 and due to intervening inclement weather (surf) the fourth quarter survey was not completed until 27 February 2015. In this report, the four 2014 surveys are referred to as having been completed in 2014 to reduce confusion with future 2015 survey work. The 2014 data are presented below along with a comparative analysis of all data collected to date.

The complete data set from the four 2014 surveys is given in Appendix 1 and this information is summarized in Table 2 along with the earlier (2007-2013) information. Drawing from some of these data and excluding Station 16, we may ask the question, "Are there any statistically significant differences among the mean number of fish species seen per transect, the mean number of individual fish censused per transect or the mean estimated standing crop in grams per square meter (g/m^2) among the twenty-eight 2007-2014 sample periods?" To address this question two nonparametric tests were used: the Kruskal-Wallis analysis of variance (ANOVA) and the Student-Newman-Kuels (SNK) Test. The Kruskal-Wallis ANOVA is able to demonstrate statistically significant differences among parameter means (by date) but cannot show where those differences are. The SNK Test is used to group related sample means and separate those means that are significantly different from one another. The results of these analyses are given in Table 3. Referring to Table 3, the Kruskal-Wallis ANOVA noted no statistically significant differences exist among the means for each of the twenty-eight sample dates for the number of fish species per transect, the number of individual fish censused per transect or for the mean estimated standing crop in g/m^2 per transect. These results point out that when considering grand means for the number of species, number of individuals or biomass (in g/m^2) per transect on each of the twenty-eight sample dates, there are no significant differences. Thus at this level of analysis (i.e., grand means), there is no statistical separation among the dates which suggests a level of stability in the fish communities at these sample sites.

Station 16 established on the terminus of the KGS discharge pipe is discussed separately because it is a man-made structure and deployed in an area with sand bottom. The outfall pipe can discharge up to 861 million gallons per day (mgd) of thermally-heated seawater discharging at its terminus. The topographical relief afforded by the steel and basalt rock substratum as well as coverage by corals is considerably more attractive to many fishes than the nearby surrounding natural reefs and the discharge of thermally-elevated water serves to attract many fishes. These features result in an enhancement of the local fish community making the structure of the fish community very different than that of any other of the fifteen natural reef sites sampled in this study. Thus as noted above, the results of fish censuses undertaken at Station 16 are discussed

separately in most analyses.

The fishes censused in the twenty-eight (December 2007 - December 2014) surveys were assigned to one of five trophic categories or feeding guilds. As noted above, these groups are herbivores (species that feed on algae), planktivores or species that feed up in the water column on zooplankton, omnivores that feed both on plant material as well as small animals, coral feeders which are a specialized group feeding on coral tissue and mucous, and the carnivores which are species feeding on fishes and invertebrates found on coral reefs. In the five surveys carried out during the preconstruction (2007-2008) period, there were 122 species of fishes encountered at the sixteen sample sites. The three surveys conducted in 2009 (during plant construction) found 107 species of fishes at these sixteen sample sites. For the five years covering the operation phase of the facility, there were 109 species of fishes recorded at the sixteen sites in 2010, in 2011, 106 species, in 2012, 100 species, in 2013, 107 species and in the four surveys covering 2014 there were 110 species sighted at the sixteen sites. In total among the twenty-eight surveys, 149 species of fishes have been recorded among the sixteen survey sites. Fifty percent or 74 species encountered were in common among the twenty-eight surveys carried out over the eight-year period. These data suggest a reasonable level of stability in these fish communities.

Of the 149 species of fishes recorded over the twenty-eight surveys, 63% (94 species) are carnivores, 17% (25 species) are herbivores, 10% (15 species) are planktivores, 5% (7 species) are omnivores and 5% (8 species) are coral feeders. The assignment of fish species to the five trophic categories are given in Appendix 1 of this report as well as in Brock (2009, 2010, 2011, 2012, 2013 and 2014) for species encountered on each transect and earlier survey dates. Table 4 summarizes the feeding guild information by survey date providing the mean percent contribution by weight of each trophic category for stations in two groups; the first group includes stations 1 through 15 (natural substratum) and the second group considers only station 16 (the Kahe outfall station). Although the data in Table 4 are in summary form, two facts emerge: (1) that the majority (here 87%) of the weight of fishes censused at the first fifteen stations is comprised of herbivores and carnivores and (2) the importance of herbivores is largely replaced by planktivores at the Kahe outfall station (station 16, here 33.1%) but carnivores remain important at Station 16 (46.8%) as they are elsewhere. The large volume of thermally-elevated water (861 mgd) is probably serving as a source of food (entrained particles that have passed through the plant) and a warm and strong unidirectional current that attracts and holds planktivorous species that naturally orient themselves into the current seeking food. In addition, the steel and armor rock superstructure that covers the Kahe facility's discharge pipe along with high coral coverage provides habitat shelter and for some fish species a suitable substratum for spawning. A considerable part of the planktivore biomass at station 16 is comprised of two sergeant major or mamo species (*Abudefduf abdominalis* and the recently recognized *Abudefduf vaigiensis*) both of which not only feed in the discharge plume and environs, but also lay demersal eggs on the rocky substratum overlaying the discharge pipe. These two species along with the paletail unicornfish or kala lolo (*Naso brevirostris*) dominate the planktivore biomass at this site together comprising almost 41% of the total estimated standing crop present based on the 2008-2013 data but in 2014 it has decreased to 27% of the total estimated standing crop.

4. Differences in Fish Community Structure in the Study Area

This study was undertaken to follow changes in coral reef fish communities as part of the environmental monitoring program related to the development of the CIP generation facility. Sixteen sites spread along 7.9 km of coastline are monitored (Figure 1); referring to Figure 1, these sites geographically fall into four groups: on the southeast are four stations offshore of Campbell Industrial Park and the generation plant (Station nos. 1-4 or East 1 through 4), three stations seaward of Ko'Olina Resort (Station nos. 5-7 or Ko'Olina 1 and 2 as well as Hawaiian Electric 1D), five stations fronting the Kahe generation facility (Station nos. 8-12 or Hawaiian Electric 5B, 7B, 7C, 7D, and 7E) and three stations to the north of Kahe Point (Station nos.13-15 or Hawaiian Electric 10C, Nanakuli 1 and 2). Because Station 16 (the Kahe discharge pipe) is a man-made structure and not natural substratum like the other fifteen monitored sites, it is excluded from the present analysis.

The question, "Are there any statistically significant differences among the mean number of fish species per transect, the mean number of individual fish per transect or the mean estimated standing crop (in g/m^2) per transect among the four above geographic groups of stations established on natural substratum and sampled in the 2007-14 period?" can be answered again using the Kruskal-Wallis ANOVA and the SNK Test. The results of these statistical procedures are given in Table 5. As noted previously, the Kruskal-Wallis ANOVA can discern whether means differ significantly but cannot separate those that are thus the SNK Test is used to demonstrate which means differ significantly from the others. In all cases the ANOVA noted significant differences exist among the four areas (i.e., CIP, Ko'Olina, Kahe and Nanakuli) for all three parameters (i.e., mean number of fish species per transect, mean number of individual fish per transect and mean standing crop of fishes per transect). The SNK Test demonstrated that the mean number of fish species, individuals and standing crops are significantly greater and statistically separable at the Ko'Olina group of stations over the three other station groups, all of which were related (Table 5). Coral community development (coverage) appears to be greater at the three Ko'Olina stations than found at any of the other transect sites and may be responsible for the greater diversity of species, numbers of individuals and standing crops present there.

Summarizing the results presented in Table 5, several non-significant trends are apparent. First, there is no statistical separation among the Nanakuli, Kahe and CIP station groups for the three parameters measured here (i.e., mean number of fish species, individuals or standing crop per transect); secondly the Nanakuli group of stations ranked second to the Ko'Olina group of stations for these three measures and lastly, the CIP and Kahe station groups have similar means especially for the mean number of fish species and individuals. These results are not unexpected because the development of benthic communities, including corals, is greater at Ko'Olina than it is offshore of most Kahe and Nanakuli stations and at all Campbell Industrial Park stations where the topographical complexity which often serves as shelter for fishes is probably the least among the four station groups. Benthic community development, which includes the development of corals and topographical complexity, are probably less at the North group of

stations (Station nos. 13-15) relative to Ko'Olina but greater than found offshore of Kahe or Campbell Industrial Park. The probable reason for the greater estimated standing crops at the CIP and Nanakuli stations over those found at Kahe stations is the presence of cover serving as shelter for fishes. At CIP station 1 there is a natural circular depression (about ten meters in diameter and 1.5 meters deep) having undercut ledges located about 6 meters shoreward of station 1 and at stations 13 and 15 there is considerable cover created by the spur and groove formations. Because these geologic features serve as shelter for these diurnally-active fishes (i.e., surgeonfishes, goatfishes, wrasses, etc.) which if present and foraging out across the substratum away from the cover will occasionally pass through the transect during censusing resulting in higher biomass estimates.

The final statistical analysis of the 2007-2014 fish census data examines the mean number of fish species per transect, the mean number of individual fish per transect and the mean fish biomass per transect (in g/m^2) examining each of the sixteen stations again using the Kruskal-Wallis ANOVA and the SNK Test. In this analysis, the question is "Are there any statistically significant differences between the mean number of fish species per transect, the mean number of individual fish per transect or the mean estimated standing crop among the 16 stations sampled in 2007-2014?" and the results are given in Table 6. Referring to Table 6, the Kruskal-Wallis ANOVA noted strong statistical differences among the means for all three parameters but the SNK Test found few clearly significant differences. These differences were: (1) the Kahe discharge pipe station has a statistically greater mean number of fish species, individuals and standing crop over all other stations and (2) the means from all of the other fifteen stations (located on natural substratum) are all related due to overlap in the SNK Test results except at station 11 where the mean number of fish species is significantly less than at all other stations (all of which are related). Station 11 also has the least mean number of individual fish (non-significant) and the second lowest mean standing crop (not statistically separable). These low numbers are probably related to the poorly developed coral community at station 11 resulting in little shelter present and most importantly, to the short transect length (10.5 m) at this station relative to all others which are 50 m in length. The obviously greater mean number of species, number individuals and standing crop at the Kahe discharge pipe is related to the presence of ample shelter, a unidirectional flow of thermally-elevated water and sufficient food resources present relative to all other stations which are located on natural substratum.

5. Fishery Resources

Appendix 1 in this report as well as in Brock (2009, 2010, 2011, 2012, 2013, 2014) provides lists of all fish species seen over the twenty-eight 2007-2014 surveys. In these lists are both species that are sought-after by commercial, subsistence and recreational fishers as well as species that are usually not. In the usually sought-after group of species, most of the individual fishes encountered on the transects were juveniles but occasionally adult individual fishes were observed. Among the species seen include a number of small schools of the mackerel scad or opelu (*Decapterus macarellus*) especially around stations fronting the Kahe Generating facility in the December 2007 survey and scattered through the various stations and sample dates were seen adults of the moano kea (*Parupeneus cyclostomus*), omilu (*Caranx melampygus*), smaller

individuals (papio) of the barred jack (*Carangoides ferdau*), lemon spot jack (*C. orthogrammus*), ulua aukea (*Caranx ignobilis*), pa'opa'o (*Gnathanodon speciosus*). Adults of other species seen include the lai (*Scomberoides lysan*), uku (*Aprion virescens*), wahanui (*Aphareus furca*), the introduced ta'ape (*Lutjanus kasmira*) especially at stations 13 and 16 and to'au (*Lutjanus fulvus*), weke (*Mulloidichthys flavolineatus*), weke'ula (*M. vanicolensis*), munu (*Parupeneus insularis*), moano (*P. multifasciatus*), malu (*P. pleurostigma*), kumu (*P. porphyreus*), nenue (*Kyphosus sandwicensis*), 'a'awa (*Bodianus bilunulatus*), kupoupou (*Cheilio inermis*), po'ou (*Oxycheilinus unifasciatus*), laenihi (*Iniistius umbrilatus*), the parrotfishes or uhus (*Scarus rubroviolaceus, S. psittacus, S. sordidus, S. perspicillatus, Calotomus carolinus*), the surgeonfishes including paku'iku'i (*Acanthurus achilles*), palani (*A. dussumieri*), maikoiko (*A. leucoparieus*), ma'i'i'i (*A. nigrofuscus*), maiko (*A. nigroris*), na'ena'e (*A. olivaceus*), manini (*A. triostegus*), pualu (*A. xanthopterus* and *A. blochii*), kole (*Ctenochaetus strigosus*), kala lolo (*Naso brevirostris*), kala holo (*N. hexacanthus*), umaumalei (*N. lituratus*), kala (*N. unicornis*), paki'i (*Bothus pantherinus*), humuhumu ele'ele (*Melichthys niger*), humuhumu hi'ukole (*M. vidua*) and the loulu (*Aluterus scriptus*). Besides these species as adults, juveniles of these and other species (e.g., the mu - *Monotaxis grandoculis*) were seen. Many of the adult individual fishes in the highly sought-after group were seen at varying distances away from the actual census areas, thus some species do not appear in the station counts (Appendix 1 of this and earlier reports).

Usually the most consistent location for finding many of the sought-after fish species both as adults and as juveniles is on the armor rock and coral encrusted steel protective cover for the Kahe plant warm-water discharge (Station 16). Because of the high degree of shelter provided by the armor rock as well as the well-developed coral community present on it and also due to the outfall (discharge), many species congregate there. Among these are many mamo (two species recognized, the Hawaiian mamo - *Abudefduf abdominalis* and the recently recognized species *Abudefduf vaigiensis*). Under the cover of the rocks are seen menpachi (*Myripristes amaneus*), aweoweo (*Priacanthus cruentatus*) and 'upapalu (*Apogon kallopterus*). In the December 2007 survey an estimated 200 grey mullet or ama'ama (*Mugil cephalus*) were encountered at Station 13. These fish had an average estimated length of 33 cm (~13 inches) contributing an estimated weight of 97.7 kilograms (215 lbs) to the standing crop at this station.

Many coral reef species other than fish are caught and consumed by people; among these are specific algae and a number of invertebrates. Some individuals are interested in the collection of shells and when these usually cryptic species are seen at a station, they are so noted. Two species of molluscs have been seen on several occasions in the 2007-2014 surveys; these are the tiger cowry (*Cypraea tigris*) and the triton shell (*Charonia tritonis*). A species important in the making of fishing lures is the pearl oyster or pa (*Pinctado margaritifera*) which is protected by law and is commonly seen at many of the survey sites. The octopus or he'e (*Octopus cyanea*) was occasionally encountered at some of the stations. Individual he'e ranged from less than a pound in weight up to an estimated four pounds. The sought-after alga, limu kohu (*Asparagopsis taxiformis*) is seasonally common at many of the stations sampled in this study.

6. Standing Crops

Coral reefs function as relatively closed systems and thus in the pristine situation may represent the accumulation of carbon over a considerable period of time (Johannes *et al.* 1972). Some of this carbon is tied up in the living biomass of the reef of which fishes are only a part. Goldman and Talbot (1975) have suggested that a reasonable maximum biomass of coral reef fishes is approximately 200 g/m^2 or 2,000 kilograms per hectare (kg/ha). Space and cover are important agents governing the distribution of coral reef fishes (Sale 1977). Similarly the standing crop of fishes on a reef is correlated with the degree of vertical relief of the substratum (Risk 1972). Studies conducted on coral reefs in Hawai'i and elsewhere have estimated fish standing crops to range from 20 to 200 g/m^2 (Brock 1954, Goldman and Talbot 1975, Brock *et al.*1979). Eliminating the direct impact of man due to fishing pressure and/or pollution, the variation in standing crop appears to be related to the variation in the local topographical complexity of the substratum which is governed, in part, by the degree of development in the coral community. Thus habitats with high structural complexity affording considerable shelter space usually harbor a greater estimated standing crop of coral reef fish; conversely, transects conducted in structurally simple habitats (e.g., sand flats) usually result in lower estimated standing crops (0.2 to 20 g/m^2). Local studies (Brock and Norris 1989) suggest that with the manipulation (increasing) of habitat space or food resources (Brock 1987), fish standing crops may approach 2,000 g/m^2. Thus under certain circumstances, coral reefs may be able to support much larger standing crops of fishes than previously realized.

High standing crops (i.e., above 200 g/m^2) were encountered during most surveys at several stations. In the 27 December 2007 survey at Station 9 where the estimated standing crop was 290 g/m^2, the opelu (*Decapterus macarellus*) made up 89% of this total at that location. Opelu are a coastal neritic species meaning that they school and move freely through the coastal waters which is very different than many coral reef fish species that have much smaller areas in which they forage. Similarly at Station 13 where the standing crop was estimated to be 594 g/m^2, the school of grey mullet or ama'ama (*Mugil cephalus*) described above comprised 82% of the total biomass. Again, ama'ama are usually seasonal in their appearance in coastal waters and travel over large areas of Hawai'i's waters. In the 4 April 2008 survey at Station 2, a school of 60 adult na'ena'e (*Acanthurus olivaceus*) swam through the census area bringing the total estimated biomass to 238 g/m^2 and these fish comprised 84% of the total weight present at this station. The 30 May 2008 survey noted a high standing crop at Station 16 (358 g/m^2) where the mamo (*Abdufduf abdominalis* and *A. viagiensis*) made up 29% of the total and the kala lolo (*Naso brevirostris*) added 13% to the total estimated weight at this station. On 19 August 2008 at Station 16 the estimated biomass was 396 g/m^2 and again, the mamo comprised 51% of the total and a school of opelu passed through the census area and contributed 22% to the standing crop present at this station. In the 25 November 2008 survey at Station 16 where the estimated standing crop was 225 g/m^2, the two mamo species again comprised 38% of the biomass present at that time. In March 2009 survey Station 6 had an estimated sanding crop of 259 g/m^2 and the palukaluka (*Scarus rubroviolaceus*) contributed 16% of the standing crop while the na'ena'e (*Acanthurus olivaceus*) added 40% to the biomass at this station. At Station 16 the where the standing crop was estimated to be 577 g/m^2, two mamo species made up 15%, the kala lolo

(*Naso brevirostris*) contributed 15% and the uhu (*Scarus sordidus*) added 22% to the standing crop present. In the May 2009 survey Station 5 had an estimated standing crop of 224 g/m^2 and the na'ena'e (*Acanthurus olivaceus*) made up 33% of it while at Station 16 where the standing crop was estimated to be 425 g/m^2, the two mamo species comprised 20% of the total weight present. The July 2009 survey noted that the estimated standing crop at Station 4 was 209 g/m^2 and the na'ena'e (*Acanthurus olivaceus*) made up 70% of it while at Station 5 the standing crop was 267 g/m^2 and again, na'ena'e made up 30% of the total biomass present. The standing crop of fishes at Station 16 was estimated to be 431 g/m^2 and the two mamo species made up 27% of it while the kala lolo (*Naso brevirostris*) added 8% to the biomass present.

The 29 March 2010 survey noted only one station with an estimated standing crop greater than 200 g/m^2; this was Station 16 where the standing crop was 561 g/m^2 and the opelu (*Decapterus macarellus*) comprised 26% and the kala lolo (*Naso brevirostris*) made up 24% of the total estimated standing crop at this station. The 14 May survey encountered estimated standing crops in excess of 200 g/m^2 at two stations; Station 5 noted a biomass of 242 g/m^2 with the na'ena'e (*Acanthurus olivaceus*) contributing 62% of this estimated weight and the kole (*Ctenochaetus strigosus*) adding another 13% to the total weight at this station. The estimated standing crop at Station 16 was 390 g/m^2 and the two mamo species (*Abudefduf abdominalis* and *A. viagiensis*) contributed 35% of this estimated weight and the kala lolo (*Naso brevirostris*) added 25% to the total at this station. In the 12 August 2010 survey the standing crop at Station 15 was estimated to be 207 g/m^2 and the whitebar surgeonfish or maiko'iko (*Acanthurus leucoparieus*) provided 27% of this total and the na'ena'e (*Acanthurus olivaeus*) added 52% to the standing crop at this station. Again the estimated biomass at Station 16 in the August 2010 survey was elevated (603 g/m^2) and five species were important contributors: the opelu (*Decapterus macarellus* - 25%), the two mamo species (*Abudefduf abdominalis* and *A. viagiensis* - 13%), the hinalea lauwili (*Thalassoma duperrey* - 18%) and the kala lolo (*Naso brevirostris* - 11%). The 29 October 2010 survey found three stations with estimated standing crops in excess of 200 g/m^2. The standing crop at Station 7 was estimated to be 245 g/m^2 and the humuhumu ele'ele (*Melichthys niger*) added 49% to the total and the red weke or weke'ula (*Mulloidichthys vanicolensis*) contributed 26%. At Station 9 the standing crop was estimated to be 730 g/m^2 where a large school of white weke (*Mulloidichthys flavolineatus*) in the transect area made up 99% of the biomass at this station. Finally at Station 16 the biomass was estimated to be 554 g/m^2 and several schools of opelu (*Decapterus macarellus*) made up 41% of the total and a school of blue-lined snapper or ta'ape (*Lutjanus kasmira*) added 23% to the total at this station.

The 25 February 2011 survey noted only one station with a high estimated standing crop which was Station 16 on the Kahe discharge pipe where the estimated standing crop was 430 g/m^2 and the bluelined snapper or ta'ape (*Lutjanus kasmira*) comprised 52 percent of it and the kala lolo (*Naso breivrostris*) made up 21 percent of the estimated weight at this station. The 16 June survey found a high standing crop (273 g/m^2) at Station 3 where the na'ena'e (*Acanthurus olivaceus*) made up 75 percent of the total estimated weight recorded at this station. At Station 6 the standing crop was estimated to be 206 g/m^2 and the palukaluka (*Scarus rubroviolaceus*) contributed 38 percent to this and the na'ena'e (*Acanthurus olivaceus*) added 27 percent to this estimated biomass while at Station 16 the standing crop was estimated to be 318 g/m^2 and the

two mamo species (*Abudefduf abdominalis* and *A. viagiensis*) added 25 percent while the kala lolo (*Naso brevirostris*) contributed 33 percent to the total at this station. In the 29 July 2011 survey the standing crop at Station 3 was 435 g/m^2 and the na'ena'e (*Acanthurus olivaceus*) made up 89 percent of the total while at Station 6 where the standing crop was 234 g/m^2, the na'ena'e comprised 22 percent and the palukaluka (*Scarus rubroviolaceus*) added 24 percent to the biomass at this station. Again the standing crop at Station 16 was high (436 g/m^2) and the ta'ape (*Lutjanus kasmira*) contributed 32 percent, the weke'ula (*Mulloidichthys vanicolensis*) added 23 percent while the kala lolo (*Naso brevirostris*) comprised 17 percent of the biomass at this station. Finally the 23 November 2011 survey found a high standing crop at Station 2 (263 g/m^2) and Station 3 (379 g/m^2) both due to the na'ena'e (*Acanthurus olivaceus*) making up 67 percent at Station 2 and 60 percent at Station 3. At Station 10 on this date, a school of weke'ula (*Mulloidichthys vanicolensis*) made up 71 percent of the estimated 318 g/m^2 and at Station 16 another school of weke'ula comprised 66 percent of the total 681 g/m^2 estimated biomass at this station.

In the four 2012 surveys, all standing crop estimates at stations in the 2 May and 23 July surveys were less than 200 g/m^2. However in the 23 May 2012 survey at Station 16 the standing crop of fishes was estimated to be 214 g/m^2 and the species contributing heavily to this biomass include the Indo-Pacific sergeant (*Abudefduf vaigiensis*) which added 19% to the station total. In the 2 November 2012 survey, the standing crop again at Station 16 was estimated to be 334 g/m^2 and a school of mackerel scad or opelu (*Decapterus macarellus*) contributed 50% to this biomass and the hinalea lauwili (*Thalassoma duperrey*) added 14% and the Indo-Pacific sergeant (*Abudefduf vaigiensis*) accounted for 11% of the total at this station.

Four surveys were completed in 2013 with the first being carried out on 3 May. Standing crop estimates at three stations exceeded 200 g/m^2; at Station 5 (Ko'Olina 1) the estimated biomass was 238 g/m^2 due largely to the manini (*Acanthurus triostegus*) making up 36% of the total and the na'ena'e (*Acanthurus olivaceus*) adding 46% to the total at this station. At Station 8 (Kahe 5-B) the standing crop was estimated to be 225 g/m^2 and the na'ena'e (*Acanthurus olivaceus*) made up 91% of the total at this station. Once again opelu (*Decapterus macarellus*) were present around the Kahe plant outfall (Station 16) during the 3 May survey comprising 50% of the total standing crop that was estimated to be 348 g/m^2. The 14 June 2013 survey noted a high standing crop at Station 2 (238 g/m^2) which was due to the na'ena'e (*Acanthurus olivaceus*) making up 85% of the estimated biomass at this station and at Station 16 (Kahe outfall) the standing crop was estimated to be 294 g/m^2 and the uhu (*Scarus sordidus*) comprised 27% of the total and the two mamo species (*Abdufduf abdominalis* and *A. viagiensis*) contributed 21% to the total at this station. The 20 September 2013 survey noted an extremely high standing crop (1,619 g/m^2) at Station 9 (Kahe 7B), 98% of which was due to a school of pelagic halfbeaks or iheihe (*Hyporhamphus pacificus*) passing through the transect area during the census. The standing crop at Station 12 (Kahe 7E) was estimated to be 372 g/m^2 and a passing school of the opelu (*Decapterus maracrellus*) made up 75% of that total. Once again the standing crop at Station 16 (Kahe discharge) was estimated to be 413 g/m^2 and the opelu (*Decapterus macarellus*) contributed 11%, the uhu (*Scarus psittacus*) added 28% and the two mamo species (*Abudefduf abdominalis* and *A. vaigiensis*) provided 24% to the total for this station. The fourth

quarter survey was carried out on 18 December 2013 where at Station 2 (CIP 2) the standing crop was estimated to be 281 g/m^2 and na'ena'e (*Acanthurus olivaceus*) added 67% and at Station 16 (Kahe outfall) the standing crop was estimated to be 296 g/m^2 and the weke'ula (*Mulloidichthys vanicolensis*) contributed 39%, the hinalea lauwili (*Thalassoma duperrey*) added 15% and the two mamo species (*Abudefduf abdominalis* and *A. viagiensis*) provided 13% to the total at this station.

The first quarter 2014 survey carried out on 8 May noted only Station 16 (Kahe discharge pipe) having an estimated standing crop greater than 200 g/m^2; in this case the standing crop was 346 g/m^2 where the ta'ape (*Lutjanus kasmira*) contributed 32% and the two mamo species (*Abudefduf abdominalis* and *A. vaigiensis*) added 27% to the total. In the second quarter survey on 6 June 2014 at Station 13 (Kahe 10), the estimated standing crop was 236 g/m^2 where a school of akule (*Selar crumenophthalmus*) made up 30% of the total and the often resident school of ta'ape (*Lutjanus kasmira*) was encountered during the census and they contributed 53% to the total estimated standing crop. At Station 16 (Kahe pipe), the standing crop was estimated to be 253 g/m^2 and the paletail unicornfish or kala lolo (*Naso brevirostris*) made up 16% and the two mamo species (*Abudefduf abdominalis* and *A. vaigensis*) comprised 32% of the total at this station. The third quarter 2014 survey was carried out on 26 September and at Station 1 (CIP 1) the standing crop was estimated to be 336 g/m^2 where the manini (*Acanthurus triostegus*) made up 10%, the na'ena'e (*Acanthurus olivaceus*) added 37% and the pualu (*Acanthurus blochii*) contributed 33% to the total at this station. At Station 6 (Ko'Olina 2) the standing crop was estimated to be 212 g/m^2 and the nenue (*Kyphosus bigibbus*) contributed 20% and the na'ena'e (*Acanthurus olivaceus*) added 32% to the total at this station. Finally on this same date at Station 16 (Kahe pipe) the standing crop was estimated to be 215 g/m^2 and the ta'ape (*Lutjanus kasmira*) made up 12% of the total, the hinalea lauwili (*Thalassoma duperrey*) and uhu (*Scarus sordidus*) each added 11% to the total at this station. As noted above, near-continuous high surf in the October 2014 through early February 2015 period precluded carrying out the fourth quarter 2014 field work until 27 February 2015 where three of the sixteen stations had standing crops above 200 g/m^2. Station 7 (Kahe 1D) had an estimated standing crop of 215 g/m^2 where the yellowstripe goatfish or weke (*Mulloidichthys flavolineatus*) made up 13% of the total, the maiko (*Acanthurus nigroris*) added 19% and the humuhumu 'ele'ele (*Melichthys niger*) contributed 28% to the total present at this station. In this fourth quarter survey, Station 13 (Kahe 10) had an estimated standing crop of 471 g/m^2 where the weke (*Mulloidichthys flavolineatus*) contributed 40% of the total and the weke'ula (*Mulloidichthys vanicolensis*) added 48% to this standing crop. Lastly, Station 16 (Kahe pipe) had an estimated standing crop of 386 g/m^2 where the ta'ape (*Lutjanus kasmira*) comprised 25%, the uhu (*Scarus sordidus*) added 22% and the two mamo species (*Abudefduf abdominalis* and *A. vaigiensis*) contributed 21% to the total for this station.

A simple review of the above data finds that the same species often contribute substantially to the estimated standing crops at the same stations over time. A major reason for this is despite many stations not having a high degree of topographic complexity present in the 4 x 50 m transect areas, is the foraging behavior of the species involved. Since many of the fishes encountered on a transect such as the na'ena'e (*Acanthurus oliveceus*), maiko (*Acanthurus*

nigroris), manini (*Acanthurus triostegus*), pualu (*Acanthurus blochii* and *A. xanthopterus*), uhus (*Scarus sordidus* and *S. psittacus*) and the palukaluka (*Scarus rubroviolaceus*) move and forage over areas considerably larger than the census area, they often will pass through the census area while it is being surveyed and are thus counted. In other instances such as at the Kahe outfall station (Station 16), the presence of a unidirectional flow of warm discharge water containing particles that may serve as food as well as the high degree of topographical complexity all serve to draw both sedentary and more mobile fish species to the area including opelu (*Decapterus macarellus*) and weke'ula (*Mulloidichthys vanicolensis*).

7. Comparative Analysis of Early Hawaiian Electric Biological Data to the 2007-2014 Data

As noted above, Hawaiian Electric's environmental monitoring program started in the 1970's. Many of the same survey sites are being monitored today. These data are given in Coles *et al.* (1985b) and in a summary table (Table 33) in Coles *et al.* (1985a). Fish transect data from seven stations sampled in the 1976-1984 period fronting the Kahe Generating facility have been compared to the 2007-2014 data collected from those same sites. The previous survey sites include Station 7 (#1-D started in 1979), Station 8 (#5-B started in 1976), Station 10 (#7-C started in 1976), Station 11 (#7-D started in 1976), Station 12 (#7-E started in 1980), Station 13 (#10-C started in 1979) and Station 14 (Nanakuli control started in 1979). In this analysis, the annual means for the number of fish species and number of fish individuals encountered over those seven stations in common between the two groups of surveys are compared by addressing the question, "Are there any statistically significant differences among the annual mean number of fish species or annual mean number of individual fish censused per transect over the 1979-1984 and 2007-2014 periods?" Again, to address this question two non-parametric tests were used: the Kruskal-Wallis analysis of variance (ANOVA) and the Student-Newman-Kuels (SNK) Test where the Kruskal-Wallis ANOVA is used to demonstrate statistically significant differences among parameter means (by date) but cannot show where those differences are and the SNK Test is used to group related sample means and separate those means that are significantly different from one another.

The results of these analyses are given in Table 7 and referring to this table, it is shown that there are no significant differences among either of the annual means for the number of fish species seen per transect or the number of individual fish censused per transect despite the imposition of three major storm events. With respect to the annual mean number of species per transect, we find the greatest annual means occurring prior to the January 1980 storm event and the lowest mean (1983) occurring following Hurricane Iwa in 1982. With the annual mean number of individual fish seen per transect, the highest means occur with the recent (2007-2014) surveys and the lowest following Hurricane Iwa (1983) but the order among the dates does not parallel that for the mean number of fish species (Table 7). Thus not all species of fish were impacted to the same degree with the occurrence of these two early high wave events. Fish standing crop information was not readily available for Stations 7, 8, 10, 11, 12, 13 or 14 in the early (1976-1984) Hawaiian Electric dataset except for 1984, thus it was not included in the above (Table 7) analysis. However, the non-parametric Wilcoxon Two-Sample Test was used

to examine the mean estimated standing crop of fishes in 1984 at the above seven stations comparing this mean to the mean estimated biomass at these stations in the 2007-2014 dataset. Despite the mean estimated standing crop (here 57 g/m^2) being greater in 2007-2014 than in 1984 (26 g/m^2), the Wilcoxon Two-Sample Test failed to find any statistically significant differences ($p>0.22$, n.s., where a $p<0.05$ signifies significance) in the estimated standing crop at these seven stations sampled minimally 22 years apart. Again the standing crop statistical results support those found with the mean number of fish species or the mean number of individual fish censused per transect (Table 7).

In summary, there are no statistically significant differences among the annual mean number of fish species or individuals censused utilizing data that span a 38-year period (1976-2014) at seven monitoring stations fronting the Kahe Generating Station despite the imposition of three major storm events in 1980, 1982 and 1992 (see Section 2 of this report). These data suggest that the fish communities have to some extent recovered from these disturbances.

8. Federally Protected Species

When encountered during field work, federally protected species are noted. Five species that are encountered (or heard underwater) around the high Hawaiian Islands are the green turtle (*Chelonia mydas*), the hawksbill turtle (*Eretmochelys imbricata*), the spinner porpoise (*Stenella longirstris*), the Hawaiian monk seal (*Monachus schauinslandi*) and present seasonally, the humpback whale (*Megaptera novaeangliae*).

Because of low population numbers, the Hawaiian green sea turtle was given protection under the federal Endangered Species Act in the mid-1970's. Green turtles as adults are known to forage and rest in the shallow waters around the main Hawaiian Islands. Reproduction in the Hawaiian population occurs primarily during the summer months in the Northwest Hawaiian Islands with adults migrating during the early summer to these isolated atolls and returning in the late summer or early fall. In the main Hawaiian Islands, green turtles rest during the day along ledges, caves or around large coral mounds in coastal waters usually from 15 to 20 m in depth. Under the cover of darkness, turtles will travel inshore to shallow subtidal and intertidal habitats for foraging on algae or limu. (Balazs *et al.* 1987). The normal range of these daily movements between resting and foraging areas is about one kilometer (Balazs 1980, Balazs *et al.* 1987). In general, appropriate algal forage for these turtles is found in shallow waters inshore of the resting areas. Selectivity of algal species consumed by Hawaiian green turtles appears to vary with the locality of sampling, but stomach content data show *Acanthophora spicifera* (an introduced species) and *Amansia glomerata* to quantitatively be the most important (Balazs *et al.* 1987); the preferences may be due to the ubiquitous distribution of these algal species.

The Hawaiian green turtle population has rebounded under the more than 30 years of federal protection afforded to it such that today, green turtles are commonly seen in the waters fronting most beaches around the islands. In contrast, the hawksbill turtle is much less common and much less is known about its biology in Hawaiian waters. Hawksbill turtles do not attain the size of green turtles in Hawaiian waters, nest on very small and isolated beaches around the main

islands and are omnivorous in their feeding habitats. In the waters surveyed under the present study, no hawksbill turtles have been observed.

Green turtles were observed on seventeen of the twenty-eight surveys completed to date. All turtles seen were juveniles (i.e., having a carapace length estimated to be less than 75 cm) except for a pair of adults (estimated straight-line carapace lengths = 90 cm) in the 10 August 2010 survey at Station 9 and a single individual (~85 cm) at Station 5 in the 20 September 2013 survey. Some turtles were sleeping while others observed were actively swimming. There is a depression in the limestone at Station 8 where green turtles often rest; in 2009 a small (~45 cm straight-line carapace length) green turtle was observed in this depression in the 19 March and 21 July 2009 surveys. In the August 2010 and 16 June 2011 surveys this same depression was occupied by a ~65 cm sleeping juvenile turtle. On the 23 November 2011 survey two turtles (~ 60 cm and ~70 cm) were found in this same depression sleeping and on the 23 May 2012 survey this depression was occupied by an ~75 cm resting turtle. In the 14 June 2013 survey an approximate 45 cm turtle was observed resting in the same depression at station 8 and in the 20 September 2013 survey a 60 cm turtle was resting at this same location as was the case in the 8 May 2014 survey. This same depression was once again occupied by a ~40 cm turtle in the 18 December 2013 survey. In the 25 November 2008 survey six green turtles were found resting on the bottom in a depression just seaward of Station 5 and again on the 23 May 2012 survey a single juvenile turtle (~70 cm) was observed at Station 16 (the Kahe Generating Station warm-water discharge) swimming in a northwest direction and in the 18 December 2013 survey a 40 cm individual green turtle was seen swimming towards shore along the discharge pipe. In the 14 June 2013 survey, green turtles were also observed at Station 6 (~70 cm) and a second individual at Station 9 (~75 cm). Turtles were again observed around the Kahe plant discharge in two of the four 2014 surveys; the first was encountered on 6 June (~70 cm individual) and again on 27 February 2015 (~50 cm individual). In no cases were any tags or tumors identified on any of the turtles sighted to date.

For many years, Hawaiian monk seals were not seen very often around the main Hawaiian Islands but the population was located in the Northwest Hawaiian Islands and over time the population numbers have declined. Despite this, in recent years an increasing number of Hawaiian monk seals are now seen on the beaches around the main islands with the occasional female giving birth on island beaches. The reason(s) for these changes in the population are unknown but the result is monk seals are now occasionally seen while carrying out environmental surveys around the main islands. On the 30 May 2008 survey an adult male monk seal approached the vessel while at anchor at Station 14. This seal carried a tag (not readable at distance) and it swam around the vessel and subsequently left heading towards the shoreline. This seal has not been seen since. In the 14 June 2013 survey while conducting census work on the Kahe facility discharge pipe, a spear fisherman swam up to the survey vessel and reported that two monk seals were presently on the beach resting near the discharge pipe. He said that on the day prior, this pair of seals took all of his speared fish and one of the seals was “aggressive”. These seals were not observed by us. Finally on 8 May 2014 while anchored on the discharge pipe a large seal was observed inshore of where we were conducting the fish census. This seal did not approach either the vessel or survey divers.

It should be noted that the endangered humpback whale is known to frequent island waters in their annual migrations to Hawaiian wintering grounds. They normally arrive in island waters about December and depart by April. In general their distribution in Hawaii appears to be limited to the 180 m (100 fathom) isobath and in shallower waters (Nitta and Naughton 1989). Whales were observed further seaward of the Barbers Point - Kahe Point study area and their songs could be heard underwater during the 27 December 2007, the 19 March 2009, the 24 March 2010, the 25 February 2011, 18 December 2013 and 27 February 2015 surveys.

Spinner porpoises are occasionally observed in the Kahe Point area and were first encountered there during this study on the 30 May 2008 survey where three pods were seen each having about 35 individuals present. In the 14 May 2010 survey a pod of about 30 individuals passed by during a census at station 10 and in the 23 July 2012 survey a small pod of approximately 20 porpoises were seen traveling northwest seaward of Stations 5 and 6. On the 18 December 2013 survey a small pod of spinner porpoises (estimated 15 individuals), were seen moving west just seaward of Station 7. Hawaiian spinner porpoises are known to rest in shallow bays during the day and at night move offshore to feed on midwater fishes and squids that rise to the surface to forage.

9. Long-Term Perspective on the Barbers Point-Kahe Point Fish Communities

As noted and documented above, the three early storm events (1980, 1982 and 1992) all impacted marine communities offshore of the Barbers Point - Kahe Point areas. These impacts were probably greatest on the coral communities which due to their sessile nature, must withstand the wave forces impinging on them or perish. Corals are relatively slow-growing and depending on the species, individual colonies may live for a considerable time and in doing so create habitat for fishes and other reef species. If disturbance to the coral community is relatively frequent, surviving corals probably do not contribute much to the three-dimensional structure of the habitat, thus keeping the fish community development in an earlier successional stage than it might otherwise be. Storms not only directly impact the living resources but also the geological condition of reef areas. As noted by the early Hawaiian Electric studies, considerable sand movement occurred with the first two major storms that occurred in 1980 and 1982 and today much of the area west of the Kahe facility's ocean outfall is now nearly devoid of sand leaving a near-featureless hard bottom that is scoured with passing small wave events that retard benthic and fish community development. A similar situation exists east of the Barbers Point Harbor entrance channel where considerable hard (limestone) substratum is present with much of it having poor benthic community development. This again results in a poorly developed resident fish community, which is what we see in much of the area today and did so forty years ago (Brock, personal observations). Thus the measures of fish community development used here (the diversity of species and numbers of individuals present as well as the standing crop) do not suggest well-developed resident fish communities at many of the sample sites. However, where topographical complexity is greater and benthic communities are better developed, the resulting fish communities are well-developed. This is best illustrated at Station 16 located at the terminus of the Kahe facility discharge, where, despite high use which includes snorkel/dive tours as well as spear fishermen, the fish community remains relatively well-

developed. The high degree of development in the resident fish communities on the Kahe discharge structure lend further support to the lack of negative impact due to the operation of the discharge.

Given the long-term extant data set spanning 38 years and the apparent lack of strong significant changes occurring with the three early (1980, 1982 and 1992) storm events (which is probably due to some level of recovery in the intervening period), suggests that the variation seen in the measures of the fish community used here will continue to fluctuate at a similar magnitude in future monitoring events as this program moves forward. The 38 years of well-documented environmental history for the Barbers Point - Kahe Point area (completed largely by the Hawaiian Electric environmental program), provides much of the explanation to the degree of development of resident fish communities we encounter in the area today.

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TABLE 1. Latitude and Longitude waypoints (in decimal minutes) for each of the sixteen permanently marked fish monitoring stations utilized in this study (GPS waypoints courtesy of the Environmental Department, Hawaiian Electric). Note that the first survey carried out on 27 December 2007 did not sample station numbers 5, 6, 7 and 16. The second survey on 4 April 2008 missed station 16 while surveys carried out subsequently on 26 occasions have sampled all sixteen sites.

Station No.	Station Area Name	Latitude	Longitude	Remarks
1	East 1	21°18.237' N	158°07.024'W	New- offshore CIP
2	East 2	21°18.452'N	158°07.152'W	New - offshore CIP
3	East 3	21°18.558'N	158°07.239'W	New - offshore CIP
4	East 4	21°18.406'N	158°07.285'W	New - offshore CIP
5	Ko'Olina 1	21°19.724'N	158°07.581'W	New - offshore Ko'Olina
6	Ko'Olina 2	21°19.904'N	158°07.693'W	New - offshore Ko'Olina
7	HECO station 1D	21°20.763'N	158°07.773'W	Old Hawaiian Electricstation
8	HECO station 5B	21°21.145'N	158°07.819'W	Old Hawaiian Electric station
9	HECO station 7B	21°21.239'N	158°07.855'W	Old Hawaiian Electric station
10	HECO station 7C	21°21.255'N	158°07.881'W	Old Hawaiian Electric station
11	HECO station 7D	21°21.268'N	158°07.893'W	Old Hawaiian Electric station
12	HECO station 7E	21°21.272'N	158°07.977'W	Old Hawaiian Electric station
13	HECO station 10C	21°21.522'N	158°07.925'W	Old Hawaiian Electric station
14	Nanakuli Control 1	21°22.329'N	158°08.440'W	Old Hawaiian Electric station
15	Nanakuli Control 2	21°22.353'N	158°08.462'W	New control station
16	On Outfall	21°21.193'N	158°07.869'W	New north side of outfall

TABLE 2. Summary of the fish censuses carried out at sixteen locations on twenty-eight surveys over the December 2007 - February 2015 period. The percent of the total biomass is that assigned to each of five trophic categories: herbivores, planktivores, omnivores, carnivores and coral feeders is also given. Note that these percentages are rounded to the nearest whole number.

Sample Date	Transect No.	No. Species	No. Individuals	Biomass g/m2	% Total Biomass (g) Herb.	Plankt.	Omni	Carni	CF
27-Dec-07	1	12	69	15	18		1	51	30
	2	19	155	143	87			9	4
	3	30	189	41	28		6	51	15
	4	Not sampled							
	5	Not sampled							
	6	Not sampled							
	7	28	306	92	40		40	19	1
	8	25	241	43	51	7	3	39	
	9	23	259	290	6	1	1	92	
	10	17	261	154		9	3	88	
	11	13	23	104	6		5	82	7
	12	34	581	63	21	1	24	51	3
	13	31	580	594	85	3	1	11	
	14	18	124	7	23	2	3	72	
	15	23	164	94	51		8	40	1
	16	Not sampled							
04-Apr-08	1	10	129	8		1	1	59	39
	2	25	333	238	89		1	9	1
	3	18	146	21	38		7	54	1
	4	25	270	116	57		3	37	3
	5	34	307	146	81	2	2	13	2
	6	31	292	164	67	1	2	29	1
	7	21	365	158	14		75	11	
	8	27	499	29	26	5	4	64	1
	9	17	75	74	25	1	1	73	
	10	11	117	8	42	1	5	52	
	11	6	21	4		1	2	97	
	12	25	390	31		1	15	79	5
	13	16	401	62	3	15	7	70	5
	14	12	260	14	1	1		98	
	15	17	214	129	83		1	15	1
	16	Not sampled							
30-May-08	1	12	77	9		1	17	82	
	2	21	220	64	65			34	1
	3	22	136	37	24		9	62	4
	4	30	293	49	28	1	23	45	3
	5	30	250	84	73		8	20	2
	6	32	265	132	77	1	7	14	1
	7	24	292	94	21		53	25	1
	8	26	412	75	70	9	1	20	
	9	21	152	95	21	67	1	11	
	10	21	167	55	60	14	3	23	
	11	12	81	21	35	2	37	26	
	12	25	453	14		4	28	60	8
	13	24	263	24	5	11	18	66	
	14	26	188	20	9		1	67	23
	15	13	80	34	69		3	26	2
	16	42	1205	358	8	43	2	47	

TABLE 2. Continued

Sample Date	Transect No.	No. Species	No. Individuals	Biomass g/m2	% Total Biomass (g) Herb.	Plankt.	Omni	Carni	CF
19-Aug-08	1	19	155	13	1		9	90	
	2	20	280	120	85		2	13	
	3	23	231	40	27		5	66	2
	4	26	415	108	43	8	6	43	
	5	24	227	69	67		9	22	2
	6	35	302	165	79	1	6	14	
	7	24	213	65	9		56	35	
	8	27	463	39	49	1	2	47	
	9	23	235	34	56	4	6	34	
	10	39	201	33	9	1	5	85	
	11	32	126	41	1	2	23	57	17
	12	23	514	33	19	2	13	56	10
	13	21	385	63	45	16	4	35	
	14	19	192	8	4	1		95	
	15	15	104	16	44	1	2	47	6
	16	37	1023	396	3	55	1	41	
25-Nov-08	1	6	20	2			6	53	40
	2	10	41	4	21		6	73	
	3	21	100	12	47	3	3	46	1
	4	20	165	79	54		1	45	
	5	31	289	91	81		1	17	1
	6	36	263	189	82	2	4	10	2
	7	31	394	60	37		36	27	
	8	33	147	29	49	6	1	43	1
	9	25	374	171	14	1		85	
	10	31	364	62	45	4	2	49	
	11	9	52	18	44	1	2	53	
	12	31	426	19	17	6	30	38	9
	13	32	931	155	20	57	4	18	1
	14	19	170	15	38		1	61	
	15	24	234	171	91		2	7	
	16	40	1017	225	10	49	1	39	1
19-Mar-09	1	14	93	13	11		1	83	5
	2	14	102	15	16		2	79	3
	3	22	126	21	18		23	50	8
	4	18	125	25	21		18	61	
	5	27	302	113	82		2	14	2
	6	33	370	259	91	2	1	5	1
	7	32	349	91	41	1	44	13	1
	8	21	353	31	32	1	3	63	1
	9	17	111	74	6		2	92	
	10	13	52	14	35			64	1
	11	5	7	4		1		99	
	12	28	251	15	34	2	2	57	5
	13	30	458	84	17	5	6	72	
	14	17	84	7	35		2	63	
	15	23	148	115	92		1	6	1
	16	48	1438	577	31	34	2	32	1

TABLE 2. Continued

Sample Date	Transect No.	No. Species	No. Individuals	Biomass g/m2	% Total Biomass (g) Herb.	Plankt.	Omni	Carni	CF
11-May-09	1	11	108	12	22		1	77	
	2	18	231	41	27		1	68	4
	3	26	224	65	64		7	27	2
	4	25	328	61	58		3	36	3
	5	31	383	224	87		3	9	1
	6	30	240	153	86	2	4	6	2
	7	26	263	51	31	1	45	22	1
	8	27	363	35	56	4	9	30	1
	9	15	88	20	51		1	48	
	10	20	159	22	32	1	14	52	1
	11	4	9	12			7	93	
	12	24	267	20	13	1	11	74	1
	13	28	459	147	20	8	1	71	
	14	11	43	6	25		8	67	
	15	17	194	174	87		1	12	
	16	39	1333	425	35	22	6	37	
21-Jul-09	1	17	141	18	2		9	81	8
	2	25	389	73	52			43	4
	3	31	301	80	26	5	31	34	4
	4	27	506	209	80		4	15	1
	5	39	582	267	65	5	6	23	1
	6	37	354	188	74	2	7	16	1
	7	33	589	155	28	2	49	21	
	8	26	800	47	47	2	7	44	
	9	27	204	70	6	4	3	87	
	10	24	212	30	15	42	2	41	
	11	10	40	12		1	2	97	
	12	26	432	20	18	6	18	46	12
	13	24	405	145	7	11	1	81	
	14	15	111	9	1	1	2	96	
	15	21	258	140	77	6	7	8	2
	16	40	1605	431	5	36	3	56	
29-Mar-10	1	17	162	30	56	0	9	25	10
	2	22	315	33	34	0	4	57	5
	3	27	197	45	70	1	10	17	2
	4	24	324	105	65	0	2	32	1
	5	31	312	129	76	4	8	10	2
	6	29	313	176	85	1	5	9	1
	7	26	336	67	26	0	46	28	0
	8	29	265	56	51	2	5	42	
	9	19	83	18	23	2	0	74	1
	10	13	53	10	40	0	21	38	
	11	10	28	14	1	0	4	95	
	12	24	245	54	7	54	15	23	0
	13	34	312	69	18	14	6	62	0
	14	11	101	7	31	0	2	65	2
	15	24	149	77	75		4	20	1
	16	29	1192	561	24	27	2	47	

TABLE 2. Continued

Sample Date	Transect No.	No. Species	No. Individuals	Biomass g/m2	% Total Biomass (g) Herb.	Plankt.	Omni	Carni	CF
14-May-10	1	18	94	15	55	0	8	37	
	2	17	91	14	33		7	48	13
	3	23	160	63	70	0	3	24	2
	4	16	326	85	71	0	6	19	4
	5	35	511	242	87	3	4	6	1
	6	37	241	164	82	2	3	14	1
	7	23	395	113	11	1	39	49	1
	8	26	361	80	78	2	6	13	0
	9	28	179	159	24	3	1	72	0
	10	21	119	55	53	24	2	20	0
	11	9	43	21		1	36	63	
	12	25	299	51	31	18	26	23	1
	13	31	369	57	9	35	5	50	0
	14	10	19	2	22		8	70	
	15	26	201	139	91	0	1	8	0
	16	33	1767	390	13	63	8	16	
12-Aug-10	1	22	198	157	69	0	1	31	0
	2	25	313	69	34	0	6	59	1
	3	25	225	28	42	0	8	49	1
	4	22	358	151	67	0	12	21	
	5	36	426	163	73	1	7	19	1
	6	30	233	118	63	2	11	23	1
	7	26	271	100	29	0	40	31	1
	8	24	425	62	73	1	5	21	0
	9	28	104	40	47	7	0	46	0
	10	20	106	31	24	49	4	23	0
	11	13	58	19	9	2	36	53	
	12	31	317	24	29	31	15	25	0
	13	32	359	60	11	12	10	68	
	14	13	51	23	85	0	0	14	2
	15	26	248	207	89	0	1	10	0
	16	33	1584	603	14	27	1	58	0
29-Oct-10	1	14	104	96	79		0	21	
	2	13	208	56	73		0	26	0
	3	27	183	49	61	0	6	32	2
	4	22	195	66	61	0	8	31	
	5	38	315	98	69	0	5	24	2
	6	36	294	123	79	2	3	15	2
	7	31	743	245	7	0	50	42	0
	8	28	262	24	33	1	6	60	0
	9	22	467	730	0	0	0	99	0
	10	17	57	21	31	0	10	59	1
	11	13	38	15	1	1	34	64	
	12	36	334	23	34	2	13	50	1
	13	35	478	192	23	5	1	69	1
	14	9	57	7		0	1	99	
	15	28	169	31	24	0	11	46	19
	16	35	1039	554	7	16	1	76	

TABLE 2. Continued

Sample Date	Transect No.	No. Species	No. Individuals	Biomass g/m2	% Total Biomass (g) Herb.	Plankt.	Omni	Carni	CF
25-Feb-11	1	9	42	5	13		1	86	
	2	16	183	66	83		1	17	
	3	17	119	18	17		16	66	1
	4	20	266	25	47	1	18	34	
	5	31	307	99	54	0	4	40	1
	6	27	328	196	49	6	4	40	1
	7	18	235	93	8		67	25	
	8	25	307	33	13	7	2	77	0
	9	13	61	10	11	19	21	48	0
	10	7	26	4		0	19	80	
	11	8	15	12		0	41	59	
	12	24	243	14	29	7	21	42	1
	13	27	427	119	22	19	5	54	
	14	9	32	2	13	1	3	83	
	15	14	69	23	28	0	6	66	0
	16	24	910	430	8	32	2	59	0
16-Jun-11	1	18	162	124	91	0	1	8	0
	2	17	123	66	78	0	2	19	0
	3	27	275	273	88		1	10	1
	4	25	340	80	66	0	6	28	0
	5	24	270	74	63	5	9	22	1
	6	33	281	207	82	1	8	8	0
	7	27	434	131	35	0	32	32	
	8	27	464	37	60	6	6	28	
	9	15	54	14	25	0	18	56	0
	10	16	103	13	6	1	0	93	
	11	11	42	6	1	1	0	98	
	12	28	769	50	2	54	8	36	0
	13	29	383	75	3	8	8	79	3
	14	12	88	5	0	1		99	
	15	21	340	108	94	0	3	3	1
	16	40	1315	318	17	59	6	17	0
29-Jul-11	1	16	137	14	4		8	89	0
	2	21	183	52	59	0	2	39	0
	3	23	277	435	96	1	2	1	0
	4	26	299	52	42	0	13	44	
	5	34	333	138	88	0	1	10	1
	6	36	375	234	86	1	5	6	1
	7	23	309	100	8	2	55	35	
	8	33	802	38	42	12	3	39	4
	9	22	477	285	13	0	0	86	0
	10	11	58	5	0	1		98	
	11	9	53	2	1	9	1	90	
	12	32	297	22	3	2	42	53	1
	13	33	327	36	13	23	10	53	0
	14	12	67	5	5	0	1	93	
	15	22	113	82	84		5	11	
	16	38	864	436	4	25	1	70	0

TABLE 2. Continued

Sample Date	Transect No.	No. Species	No. Individuals	Biomass g/m2	% Total Biomass (g) Herb.	Plankt.	Omni	Carni	CF
23-Nov-11	1	15	179	161	92		0	8	0
	2	22	348	263	88		0	11	1
	3	38	320	379	92		2	5	1
	4	26	360	166	81	0	4	14	1
	5	29	320	122	83	0	3	13	0
	6	30	291	188	85	0	3	11	1
	7	26	244	68	16	0	64	19	1
	8	27	343	32	45	7	5	41	1
	9	23	102	29	61	0	4	34	0
	10	20	85	19	40	0	5	53	2
	11	13	26	50	5		10	86	
	12	34	691	24	30	4	21	44	1
	13	35	1253	318	1	6	2	91	
	14	12	44	7	56	0	1	43	
	15	17	85	16	56	0	17	21	6
	16	28	1318	681	10	19	0	70	0
02-May-12	1	9	74	16	6		7	87	
	2	13	130	27	59	0	0	40	1
	3	23	137	65	66	7	3	23	2
	4	26	251	128	52	5	3	41	
	5	29	227	93	73	0	3	22	1
	6	35	276	147	75	2	4	18	1
	7	25	315	82	17	0	43	40	0
	8	31	371	130	56	0	4	39	0
	9	21	116	20	32	1	12	54	1
	10	15	78	16	20	0	7	71	1
	11	11	31	67	79		0	20	0
	12	28	262	50	31	1	16	52	1
	13	35	339	173	7	4	3	85	0
	14	14	89	9	20	0	1	79	
	15	20	150	54	84	0	4	12	
	16	26	568	143	20	40	6	33	0
23-May-12	1	15	105	52	84	0	0	16	
	2	15	194	53	60	0	3	36	1
	3	23	176	75	69	0	4	26	2
	4	18	357	49	36	1	11	53	
	5	28	211	57	73	0	4	22	1
	6	32	259	163	85	1	6	8	0
	7	19	247	48	39	1	21	40	
	8	22	270	42	36	0	5	58	0
	9	17	59	20	25	0	5	70	0
	10	13	36	10	65		10	23	1
	11	9	23	30	44		0	56	
	12	18	211	27	9	1	32	57	1
	13	28	211	71	5	6	5	84	
	14	11	89	4	52	2	1	45	
	15	17	118	19	23	0	23	54	
	16	23	846	214	14	27	2	58	0

TABLE 2. Continued

Sample Date	Transect No.	No. Species	No. Individuals	Biomass g/m2	% Total Biomass (g) Herb.	Plankt.	Omni	Carni	CF
23-Jul-12	1	23	274	189	67	0	0	32	0
	2	18	187	55	63	0	2	35	0
	3	21	114	39	65		13	21	2
	4	19	344	36	16	1	15	68	
	5	30	185	46	60	1	10	26	3
	6	30	184	134	79	1	3	16	0
	7	24	249	50	26	0	54	20	0
	8	29	212	41	57	0	3	39	1
	9	25	81	26	43	0	6	51	1
	10	13	64	9	16	1	11	71	1
	11	9	20	82	1	2		97	
	12	24	274	32	5	1	35	55	4
	13	34	439	92	2	14	5	78	1
	14	15	54	6	1	0	1	97	
	15	19	102	88	80	11	3	5	1
	16	30	685	153	28	44	4	25	0
02-Nov-12	1	18	201	86	76	0	2	22	
	2	17	224	52	57	0	2	40	0
	3	24	147	109	86		2	11	1
	4	22	285	51	54	0	21	24	1
	5	30	259	137	78		4	17	1
	6	31	249	139	74	0	5	19	1
	7	30	662	182	25	1	25	49	0
	8	24	348	93	79	4	3	12	1
	9	32	219	155	8	0	1	91	0
	10	19	60	21	12	2	10	74	2
	11	8	14	20		0	10	90	
	12	33	530	29	26	16	15	43	1
	13	32	467	186	4	7	3	87	0
	14	16	68	6	23		4	72	
	15	23	200	108	86	0	4	10	1
	16	33	1316	334	4	23	1	73	0
03-May-13	1	18	233	128	75	0	1	24	
	2	18	165	118	83	0	2	15	0
	3	23	110	16	32		19	46	3
	4	23	302	62	59	0	12	28	1
	5	18	540	237	93	0	1	5	0
	6	30	257	104	71	2	10	16	1
	7	19	428	181	16	0	54	30	
	8	24	286	225	93	0	0	6	0
	9	14	35	19	29	0	5	66	
	10	10	17	6	71	1	5	24	
	11	7	22	26	19	0	0	80	
	12	20	186	37	45	0	34	20	1
	13	28	327	114	4	8	4	83	0
	14	10	59	4	0	0	1	99	
	15	20	183	124	88		1	10	1
	16	31	1155	347	7	14	2	77	0

TABLE 2. Continued

Sample Date	Transect No.	No. Species	No. Individuals	Biomass g/m2	% Total Biomass (g) Herb.	Plankt.	Omni	Carni	CF
14-Jun-13	1	18	214	103	60		4	36	0
	2	18	289	238	92	0	2	6	0
	3	14	181	89	71	0	0	29	
	4	22	385	70	32	0	22	45	
	5	21	342	181	89	0	1	10	0
	6	30	229	116	81	0	5	13	1
	7	28	370	97	32	0	36	31	0
	8	24	263	89	81	0	3	15	1
	9	12	106	8	3	0	19	77	
	10	10	28	8		0	31	69	
	11	6	7	8			2	98	
	12	22	409	35	15	10	48	27	0
	13	23	468	145	2	2	1	94	0
	14	9	56	4	11	0	1	88	
	15	16	167	81	84	0	6	10	0
	16	34	816	294	47	24	1	28	0
20-Sep-13	1	21	206	90	80	0	2	18	
	2	18	129	55	81		2	17	0
	3	19	132	16	28		14	49	9
	4	22	240	24	13	1	14	72	
	5	26	324	90	68	1	7	22	3
	6	31	259	126	64	2	10	23	2
	7	28	282	95	13	2	56	28	1
	8	27	184	65	80	0	3	16	1
	9	17	266	1619	0	0	0	100	0
	10	16	46	12	1	0	11	87	1
	11	15	38	9	1	1	60	37	0
	12	31	804	372	8	3	11	78	0
	13	41	432	121	36	7	3	54	0
	14	16	154	31	56		0	43	
	15	32	259	131	83	2	4	10	1
	16	36	1554	413	46	31	1	22	0
18-Dec-13	1	22	231	115	84	0	1	14	0
	2	23	261	281	93		0	6	1
	3	26	167	64	71	0	1	25	2
	4	21	251	135	63	0	14	23	0
	5	20	165	39	66		9	23	1
	6	31	281	109	76	5	7	11	1
	7	21	337	102	16	0	51	31	2
	8	24	163	37	64	0	5	30	1
	9	23	79	13	27	3	8	54	8
	10	17	73	19	18	3	7	70	1
	11	16	76	31	24	12	17	46	0
	12	35	375	27	21	3	20	55	0
	13	37	336	107	8	1	3	88	0
	14	14	64	10	41	0	1	58	
	15	23	233	163	75	19	2	4	1
	16	36	1004	296	13	16	2	69	0

TABLE 2. Continued

Sample Date	Transect No.	No. Species	No. Individuals	Biomass g/m2	% Total Biomass (g) Herb.	Plankt.	Omni	Carni	CF
08-May-14	1	15	94	22	60	0	0	39	1
	2	20	120	25	37	0	10	48	5
	3	14	115	14	38	0	35	24	3
	4	19	155	71	60	0	6	34	0
	5	29	265	101	83	0	5	11	2
	6	31	211	150	89	3	4	3	1
	7	17	364	100	48		21	30	0
	8	27	287	153	68	0	1	31	0
	9	17	99	10	42	1	11	44	2
	10	13	32	8	7	0	16	75	1
	11	6	17	31	46		15	38	
	12	27	190	27	25	2	15	58	0
	13	25	529	109	37	9	1	53	0
	14	7	16	1	47			53	
	15	21	201	190	95		2	3	
	16	37	1339	346	12	37	4	47	0
06-Jun-14	1	17	155	111	71	0	0	29	0
	2	14	151	64	77		2	17	3
	3	14	73	64	65		3	32	0
	4	21	220	95	74	0	8	18	
	5	25	266	84	81		3	14	2
	6	27	269	135	87	1	2	8	2
	7	28	445	149	14	0	64	21	0
	8	24	220	41	57	3	3	36	1
	9	18	48	38	3	0	9	88	
	10	36	203	67	55	5	7	32	0
	11	8	17	78			9	91	
	12	25	187	40	34	12	14	32	8
	13	33	471	235	7	4	1	87	0
	14	8	11	11			0	100	
	15	22	152	102	88	0	4	7	0
	16	33	983	253	17	54	6	23	0
26-Sep-14	1	20	482	336	88	0	0	12	0
	2	21	292	95	83	0	3	13	0
	3	21	210	26	28	0	42	29	1
	4	33	409	167	71	0	5	23	1
	5	31	359	107	69	1	11	17	1
	6	26	371	212	87	1	8	5	0
	7	30	816	150	31	1	36	32	0
	8	27	214	18	27	1	13	58	1
	9	17	77	8	37	0	8	53	2
	10	26	152	20	6	1	5	88	0
	11	20	77	26	5	1	1	92	0
	12	35	635	48	4	4	31	61	0
	13	39	485	130	68	2	1	29	1
	14	14	148	12	43		2	54	1
	15	28	284	148	82		7	11	0
	16	36	1285	215	18	21	2	59	0

TABLE 2. Continued

Sample Date	Transect No.	No. Species	No. Individuals	Biomass g/m2	% Total Biomass (g) Herb.	Plankt.	Omni	Carni	CF
27-Feb-15	1	18	264	153	79	0	0	21	
	2	23	360	182	87	0	2	10	1
	3	32	343	128	74	11	6	7	1
	4	28	439	175	82	0	2	16	0
	5	25	336	121	28	1	4	66	1
	6	26	260	104	77		6	17	1
	7	31	1049	215	46		29	25	0
	8	21	194	64	87	0	4	8	0
	9	10	26	8	37	0	5	57	1
	10	4	11	3			1	99	
	11	4	7	3			5	85	10
	12	19	120	33	20	18	3	59	0
	13	31	605	471	1	1	0	97	1
	14	12	59	8	44		6	50	
	15	17	197	133	93		3	4	1
	16	34	1595	386	28	29	5	38	0

TABLE 3. Results of the Kruskal-Wallis ANOVA and the Student-Neuman-Keuls (SNK) Test addressing the question , "Are there any statistically significant differences among the mean number of fish species seen per transect,the mean number of individual fish censused per transect or the mean estimated total standing crop (in g/m2) per transect for the 15 stations among the twenty-eight 2007-2014 sample periods?" The Kruskal-Wallis result is given as a "p" value at the top of the entry where ($p<0.05$ or less for significance). The SNK Test is used to separate means that are significantly different from one another. In the body of the table are given the sample date and mean for a given parameter on that date. Letters are used to show differences with the SNK Test; letters with the same designation show means and sample dates that are related and changes in letter designation show where significant differences exist. Overlaps in letters indicate a lack of significant differences and in such cases, only the extremes may be significantly different.

1. Mean Number of Fish Species Per Transect (p>0.24, n.s.)

Date	[n]	Mean	SNK Grouping
Sep-14	15	25.9	A
Jul-09	15	25.5	A
Aug-10	15	24.9	A
Aug-08	15	24.7	A
Oct-10	15	24.6	A
Nov-11	15	24.5	A
Sep-13	15	24.0	A
Nov-08	15	23.9	A
Nov-12	15	23.9	A
Jul-11	15	23.5	A
Dec-13	15	23.5	A
May-10	15	23.0	A
Dec-07	12	22.8	A
Mar-10	15	22.7	A
May-08	15	22.6	A
May-12	15	22.3	A
Jul-12	15	22.2	A
Jun-11	15	22.0	A
Jun-14	15	21.3	A
Mar-09	15	20.9	A
May-09	15	20.9	A
Apr-08	15	20.3	A
Feb-15	15	20.1	A
May-14	15	19.2	A
bMay-12	15	19.0	A
May-13	15	18.8	A
Jun-13	15	18.2	A
Feb-11	15	17.7	A

Interpretation: There are no significant differences among the mean number of species found per transect over the twenty-eight sample periods.

TABLE 3. Continued.

2. Mean Number of Individual Fish Per Transect (p>0.54, n.s.)

YEAR	[n]	Mean	SNK Grouping
Jul-09	15	355	A
Sep-14	15	334	A
Nov-11	15	313	A
Feb-15	15	285	A
Jun-11	15	275	A
Jul-11	15	274	A
Aug-08	15	270	A
Nov-08	15	265	A
Nov-12	15	262	A
Oct-10	15	260	A
Apr-08	15	255	A
Sep-13	15	250	A
Aug-10	15	246	A
Dec-07	12	246	A
Jun-13	15	234	A
May-10	15	227	A
May-09	15	224	A
May-08	15	222	A
Mar-10	15	213	A
May-13	15	210	A
Dec-13	15	206	A
Mar-09	15	195	A
Jun-14	15	193	A
May-12	15	190	A
Jul-12	15	186	A
May-14	15	180	A
Feb-11	15	177	A
bMay-12	15	171	A

Interpretation: There are no significant differences among the mean number of species found per transect over the twenty-eight sample periods.

3. Mean Standing Crop of Fish in g/m2 Per Transect (p>0.85, n.s.)

YEAR	[n]	Mean	SNK Grouping
Sep-13	15	190	A
Nov-11	15	137	A
Oct-10	15	123	A
Feb-15	15	120	A
Dec-07	12	118	A
Jul-11	15	100	A
Jul-09	15	100	A
Aug-10	15	98	A
May-13	15	93	A
Sep-14	15	92	A
Nov-12	15	88	A
May-10	15	85	A
Jun-11	15	84	A
Jun-14	15	84	A
Jun-13	15	83	A
Dec-13	15	83	A
May-09	15	80	A
Mar-09	15	72	A
Mar-10	15	72	A
May-14	15	70	A
Nov-08	15	68	A
Apr-08	15	62	A
Aug-08	15	59	A
May-12	15	59	A
May-08	15	57	A
Feb-11	15	54	A
Jul-12	15	48	A
bMay-12	15	48	A

Interpretation: Despite the range in the estimated total standing crop per station over the twenty-eight sample dates, there are no significant differences.

TABLE 4. Percent contribution based on estimated biomass for each of five feeding guilds of fishes as determined across all fifteen natural substratum stations over twenty-eight survey dates in Part A. In Part B is given the same information for station 16 (Kahe outfall pipe) which was sampled commencing with the 30 May 2008 survey. In the body of the table are given the percent contribution by weight to each trophic category. Note that the December 2007 survey did not sample three of the fifteen stations. Data summarized from Table 2.

PART A. Stations 1 - 15:

Mean Percent by Weight

Date	[n]	Herbivore	Planktivore	Omnivore	Coral Feeder	Carnivore
27-Dec-07	12	35	2	8	5	50
04-Apr-08	15	35	2	8	4	51
30-May-08	15	37	7	14	3	39
19-Aug-08	15	36	2	10	3	49
25-Nov-08	15	43	5	6	4	42
19-Mar-09	15	35	1	7	2	55
11-May-09	15	44	1	8	1	46
21-Jul-09	15	33	6	10	2	49
29-Mar-10	15	44	5	9	2	40
19-May-10	15	51	6	9	1	33
12-Aug-10	15	49	7	10	1	33
29-Oct-10	15	41	1	9	1	48
25-Feb-11	15	30	6	15	1	54
16-Jun-11	15	46	6	7	1	41
29-Jul-11	15	36	4	11	1	50
23-Nov-11	15	55	2	9	1	33
02-May-12	15	42	2	8	1	48
23-May-12	15	48	1	8	1	42
23-Jul-12	15	36	2	12	1	50
02-Nov-12	15	46	3	8	1	47
03-May-13	15	52	1	10	1	37
14-Jun-13	15	50	1	12	>1	43
20-Sep-13	15	41	2	13	2	44
18-Dec-13	15	50	4	10	1	36
08-May-14	15	52	1	10	1	36
06-Jun-14	15	55	3	9	2	41
26-Sep-14	15	49	1	12	1	38
27-Feb-15	15	58	4	5	1	41
Grand Means		43.9	3.1	9.5	1.7	43.4

PART B. Stations 16 (Outfall Pipe) Only:

Mean Percent by Weight

Date	[n]	Herbivore	Planktivore	Omnivore	Coral Feeder	Carnivore
30-May-08	1	8	43	2		47
19-Aug-08	1	3	55	1		41
25-Nov-08	1	10	49	1	>1	39
19-Mar-09	1	32	34	2	>1	32
11-May-09	1	35	22	6		37
21-Jul-09	1	5	36	3		56
29-Mar-10	1	24	27	2		47
19-May-10	1	13	63	8		16
12-Aug-10	1	14	27	1		58
29-Oct-10	1	7	16	1		76
25-Feb-11	1	8	32	2	>1	59
16-Jun-11	1	17	59	6	>1	17
29-Jul-11	1	4	25	1	>1	70
23-Nov-11	1	10	19	>1	>1	70
02-May-12	1	20	40	6	>1	33
23-May-12	1	14	27	2	>1	58
23-Jul-12	1	28	44	4	>1	24
02-Nov-12	1	4	23	1	>1	73
03-May-13	1	7	15	2	>1	77
14-Jun-13	1	47	24	1	>1	28
20-Sep-13	1	46	31	>1	>1	22
18-Dec-13	1	13	16	2	>1	69
08-May-14	1	12	37	4	>1	47
06-Jun-14	1	17	54	6	>1	23
26-Sep-14	1	18	21	2	>1	59
27-Feb-15	1	28	29	5	>1	38
Grand Means		17.1	33.1	2.9	0.2	46.8

TABLE 5. Results of the Kruskal-Wallis ANOVA and the Student-Neuman-Keuls (SNK) Test addressing the question, "Are there any statistically significant differences among the mean number of fish species per transect, the mean number of individual fish per transect or the mean estimated standing crop (in g/m^2) per transect among the four geographic groups of stations established on natural substratum stations 1 - 15) and sampled in the 2007-2014 period?" The four groups of transects are CIP (station nos. 1-4), Ko'Olina (station nos. 5-7), Kahe (station nos. 8-12) and North (station nos. 13-15). The Kruskal-Wallis result is given as a "p" value at the top of the entry where ($p<0.05$ or less for significance). The SNK Test is used to separate means that are significantly different from one another. In the body of the table are given the four geographically-related groups of stations and parameter means per transect for each of those groups. Letters are used to show differences with the SNK Test; letters with the same designation show means and station groups that are related and changes in letter designation show where significant differences exist. Overlaps in the letters indicate a lack of significant differences and in such cases, only the extremes may be significantly different.

1. Mean Number of Fish Species Per Transect by Station Group ($p<0.0001$, Significant)

Station Group	(n)	Mean	SNK Grouping
Ko'Olina	81	28.7	A
Nanakuli	84	21.6	B
Kahe	140	20.4	B
CIP	112	20.3	B

Interpretation: Both the Kruskal-Wallis ANOVA and the SNK Test found significant differences among station groups, where the mean number of fish species per transect at Ko'Olina stations is significantly greater than at any of the other station groups which are all related over the twenty-eight sample periods.

2. Mean Number of Individual Fish Per Transect by Station Group ($p<0.0001$, Significant)

Station Group	(n)	Mean	SNK Grouping
Ko'Olina	81	335	A
Nanakuli	84	243	B
CIP	112	215	B
Kahe	140	203	B

Interpretation: Both the Kruskal-Wallis ANOVA and the SNK Test found significant differences among station groups, where the mean number of individual fish per transect at Ko'Olina is significantly greater than at any of the other station groups which are all related over the twenty-eight sample periods.

TABLE 5. Continued.

3. Mean Standing Crop of Fishes (in g/m^2) Per Transect by Station Group (p<0.0001, Significant)

Station Group	(n)	Mean	SNK Grouping
Ko'Olina	81	131	A
Nanakuli	84	87	B
CIP	112	85	B
Kahe	140	61	B

Interpretation: Both the Kruskal-Wallis ANOVA and the SNK Test found significant differences among station groups, where the mean estimated fish standing crop was significantly greater at stations offshore of Ko'Olina than at any of the other three station groups which were all statistically related.

TABLE 6. Results of the Kruskal-Wallis ANOVA and the Student-Neuman-Keuls (SNK) Test addressing the question, "Are there any statistically significant differences among the mean number of fish species per transect, the mean number of individual fish per transect or the mean estimated standing crop (in g/m2) per transect seen among the sixteen stations established and sampled over the twenty-eight periods in 2007-2014?" The Kruskal-Wallis result is given as a "p" value at the top of the entry (where $p<0.05$ or less for significance). The SNK Test is used to separate means that are significantly different from one another. In the body of the table are given the stations, the number of times each was sampled (n) and parameter means per transect for each. Letters are used to show differences with the SNK Test; letters with the same designation show means and station groups that are related and changes in letter designation show where significant differences exist. Overlaps in the letters indicate a lack of significant differences and in such cases, only the extremes may be significantly different.

1. Mean Number of Fish Species Per Station in 2007-14 ($p < 0.0001$, Significant)

Station Group	[n]	Mean	SNK Grouping			
16 (Pipe)	26	34	A			
6 (Ko'Olina 2)	27	32		B		
13 (HECO 10C)	28	31		B		
5 (Ko'Olina 1)	27	29		B	C	
12 (HECO 7E)	28	27			C	D
8 (HECO 5B)	28	26	E		C	D
7 (HECO 1D)	27	26	E			D
4 (East 4)	28	23	E	F		
3 (East 3)	28	23	E	F		
15 (Nana-2)	28	21		F	G	
9 (HECO 7B)	28	20		F	G	
2 (East 2)	28	19			G	H
10 (HECO 7C)	28	18			G	H
1 (East 1)	28	16	I			H
14 (Nana-1)	28	13	I			
11 (HECO 7D)	28	11		J		

Interpretation:

The Kruskal-Wallis ANOVA noted significant differences in the mean number of fish species per transect across the sixteen stations. The SNK Test results show that the number of fish species is significantly greater on the Kahe discharge pipe relative to all other stations on natural substratum due to overlap. However, the SNK Test noted that station 11 has significantly fewer species present probably due to the (1) short transect length (i.e. 10.5m versus 50m) and (2) poor development of topographical complexity that provides shelter space relative to other natural substratum sites.

TABLE 6. Continued.

2. Mean Number of Individual Fish Censused Per Station in 2007-14 (p < 0.0001, Significant)

Station Group	[n]	Mean	Grouping			
16 (Pipe)	26	1183	A			
13 (HECO 10C)	28	461		B		
7 (HECO 1D)	27	407		B	C	
12 (HECO 7E)	28	382		B	C	D
8 (HECO 5B)	28	340	E		C	D
5 (Ko'Olina 1)	27	319	E		C	D
4 (East 4)	28	304	E			D
6 (Ko'Olina 2)	28	280	E	F		
2 (East 2)	28	215		F	G	
3 (East 3)	28	183			G	H
15 (Nana-2)	28	179			G	H
1 (East 1)	28	157			G	H
9 (HECO 7B)	28	151			G	H
10 (HECO 7C)	28	105		I		H
14 (Nana-1)	28	89		I		H
11 (HECO 7D)	28	36		I		

Interpretation:
The Kruskal-Wallis ANOVA noted statistically significant differences in the mean number of individual fish censused among the 16 transects over the twenty-eight surveys in 2007-14. However, the SNK Test found only one clearly-obvious statistically significant station (i.e., without overlap); this was with station 16 (Kahe discharge pipe) having significantly more individual fishes present than any other station, otherwise overlap obscures further separation.

3. Mean Estimated Fish Standing Crop (g/m2) by Station in 2007-14 (p < 0.0001, Significant)

Station Group	[n]	Mean	Grouping			
16 (Pipe)	26	376	A			
9 (HECO 7B)	27	159		B		
6 (Ko'Olina 2)	28	148		B		
13 (HECO 10C)	28	145		B	C	
5 (Ko'Olina 1)	27	124		B	C	D
7 (HECO 1D)	27	113	E	B	C	D
15 (Nana-2)	28	103	E	B	C	D
2 (East 2)	28	92	E	BF	C	D
3 (East 3)	28	90	E	BF	C	D
4 (East 4)	28	83	E	BF	C	D
1 (East 1)	28	75	E	BF	C	D
8 (HECO 5B)	28	60	E	F	C	D
12 (HECO 7E)	28	44	E	F		D
10 (HECO 7C)	28	27	E	F		
11 (HECO 7D)	28	26		F		
14 (Nana-1)	28	9		F		

Interpretation:
Only one station (Kahe Discharge) had a statistically greater estimated standing crop of fishes present than found at any of the other fifteen stations whose estimated standing crops are all statistically related due to overlap.

TABLE 7. Results of the Kruskal-Wallis ANOVA and the Student-Neuman-Keuls (SNK) Test addressing the question , "Are there any statistically significant differences among the annual mean number of fish species per transect or the annual mean number of individual fish censused per transect among seven stations sampled in common over seventeen years encompassing a 38-year period (i.e., 1976-1984 and 2007-2014 sample periods)?" The Kruskal-Wallis result is given as a "p" value at the top of the entry where ($p<0.05$ or less for significance). The SNK Test is used to separate means that are significantly different from one another. In the body of the table are given the sample date and mean for a given parameter on that date. Letters are used to show differences with the SNK Test; letters with the same designation show means and sample dates that are related and changes in letter designation show where significant differences exist. Overlaps in the letters indicate a lack of significant differences and in such cases, only the extremes may be significantly different.

1. Mean Number of Fish Species Per Transect ($p>0.71$, n.s.)

YEAR	[n]	Mean	SNK Grouping
1976	3	29.0	A
1977	3	26.0	A
1979	6	24.3	A
1978	3	24.0	A
2007	7	23.7	A
2008	7	23.6	A
1984	7	23.4	A
1980	6	23.2	A
2010	7	22.3	A
2014	7	21.6	A
2011	7	21.1	A
2012	7	21.1	A
2009	7	21.0	A
2013	7	20.6	A
1981	6	19.2	A
1982	6	17.7	A
1983	6	15.8	A

Interpretation:
There are no significant differences among the mean number of species found per transect at these seven stations among the seventeen years of sampling. Note that the highest annual means occur before the January 1980 storm event and the lowest follow that period as well as after the November 1982 hurricane.

TABLE 7. Continued.

2. Mean Number of Individual Fish Per Transect (p>0.76, n.s.)

YEAR	[n]	Mean	SNK Grouping
2008	7	303.1	A
2007	7	302.3	A
2011	7	276.7	A
2009	7	271.7	A
2014	7	270.4	A
1980	6	250.3	A
2010	7	232.3	A
2013	7	224.7	A
2012	7	215.4	A
1976	3	201.7	A
1979	6	195.0	A
1981	6	173.2	A
1978	3	169.0	A
1977	3	163.0	A
1984	7	150.0	A
1982	6	141.0	A
1983	6	85.8	A

Interpretation:
There are no significant differences among the mean number of individual fish censused per transect at these seven stations among the seventeen years of sampling. Note that the hierarchy of annual mean number of individual fish censused does not parallel that for the annual mean number of species counted at these stations. In other words, the impact of the two storm events (1980 and 1982) produced a different result with respect to the number of individual fish and the number of species counted.

FIGURE 1. Map showing the southwest coastline of Oahu from the Barbers Point Harbor on the southeast to Nanakuli Beach Park 7.9 km to the northwest. The approximate locations of each of the sixteen permanently marked stations monitored in this study are numbered. All stations except station 16 have an orientation that parallels the coastline and all are 50 m in length except for station 11 (or 7-D) which is 10.5 m in length. Station 16 is established on the terminus of the Kahe Generating facility ocean warm-water outfall and thus has an orientation that is perpendicular to the shoreline. Map courtesy of the Hawaiian Electric, Environmental Department.


Nana Control 2
Nana Control 1
Station 10C
Station 7D
Station 7E
Station 7C
Station 7B
Outfall Pipe
Station 5B
Station 1D
Ko Olina 2
Ko Olina 1
EAST 3
EAST 2
EAST 4
EAST 1
NANAKULI
MAKAKILO CITY
HONOULIULI
KALAELOA AIRPORT
Barbers Point Harbor
CORAL PIT
Honokai Hale
Milo Cove
Anianikū Cove
Ka'ula Bay
Kahe Point
Gilbert
Kalaeloa
Map created with TOPO! ©2006 National Geographic
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
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TN MN
10°
05/13/09

APPENDIX 1. Results of fish censuses carried out on each of four 2014 surveys conducted on 8 May, 6 June, 26 September and 27 February 2015 (representing fourth quarter 2014). Data from the earlier surveys that comprise the first annual report are given in Brock (2009), second annual report (Brock 2010), third annual report (Brock 2011), fourth annual report (Brock 2012), fifth annual report (Brock 2013) and sixth annual report (Brock 2014). In the body of the table are given the list of fish species observed at each station, the trophic or feeding guild category for each species (where C=carnivore, H=herbivore, O=omnivore, P=planktivore and CF=coral feeder), the station number (1 through 16) as well as station name, the number of individuals of each species censused as well as the biomass (in grams) for each. Also given for each of the five trophic categories is a summary of the total number of individual fishes, the total standing crop and the percent of the total standing crop for each trophic category. Note that the total standing crop is given in grams and the area censused at each station is 200 m^2 except for station 11 (previous Hawaiian Electric Station 7-D) which the census area is 10.5 m long and 4 m wide or 42 m^2. Biomass estimates for each species are based on species-specific regression coefficients using linear regression techniques (Ricker 1975, Brock and Norris 1989).

8 MAY 2014 FIELD DATA

GRP	08-May-14 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Parupeneus multifasciatus	1	EAST1	1	96.08			
C	Parupeneus multifasciatus	1	EAST1	2	108.80			
C	Paracirrhites arcatus	1	EAST1	2	32.70			
C	Paracirrhites forsteri	1	EAST1	1	39.65			
C	Thalassoma duperrey	1	EAST1	2	194.10			
C	Thalassoma duperrey	1	EAST1	10	111.63			
C	Thalassoma duperrey	1	EAST1	4	109.56			
C	Thalassoma duperrey	1	EAST1	9	494.54			
C	Coris gaimard	1	EAST1	1	83.79			
C	Stethojulis balteata	1	EAST1	2	28.82			
C	Rhinecanthus rectangulus	1	EAST1	3	257.62			
C	Sufflamen fraenatus	1	EAST1	1	144.65	38	1701.94	38.9
CF	Chaetodon quadrimaculatus	1	EAST1	2	50.61	2	50.61	1.2
H	Acanthurus nigrofuscus	1	EAST1	16	382.35			
H	Acanthurus nigrofuscus	1	EAST1	13	705.28			
H	Acanthurus nigrofuscus	1	EAST1	11	156.34			
H	Acanthurus olivaceus	1	EAST1	2	1126.34			
H	Acanthurus olivaceus	1	EAST1	2	94.95			
H	Naso lituratus	1	EAST1	2	29.80			
H	Naso lituratus	1	EAST1	1	72.58			
H	Naso unicornis	1	EAST1	1	38.92	48	2606.57	59.6
O	Canthigaster jactator	1	EAST1	3	10.69	3	10.69	0.2
P	Chromis vanderbilti	1	EAST1	3	0.95	3	0.95	0.02
	TOTAL	1	EAST1	94	4370.75	94	4370.75	100
C	Parupeneus multifasciatus	2	EAST2	1	235.75			
C	Plectroglyphidodon johnstonian	2	EAST2	2	3.44			
C	Plectroglyphidodon imparipenni	2	EAST2	4	3.45			
C	Paracirrhites arcatus	2	EAST2	1	16.35			
C	Thalassoma duperrey	2	EAST2	6	66.98			
C	Thalassoma duperrey	2	EAST2	3	291.16			
C	Thalassoma duperrey	2	EAST2	10	549.49			
C	Thalassoma duperrey	2	EAST2	12	328.69			
C	Coris gaimard	2	EAST2	1	139.13			
C	Halichoeres ornatissimus	2	EAST2	1	16.45			
C	Halichoeres ornatissimus	2	EAST2	1	25.14			
C	Rhinecanthus rectangulus	2	EAST2	1	85.87			
C	Sufflamen fraenatus	2	EAST2	3	433.95			
C	Sufflamen fraenatus	2	EAST2	1	224.79			
C	Ostracion meleagris	2	EAST2	1	24.55	48	2445.19	48.0
CF	Chaetodon unimaculatus	2	EAST2	2	50.61			
CF	Chaetodon ornatissimus	2	EAST2	2	138.00			
CF	Chaetodon quadrimaculatus	2	EAST2	2	50.61	6	239.22	4.7
H	Acanthurus nigrofuscus	2	EAST2	18	255.83			
H	Acanthurus nigrofuscus	2	EAST2	29	693.01			
H	Ctenochaetus strigosus	2	EAST2	1	0.87			
H	Ctenochaetus strigosus	2	EAST2	1	7.58			
H	Naso lituratus	2	EAST2	1	622.36			
H	Naso lituratus	2	EAST2	1	311.61	51	1891.26	37.1
O	Stegastes fasciolatus	2	EAST2	1	14.76			
O	Melichthys vidua	2	EAST2	1	296.24			
O	Melichthys vidua	2	EAST2	1	199.03			
O	Canthigaster jactator	2	EAST2	3	10.69	6	520.72	10.2
P	Chromis vanderbilti	2	EAST2	9	2.84	9	2.84	0.1
	TOTAL	2	EAST2	120	5099.23	120	5099.23	100

GRP	08-May-14 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Parupeneus multifasciatus	3	EAST3	4	108.47			
C	Plectroglyphidodon johnstonianı	3	EAST3	6	10.33			
C	Paracirrhites arcatus	3	EAST3	1	16.35			
C	Thalassoma duperrey	3	EAST3	4	219.80			
C	Thalassoma duperrey	3	EAST3	2	194.10			
C	Thalassoma duperrey	3	EAST3	5	136.95	22	686.00	24.3
CF	Chaetodon unimaculatus	3	EAST3	2	50.61			
CF	Chaetodon multicinctus	3	EAST3	2	26.06	4	76.67	2.7
H	Acanthurus nigrofuscus	3	EAST3	22	525.73			
H	Acanthurus nigrofuscus	3	EAST3	27	383.74			
H	Ctenochaetus strigosus	3	EAST3	2	15.15			
H	Ctenochaetus strigosus	3	EAST3	3	45.60			
H	Ctenochaetus strigosus	3	EAST3	4	107.38	58	1077.60	38.1
O	Stegastes fasciolatus	3	EAST3	3	44.29			
O	Stegastes fasciolatus	3	EAST3	3	77.94			
O	Melichthys niger	3	EAST3	1	163.34			
O	Melichthys vidua	3	EAST3	3	597.09			
O	Cantherhines sandwichiensis	3	EAST3	1	82.05			
O	Canthigaster jactator	3	EAST3	5	17.81	16	982.52	34.7
P	Chromis vanderbilti	3	EAST3	15	4.74	15	4.74	0.2
	TOTAL	3	EAST3	115	2827.52	115	2827.52	100
C	Cephalopholis argus	4	EAST4	1	638.29			
C	Parupeneus multifasciatus	4	EAST4	1	155.42			
C	Parupeneus multifasciatus	4	EAST4	3	163.20			
C	Bodianus bilunulatus	4	EAST4	1	467.86			
C	Labroides phthirophagus	4	EAST4	1	0.63			
C	Thalassoma duperrey	4	EAST4	16	879.18			
C	Thalassoma duperrey	4	EAST4	17	465.64			
C	Thalassoma duperrey	4	EAST4	17	1649.88			
C	Stethojulis balteata	4	EAST4	1	14.41			
C	Stethojulis balteata	4	EAST4	3	107.29			
C	Halichoeres ornatissimus	4	EAST4	2	32.90			
C	Halichoeres ornatissimus	4	EAST4	1	9.52			
C	Halichoeres ornatissimus	4	EAST4	1	25.14			
C	Rhinecanthus rectangulus	4	EAST4	1	144.65	66	4754.01	33.5
CF	Chaetodon quadrimaculatus	4	EAST4	2	50.61	2	50.61	0.4
H	Calotomus carolinus	4	EAST4	1	707.00			
H	Acanthurus triostegus	4	EAST4	7	700.10			
H	Acanthurus nigrofuscus	4	EAST4	15	112.87			
H	Acanthurus nigrofuscus	4	EAST4	12	651.03			
H	Acanthurus nigrofuscus	4	EAST4	20	477.94			
H	Acanthurus olivaceus	4	EAST4	9	5068.53			
H	Acanthurus blochii	4	EAST4	1	453.59			
H	Naso lituratus	4	EAST4	1	311.61	66	8482.68	59.8
O	Melichthys niger	4	EAST4	3	490.01			
O	Melichthys vidua	4	EAST4	2	398.06			
O	Canthigaster jactator	4	EAST4	1	3.56	6	891.63	6.3
P	Chromis vanderbilti	4	EAST4	15	4.74	15	4.74	0.03
	TOTAL	4	EAST4	155	14183.67	155	14183.67	100

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GRP	SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Aulostomus chinensis	5	KO1	1	88.50			
C	Parupeneus multifasciatus	5	KO1	2	54.23			
C	Parupeneus multifasciatus	5	KO1	1	96.08			
C	Parupeneus bifasciatus	5	KO1	1	107.31			
C	Parupeneus bifasciatus	5	KO1	1	29.20			
C	Plectroglyphidodon johnstonian	5	KO1	2	3.44			
C	Plectroglyphidodon imparipenni	5	KO1	1	0.86			
C	Cirrhitus pinnulatus	5	KO1	1	90.86			
C	Labroides phthirophagus	5	KO1	2	1.26			
C	Thalassoma duperrey	5	KO1	6	582.31			
C	Thalassoma duperrey	5	KO1	9	494.54			
C	Thalassoma duperrey	5	KO1	7	191.73			
C	Thalassoma duperrey	5	KO1	7	78.14			
C	Thalassoma ballieui	5	KO1	1	167.53			
C	Gomphosus varius	5	KO1	2	22.08			
C	Stethojulis balteata	5	KO1	2	71.53			
C	Sufflamen bursa	5	KO1	1	85.87	47	2165.48	10.7
CF	Chaetodon unimaculatus	5	KO1	2	50.61			
CF	Chaetodon ornatissimus	5	KO1	2	138.00			
CF	Chaetodon multicinctus	5	KO1	6	78.18			
CF	Exallias brevis	5	KO1	1	49.35	11	316.14	1.6
H	Scarus sordidus	5	KO1	5	179.97			
H	Acanthurus triostegus	5	KO1	3	51.50			
H	Acanthurus triostegus	5	KO1	1	46.32			
H	Acanthurus leucopareius	5	KO1	5	1163.38			
H	Acanthurus leucopareius	5	KO1	1	66.74			
H	Acanthurus leucopareius	5	KO1	2	748.13			
H	Acanthurus nigrofuscus	5	KO1	22	1193.55			
H	Acanthurus nigrofuscus	5	KO1	33	788.60			
H	Acanthurus olivaceus	5	KO1	8	2093.34			
H	Acanthurus olivaceus	5	KO1	4	2252.68			
H	Acanthurus olivaceus	5	KO1	7	2752.47			
H	Ctenochaetus strigosus	5	KO1	32	2107.68			
H	Ctenochaetus strigosus	5	KO1	32	859.00			
H	Ctenochaetus strigosus	5	KO1	15	1982.01			
H	Zebrasoma flavescens	5	KO1	5	47.42			
H	Zebrasoma flavescens	5	KO1	4	104.12			
H	Naso lituratus	5	KO1	1	311.61	180	16748.52	82.7
O	Stegastes fasciolatus	5	KO1	7	181.86			
O	Melichthys niger	5	KO1	3	744.09			
O	Canthigaster jactator	5	KO1	1	3.56	11	929.52	4.6
P	Abudefduf abdominalis	5	KO1	3	94.00			
P	Chromis vanderbilti	5	KO1	13	4.11	16	98.10	0.5
	TOTAL	5	KO1	265	20257.76	265	20257.76	100

	SPECIES			NO.	BIOMASS	TOTAL	TOTAL	PERCENT
C	Adioryx spinifer	6	KO2	1	265.90			
C	Parupeneus multifasciatus	6	KO2	3	81.35			
C	Parupeneus multifasciatus	6	KO2	1	54.40			
C	Parupeneus bifasciatus	6	KO2	1	29.20			
C	Chaetodon lunula	6	KO2	1	35.99			
C	Plectroglyphidodon johnstonian	6	KO2	2	3.44			
C	Paracirrhites forsteri	6	KO2	1	39.65			
C	Labroides phthirophagus	6	KO2	1	0.63			
C	Thalassoma duperrey	6	KO2	2	54.78			
C	Thalassoma duperrey	6	KO2	3	164.85			
C	Gomphosus varius	6	KO2	1	22.60			
C	Stethojulis balteata	6	KO2	1	35.76	18	788.55	2.6
CF	Chaetodon unimaculatus	6	KO2	2	50.61			
CF	Chaetodon ornatissimus	6	KO2	2	138.00			
CF	Chaetodon quadrimaculatus	6	KO2	2	50.61			
CF	Chaetodon multicinctus	6	KO2	6	78.18	12	317.40	1.1
H	Scarus sordidus	6	KO2	1	1427.57			
H	Scarus psittacus	6	KO2	3	434.82			
H	Scarus psittacus	6	KO2	1	37.87			
H	Scarus psittacus	6	KO2	1	786.15			
H	Scarus rubroviolaceus	6	KO2	1	147.03			
H	Scarus rubroviolaceus	6	KO2	1	43.92			
H	Acanthurus triostegus	6	KO2	5	231.58			
H	Acanthurus leucopareius	6	KO2	3	82.55			
H	Acanthurus nigrofuscus	6	KO2	24	573.53			
H	Acanthurus nigrofuscus	6	KO2	6	325.51			
H	Acanthurus olivaceus	6	KO2	8	379.82			
H	Acanthurus olivaceus	6	KO2	8	2093.34			
H	Acanthurus olivaceus	6	KO2	27	15205.60			
H	Acanthurus blochii	6	KO2	1	155.58			
H	Acanthurus blochii	6	KO2	1	29.03			
H	Acanthurus blochii	6	KO2	1	453.59			
H	Ctenochaetus strigosus	6	KO2	13	348.97			
H	Ctenochaetus strigosus	6	KO2	9	1189.20			
H	Ctenochaetus strigosus	6	KO2	4	263.46			
H	Zebrasoma flavescens	6	KO2	12	639.36			
H	Zebrasoma flavescens	6	KO2	4	6.75			
H	Zebrasoma flavescens	6	KO2	4	104.12			
H	Naso lituratus	6	KO2	2	1244.71			
H	Naso lituratus	6	KO2	2	623.23	142	26827.28	89.3
O	Stegastes fasciolatus	6	KO2	2	51.96			
O	Melichthys niger	6	KO2	4	653.34			
O	Melichthys vidua	6	KO2	1	566.54			
O	Canthigaster jactator	6	KO2	4	14.25	11	1286.10	4.3
P	Abudefduf abdominalis	6	KO2	26	814.65			
P	Chromis hanui	6	KO2	2	1.49	28	816.14	2.7
	TOTAL	6	KO2	211	30035.47	211	30035.47	100

GRP	08-May-14 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Parupeneus multifasciatus	7	KAHE1D	2	192.16			
C	Parupeneus multifasciatus	7	KAHE1D	2	54.23			
C	Plectroglyphidodon johnstonian	7	KAHE1D	5	8.61			
C	Plectroglyphidodon imparipenni	7	KAHE1D	1	0.86			
C	Labroides phthirophagus	7	KAHE1D	2	1.26			
C	Thalassoma duperrey	7	KAHE1D	12	328.69			
C	Thalassoma duperrey	7	KAHE1D	43	4173.23			
C	Thalassoma duperrey	7	KAHE1D	20	1098.98			
C	Gomphosus varius	7	KAHE1D	1	22.60			
C	Anampses cuvier	7	KAHE1D	1	64.38			
C	Sufflamen bursa	7	KAHE1D	1	85.87	90	6030.87	30.2
CF	Chaetodon multicinctus	7	KAHE1D	6	39.94	6	39.94	0.2
H	Scarus psittacus	7	KAHE1D	21	1664.63			
H	Scarus psittacus	7	KAHE1D	86	3257.05			
H	Acanthurus triostegus	7	KAHE1D	2	34.33			
H	Acanthurus triostegus	7	KAHE1D	2	92.63			
H	Acanthurus nigrofuscus	7	KAHE1D	29	1573.32			
H	Acanthurus nigrofuscus	7	KAHE1D	30	716.91			
H	Acanthurus olivaceus	7	KAHE1D	28	1329.36			
H	Acanthurus olivaceus	7	KAHE1D	30	592.30			
H	Ctenochaetus strigosus	7	KAHE1D	5	329.32			
H	Ctenochaetus strigosus	7	KAHE1D	2	53.69			
H	Zebrasoma flavescens	7	KAHE1D	1	9.48	236	9653.02	48.3
O	Melichthys niger	7	KAHE1D	26	4246.72			
O	Canthigaster jactator	7	KAHE1D	6	21.37	32	4268.10	21.3
	TOTAL	7	KAHE1D	364	19991.93	364	19991.93	100
C	Fistularia commersoni	8	KAHE5B	1	130.63			
C	Mulloides flavolineatus	8	KAHE5B	23	6194.84			
C	Parupeneus pleurostigma	8	KAHE5B	1	98.25			
C	Parupeneus multifasciatus	8	KAHE5B	5	272.00			
C	Parupeneus multifasciatus	8	KAHE5B	4	108.47			
C	Parupeneus multifasciatus	8	KAHE5B	5	480.41			
C	Plectroglyphidodon johnstonian	8	KAHE5B	4	6.89			
C	Plectroglyphidodon imparipenni	8	KAHE5B	2	1.72			
C	Paracirrhites arcatus	8	KAHE5B	2	32.70			
C	Thalassoma duperrey	8	KAHE5B	10	549.49			
C	Thalassoma duperrey	8	KAHE5B	9	873.47			
C	Thalassoma duperrey	8	KAHE5B	9	246.51			
C	Gomphosus varius	8	KAHE5B	1	11.04			
C	Halichoeres ornatissimus	8	KAHE5B	1	16.45			
C	Zanclus cornutus	8	KAHE5B	1	104.16			
C	Sufflamen bursa	8	KAHE5B	3	257.62	81	9384.64	30.6
CF	Chaetodon multicinctus	8	KAHE5B	2	26.06			
CF	Pervagor melanocephalus	8	KAHE5B	1	16.22	3	42.28	0.1
H	Calotomus carolinus	8	KAHE5B	1	339.30			
H	Calotomus carolinus	8	KAHE5B	1	1288.03			
H	Acanthurus triostegus	8	KAHE5B	1	17.17			
H	Acanthurus nigrofuscus	8	KAHE5B	18	430.15			
H	Acanthurus nigrofuscus	8	KAHE5B	8	434.02			
H	Acanthurus olivaceus	8	KAHE5B	25	2344.22			
H	Acanthurus olivaceus	8	KAHE5B	24	1139.45			
H	Acanthurus olivaceus	8	KAHE5B	15	8447.55			
H	Acanthurus olivaceus	8	KAHE5B	23	6018.34			
H	Acanthurus blochii	8	KAHE5B	1	12.25			
H	Ctenochaetus strigosus	8	KAHE5B	4	30.30			
H	Ctenochaetus strigosus	8	KAHE5B	2	30.40			
H	Naso lituratus	8	KAHE5B	1	311.61			
H	Naso unicornis	8	KAHE5B	1	38.92	125	20881.72	68.1
O	Stegastes fasciolatus	8	KAHE5B	4	59.05			
O	Melichthys vidua	8	KAHE5B	1	199.03			
O	Cantherhines sandwichiensis	8	KAHE5B	1	82.05			
O	Canthigaster jactator	8	KAHE5B	1	3.56	7	343.70	1.1
P	Chromis vanderbilti	8	KAHE5B	71	22.43	71	22.43	0.1
	TOTAL	8	KAHE5B	287	30674.77	287	30674.77	100
C	Aulostomus chinensis	9	KAHE7B	1	52.00			
C	Lutjanus kasmira	9	KAHE7B	12	111.11			
C	Parupeneus multifasciatus	9	KAHE7B	2	54.23			
C	Parupeneus multifasciatus	9	KAHE7B	2	108.80			
C	Paracirrhites arcatus	9	KAHE7B	2	6.89			
C	Thalassoma duperrey	9	KAHE7B	1	97.05			
C	Thalassoma duperrey	9	KAHE7B	1	54.95			
C	Thalassoma duperrey	9	KAHE7B	1	27.39			
C	Stethojulis balteata	9	KAHE7B	1	35.76			
C	Zanclus cornutus	9	KAHE7B	1	24.04			
C	Zanclus cornutus	9	KAHE7B	1	104.16			
C	Sufflamen bursa	9	KAHE7B	2	171.75	27	848.13	44.1
CF	Pervagor spilosoma	9	KAHE7B	2	32.43	2	32.43	1.7
H	Acanthurus nigrofuscus	9	KAHE7B	1	7.52			
H	Acanthurus nigrofuscus	9	KAHE7B	4	95.59			
H	Acanthurus nigrofuscus	9	KAHE7B	1	54.25			
H	Acanthurus olivaceus	9	KAHE7B	3	281.31			
H	Acanthurus olivaceus	9	KAHE7B	4	189.91			
H	Naso lituratus	9	KAHE7B	3	44.69			
H	Naso lituratus	9	KAHE7B	2	72.69			
H	Naso unicornis	9	KAHE7B	2	20.49			
H	Naso unicornis	9	KAHE7B	1	38.92	21	805.37	41.9
O	Melichthys vidua	9	KAHE7B	1	199.03			
O	Canthigaster jactator	9	KAHE7B	3	10.69	4	209.72	10.9
P	Dascyllus albisella	9	KAHE7B	5	15.44			
P	Chromis vanderbilti	9	KAHE7B	40	12.64	45	28.08	1.5
	TOTAL	9	KAHE7B	99	1923.73	99	1923.73	100

GRP	08-May-14 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Parupeneus multifasciatus	10	KAHE7C	5	272.00			
C	Forcipiger flavissimus	10	KAHE7C	1	9.15			
C	Paracirrhites arcatus	10	KAHE7C	2	32.70			
C	Zanclus cornutus	10	KAHE7C	1	104.16			
C	Sufflamen bursa	10	KAHE7C	7	601.11			
C	Sufflamen fraenatus	10	KAHE7C	1	144.65	17	1163.77	75.2
CF	Pervagor spilosoma	10	KAHE7C	1	16.22	1	16.22	1.0
H	Acanthurus triostegus	10	KAHE7C	1	17.17			
H	Acanthurus olivaceus	10	KAHE7C	1	93.77	2	110.94	7.2
O	Melichthys vidua	10	KAHE7C	1	199.03			
O	Canthigaster coronata	10	KAHE7C	2	44.10			
O	Canthigaster jactator	10	KAHE7C	3	10.69	6	253.82	16.4
P	Chromis vanderbilti	10	KAHE7C	6	1.90	6	1.90	0.1
	TOTAL	10	KAHE7C	32	1546.63	32	1546.63	100
C	Zanclus cornutus	11	KAHE7D	1	104.16			
C	Sufflamen bursa	11	KAHE7D	2	171.75			
C	Sufflamen fraenatus	11	KAHE7D	1	224.79	4	500.70	38.4
H	Acanthurus triostegus	11	KAHE7D	11	509.47			
H	Acanthurus olivaceus	11	KAHE7D	1	93.77	12	603.23	46.3
O	Melichthys vidua	11	KAHE7D	1	199.03	1	199.03	15.3
	TOTAL	11	KAHE7D	17	1302.96	17	1302.96	100
C	Adioryx xantherythrus	12	KAHE7E	3	38.39			
C	Myripristis amaenus	12	KAHE7E	2	10.90			
C	Aulostomus chinensis	12	KAHE7E	2	55.44			
C	Apogon kallopterus	12	KAHE7E	2	68.33			
C	Parupeneus pleurostigma	12	KAHE7E	8	243.51			
C	Parupeneus multifasciatus	12	KAHE7E	10	543.99			
C	Parupeneus multifasciatus	12	KAHE7E	5	55.26			
C	Parupeneus multifasciatus	12	KAHE7E	25	677.91			
C	Parupeneus multifasciatus	12	KAHE7E	2	310.84			
C	Paracirrhites arcatus	12	KAHE7E	2	6.89			
C	Thalassoma duperrey	12	KAHE7E	4	219.80			
C	Thalassoma duperrey	12	KAHE7E	4	109.56			
C	Thalassoma duperrey	12	KAHE7E	1	97.05			
C	Stethojulis balteata	12	KAHE7E	2	71.53			
C	Anampses chrysocephalus	12	KAHE7E	3	7.88			
C	Sufflamen bursa	12	KAHE7E	5	429.37			
C	Sufflamen fraenatus	12	KAHE7E	1	144.65	81	3091.31	57.7
CF	Chaetodon multicinctus	12	KAHE7E	2	13.31	2	13.31	0.2
H	Calotomus carolinus	12	KAHE7E	1	34.69			
H	Acanthurus triostegus	12	KAHE7E	2	58.44			
H	Acanthurus triostegus	12	KAHE7E	4	185.26			
H	Acanthurus nigrofuscus	12	KAHE7E	4	95.59			
H	Acanthurus nigrofuscus	12	KAHE7E	13	97.82			
H	Acanthurus olivaceus	12	KAHE7E	1	261.67			
H	Acanthurus olivaceus	12	KAHE7E	2	327.03			
H	Acanthurus olivaceus	12	KAHE7E	1	47.48			
H	Ctenochaetus strigosus	12	KAHE7E	3	22.73			
H	Naso lituratus	12	KAHE7E	6	89.39			
H	Naso lituratus	12	KAHE7E	1	36.34			
H	Naso unicornis	12	KAHE7E	1	73.36	39	1329.79	24.8
O	Melichthys vidua	12	KAHE7E	4	796.12			
O	Canthigaster jactator	12	KAHE7E	1	3.56	5	799.68	14.9
P	Chaetodon kleini	12	KAHE7E	12	78.70			
P	Dascyllus albisella	12	KAHE7E	6	18.53			
P	Chromis vanderbilti	12	KAHE7E	35	11.06			
P	Chromis hanui	12	KAHE7E	5	3.73			
P	Chromis agilis	12	KAHE7E	5	7.28	63	119.29	2.2
	TOTAL	12	KAHE7E	190	5353.38	190	5353.38	100
C	Lutjanus kasmira	13	KAHE10	120	6882.30			
C	Lutjanus kasmira	13	KAHE10	70	1810.01			
C	Lutjanus kasmira	13	KAHE10	45	416.64			
C	Monotaxis grandoculis	13	KAHE10	1	22.60			
C	Parupeneus pleurostigma	13	KAHE10	4	392.99			
C	Parupeneus multifasciatus	13	KAHE10	1	155.42			
C	Parupeneus multifasciatus	13	KAHE10	2	108.80			
C	Parupeneus multifasciatus	13	KAHE10	2	192.16			
C	Forcipiger flavissimus	13	KAHE10	1	9.15			
C	Plectroglyphidodon johnstonian	13	KAHE10	3	5.17			
C	Plectroglyphidodon imparipenni	13	KAHE10	1	0.86			
C	Paracirrhites arcatus	13	KAHE10	1	3.45			
C	Paracirrhites arcatus	13	KAHE10	3	49.05			
C	Thalassoma duperrey	13	KAHE10	9	873.47			
C	Thalassoma duperrey	13	KAHE10	3	164.85			
C	Thalassoma duperrey	13	KAHE10	3	82.17			
C	Thalassoma duperrey	13	KAHE10	4	44.65			
C	Stethojulis balteata	13	KAHE10	1	35.76			
C	Zanclus cornutus	13	KAHE10	1	54.90			
C	Zanclus cornutus	13	KAHE10	1	104.16			
C	Sufflamen bursa	13	KAHE10	2	171.75	278	11580.31	53.2
CF	Chaetodon multicinctus	13	KAHE10	2	26.06	2	26.06	0.1
H	Acanthurus leucopareius	13	KAHE10	1	27.52			
H	Acanthurus nigrofuscus	13	KAHE10	5	119.49			
H	Acanthurus nigrofuscus	13	KAHE10	120	6510.30			
H	Acanthurus olivaceus	13	KAHE10	15	712.15			
H	Acanthurus blochii	13	KAHE10	2	24.49			
H	Ctenochaetus strigosus	13	KAHE10	5	134.22			
H	Ctenochaetus strigosus	13	KAHE10	3	396.40			
H	Naso lituratus	13	KAHE10	5	74.49	156	7999.05	36.7
O	Stegastes fasciolatus	13	KAHE10	8	207.84			
O	Canthigaster jactator	13	KAHE10	1	3.56	9	211.40	1.0
P	Hemitaurichthys thompsoni	13	KAHE10	1	21.17			
P	Dascyllus albisella	13	KAHE10	14	43.24			
P	Abudefduf abdominalis	13	KAHE10	50	1566.63			
P	Chromis ovalis	13	KAHE10	4	23.73			
P	Chromis ovalis	13	KAHE10	15	299.08	84	1953.84	9.0
	TOTAL	13	KAHE10	529	21770.67	529	21770.67	100

08-May-14

GRP	SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Plectroglyphidodon imparipenni	14	NANA1	1	0.86			
C	Cirrhitops fasciatus	14	NANA1	1	8.23			
C	Thalassoma duperrey	14	NANA1	1	11.16			
C	Thalassoma duperrey	14	NANA1	3	82.17			
C	Thalassoma duperrey	14	NANA1	3	9.45			
C	Stethojulis balteata	14	NANA1	1	4.00			
C	Ostracion meleagris	14	NANA1	1	6.76	11	122.64	52.6
H	Acanthurus nigrofuscus	14	NANA1	4	95.59			
H	Naso lituratus	14	NANA1	1	14.90	5	110.49	47.4
	TOTAL	14	NANA1	16	233.12	16	233.12	100
C	Lutjanus fulvus	15	NANA2	1	221.56			
C	Monotaxis grandoculis	15	NANA2	1	13.74			
C	Parupeneus multifasciatus	15	NANA2	3	288.24			
C	Parupeneus multifasciatus	15	NANA2	1	155.42			
C	Parupeneus multifasciatus	15	NANA2	1	340.44			
C	Plectroglyphidodon johnstonian	15	NANA2	1	1.72			
C	Bodianus bilunulatus	15	NANA2	1	37.87			
C	Thalassoma duperrey	15	NANA2	1	54.95			
C	Gomphosus varius	15	NANA2	1	22.60			
C	Sufflamen bursa	15	NANA2	2	171.75	13	1308.30	3.4
H	Calotomus carolinus	15	NANA2	1	1288.03			
H	Calotomus carolinus	15	NANA2	1	34.69			
H	Acanthurus triostegus	15	NANA2	11	1100.16			
H	Acanthurus triostegus	15	NANA2	8	370.52			
H	Acanthurus leucopareius	15	NANA2	25	3317.51			
H	Acanthurus leucopareius	15	NANA2	12	800.89			
H	Acanthurus leucopareius	15	NANA2	40	9307.01			
H	Acanthurus nigrofuscus	15	NANA2	20	477.94			
H	Acanthurus nigrofuscus	15	NANA2	7	379.77			
H	Acanthurus olivaceus	15	NANA2	22	12389.75			
H	Acanthurus olivaceus	15	NANA2	5	1966.05			
H	Acanthurus dussumieri	15	NANA2	2	1128.71			
H	Acanthurus blochii	15	NANA2	4	1814.38			
H	Acanthurus blochii	15	NANA2	7	685.83			
H	Ctenochaetus strigosus	15	NANA2	5	134.22			
H	Ctenochaetus strigosus	15	NANA2	4	30.30			
H	Ctenochaetus strigosus	15	NANA2	1	65.86			
H	Zebrasoma flavescens	15	NANA2	5	266.40			
H	Naso lituratus	15	NANA2	1	622.36	181	36180.37	95.0
O	Stegastes fasciolatus	15	NANA2	4	103.92			
O	Melichthys niger	15	NANA2	2	496.06			
O	Canthigaster jactator	15	NANA2	1	3.56	7	603.55	1.6
	TOTAL	15	NANA2	201	38092.21	201	38092.21	100
C	Myripristis amaenus	16	PIPE	12	984.99			
C	Aulostomus chinensis	16	PIPE	1	52.00			
C	Lutjanus kasmira	16	PIPE	46	2638.22			
C	Lutjanus kasmira	16	PIPE	175	19242.77			
C	Mulloides flavolineatus	16	PIPE	6	1149.80			
C	Mulloides flavolineatus	16	PIPE	15	1251.67			
C	Parupeneus pleurostigma	16	PIPE	7	406.06			
C	Parupeneus pleurostigma	16	PIPE	10	1533.91			
C	Parupeneus multifasciatus	16	PIPE	1	155.42			
C	Parupeneus multifasciatus	16	PIPE	1	96.08			
C	Forcipiger flavissimus	16	PIPE	1	9.15			
C	Plectroglyphidodon johnstonian	16	PIPE	4	6.89			
C	Paracirrhites arcatus	16	PIPE	4	65.39			
C	Thalassoma lutescens	16	PIPE	1	97.05			
C	Thalassoma duperrey	16	PIPE	20	1941.04			
C	Thalassoma duperrey	16	PIPE	6	329.69			
C	Thalassoma purpureum	16	PIPE	1	946.59			
C	Gomphosus varius	16	PIPE	9	558.26			
C	Gomphosus varius	16	PIPE	3	67.80			
C	Gomphosus varius	16	PIPE	1	39.39			
C	Coris venusta	16	PIPE	4	347.46			
C	Macropharyngodon geoffroy	16	PIPE	2	37.26			
C	Halichoeres ornatissimus	16	PIPE	3	75.41			
C	Zanclus cornutus	16	PIPE	2	109.80			
C	Sufflamen bursa	16	PIPE	5	429.37			
C	Sufflamen fraenatus	16	PIPE	1	144.65	341	32716.12	47.3
CF	Chaetodon multicinctus	16	PIPE	4	52.12	4	52.12	0.1
H	Calotomus carolinus	16	PIPE	3	1017.91			
H	Calotomus carolinus	16	PIPE	2	263.37			
H	Scarus sordidus	16	PIPE	1	76.01			
H	Scarus psittacus	16	PIPE	1	1437.46			
H	Scarus psittacus	16	PIPE	1	1437.46			
H	Acanthurus nigrofuscus	16	PIPE	55	2983.89			
H	Acanthurus nigrofuscus	16	PIPE	24	573.53			
H	Acanthurus olivaceus	16	PIPE	1	163.52			
H	Naso lituratus	16	PIPE	1	72.58			
H	Naso lituratus	16	PIPE	1	36.34	90	8062.08	11.7
O	Stegastes fasciolatus	16	PIPE	10	259.80			
O	Melichthys niger	16	PIPE	4	653.34			
O	Melichthys vidua	16	PIPE	2	398.06			
O	Melichthys vidua	16	PIPE	8	994.77			
O	Cantherhines sandwichiensis	16	PIPE	1	196.14			
O	Canthigaster jactator	16	PIPE	9	32.06	34	2534.17	3.7
P	Chaetodon miliaris	16	PIPE	5	105.84			
P	Abudefduf abdominalis	16	PIPE	239	7488.49			
P	Abudefduf vaigensis	16	PIPE	241	11291.31			
P	Chromis vanderbilti	16	PIPE	12	3.79			
P	Chromis ovalis	16	PIPE	110	1271.56			
P	Chromis ovalis	16	PIPE	230	4585.91			
P	Naso hexacanthus	16	PIPE	12	206.34			
P	Naso hexacanthus	16	PIPE	21	817.41	870	25770.65	37.3
	TOTAL	16	PIPE	1339	69135.13	1339	69135.13	100

6 JUNE 2014 FIELD DATA

06-Jun-14

GRP	SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Parupeneus multifasciatus	1	EAST1	3	707.24			
C	Parupeneus multifasciatus	1	EAST1	1	472.94			
C	Parupeneus multifasciatus	1	EAST1	11	1709.65			
C	Parupeneus multifasciatus	1	EAST1	12	1152.98			
C	Chaetodon lunula	1	EAST1	1	35.99			
C	Paracirrhites arcatus	1	EAST1	3	24.35			
C	Paracirrhites forsteri	1	EAST1	2	79.29			
C	Thalassoma duperrey	1	EAST1	12	659.39			
C	Thalassoma duperrey	1	EAST1	7	679.36			
C	Thalassoma duperrey	1	EAST1	5	136.95			
C	Coris gaimard	1	EAST1	1	83.79			
C	Coris gaimard	1	EAST1	1	215.88			
C	Rhinecanthus rectangulus	1	EAST1	2	171.75			
C	Sufflamen fraenatus	1	EAST1	1	224.79	62	6354.36	28.7
CF	Chaetodon unimaculatus	1	EAST1	2	50.61	2	50.61	0.2
H	Acanthurus triostegus	1	EAST1	3	300.04			
H	Acanthurus triostegus	1	EAST1	1	187.60			
H	Acanthurus nigrofuscus	1	EAST1	6	143.38			
H	Acanthurus nigrofuscus	1	EAST1	17	922.29			
H	Acanthurus olivaceus	1	EAST1	9	5068.53			
H	Acanthurus olivaceus	1	EAST1	11	1031.46			
H	Acanthurus olivaceus	1	EAST1	5	237.38			
H	Acanthurus olivaceus	1	EAST1	3	785.00			
H	Acanthurus dussumieri	1	EAST1	5	2821.77			
H	Acanthurus blochii	1	EAST1	2	907.19			
H	Acanthurus blochii	1	EAST1	3	2351.43			
H	Naso lituratus	1	EAST1	2	897.88			
H	Naso lituratus	1	EAST1	3	44.69	70	15698.66	71.0
O	Canthigaster jactator	1	EAST1	2	7.12	2	7.12	0.03
P	Chromis vanderbilti	1	EAST1	19	6.00	19	6.00	0.03
	TOTAL	1	EAST1	155	22116.76	155	22116.76	100
C	Parupeneus multifasciatus	2	EAST2	1	155.42			
C	Plectroglyphidodon johnstonianu	2	EAST2	2	1.72			
C	Paracirrhites arcatus	2	EAST2	2	32.70			
C	Thalassoma duperrey	2	EAST2	10	273.90			
C	Thalassoma duperrey	2	EAST2	13	714.34			
C	Thalassoma duperrey	2	EAST2	9	873.47			
C	Gomphosus varius	2	EAST2	2	45.20			
C	Stethojulis balteata	2	EAST2	1	72.39			
C	Halichoeres ornatissimus	2	EAST2	2	32.90	42	2202.04	17.2
CF	Chaetodon ornatissimus	2	EAST2	2	273.78			
CF	Chaetodon quadrimaculatus	2	EAST2	4	101.22	6	375.00	2.9
H	Acanthurus nigrofuscus	2	EAST2	26	369.53			
H	Acanthurus nigrofuscus	2	EAST2	48	1147.06			
H	Acanthurus nigrofuscus	2	EAST2	7	52.67			
H	Acanthurus olivaceus	2	EAST2	6	1570.00			
H	Acanthurus olivaceus	2	EAST2	12	6758.04	99	9897.31	77.4
O	Stegastes fasciolatus	2	EAST2	1	7.39			
O	Melichthys vidua	2	EAST2	1	296.24			
O	Canthigaster jactator	2	EAST2	2	7.12	4	310.75	2.4
	TOTAL	2	EAST2	151	12785.10	151	12785.10	100

GRP	06-Jun-14 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Gymnothorax flavimarginatus	3	EAST3	1	3175.15			
C	Parupeneus multifasciatus	3	EAST3	1	54.40			
C	Plectroglyphidodon johnstonianu	3	EAST3	2	3.44			
C	Paracirrhites arcatus	3	EAST3	1	16.35			
C	Thalassoma duperrey	3	EAST3	5	274.74			
C	Thalassoma duperrey	3	EAST3	4	388.21			
C	Thalassoma duperrey	3	EAST3	4	109.56			
C	Gomphosus varius	3	EAST3	1	22.60	19	4044.45	31.6
CF	Chaetodon multicinctus	3	EAST3	2	13.31			
CF	Chaetodon multicinctus	3	EAST3	2	26.06	4	39.37	0.3
H	Calotomus carolinus	3	EAST3	1	34.69			
H	Acanthurus nigrofuscus	3	EAST3	10	142.13			
H	Acanthurus nigrofuscus	3	EAST3	10	238.97			
H	Acanthurus olivaceus	3	EAST3	14	7884.38			
H	Ctenochaetus strigosus	3	EAST3	1	0.87	36	8301.04	64.8
O	Stegastes fasciolatus	3	EAST3	7	103.34			
O	Melichthys vidua	3	EAST3	1	296.24			
O	Canthigaster jactator	3	EAST3	6	21.37	14	420.95	3.3
	TOTAL	3	EAST3	73	12805.82	73	12805.82	100
C	Gymnothorax meleagris	4	EAST4	1	73.65			
C	Parupeneus pleurostigma	4	EAST4	1	58.01			
C	Parupeneus multifasciatus	4	EAST4	1	3.12			
C	Parupeneus multifasciatus	4	EAST4	1	96.08			
C	Parupeneus multifasciatus	4	EAST4	2	108.80			
C	Paracirrhites arcatus	4	EAST4	3	49.05			
C	Paracirrhites forsteri	4	EAST4	1	39.65			
C	Labroides phthirophagus	4	EAST4	2	1.26			
C	Pseudocheilinus octotaenia	4	EAST4	1	14.41			
C	Thalassoma duperrey	4	EAST4	15	410.86			
C	Thalassoma duperrey	4	EAST4	19	1044.03			
C	Thalassoma duperrey	4	EAST4	9	873.47			
C	Thalassoma duperrey	4	EAST4	6	66.98			
C	Coris flavovittata	4	EAST4	1	449.84			
C	Stethojulis balteata	4	EAST4	1	35.76			
C	Halichoeres ornatissimus	4	EAST4	1	4.41			
C	Plagiotremus ewaensis	4	EAST4	1	0.95			
C	Rhinecanthus rectangulus	4	EAST4	1	85.87			
C	Ostracion meleagris	4	EAST4	1	24.55	68	3440.74	18.1
H	Acanthurus triostegus	4	EAST4	14	1400.20			
H	Acanthurus nigrofuscus	4	EAST4	22	312.68			
H	Acanthurus nigrofuscus	4	EAST4	15	358.46			
H	Acanthurus olivaceus	4	EAST4	9	2355.00			
H	Acanthurus olivaceus	4	EAST4	17	9573.89	77	14000.23	73.7
O	Melichthys niger	4	EAST4	2	326.67			
O	Melichthys vidua	4	EAST4	4	1184.95			
O	Canthigaster jactator	4	EAST4	4	14.25	10	1525.87	8.0
P	Chromis vanderbilti	4	EAST4	65	20.53	65	20.53	0.1
	TOTAL	4	EAST4	220	18987.37	220	18987.37	100

	06-Jun-14						GROUP	GROUP
GRP	SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	BIOMASS	PERCENT
C	Parupeneus multifasciatus	5	KO1	3	288.24			
C	Parupeneus bifasciatus	5	KO1	1	59.77			
C	Plectroglyphidodon johnstonianu	5	KO1	1	1.72			
C	Plectroglyphidodon imparipennis	5	KO1	1	0.86			
C	Paracirrhites arcatus	5	KO1	1	16.35			
C	Cirrhitus pinnulatus	5	KO1	1	90.86			
C	Thalassoma duperrey	5	KO1	7	679.36			
C	Thalassoma duperrey	5	KO1	10	549.49			
C	Thalassoma duperrey	5	KO1	15	410.86			
C	Gomphosus varius	5	KO1	3	33.12			
C	Gomphosus varius	5	KO1	1	22.60			
C	Stethojulis balteata	5	KO1	2	71.53			
C	Zanclus cornutus	5	KO1	1	104.16			
C	Sufflamen bursa	5	KO1	1	85.87	48	2414.80	14.3
CF	Chaetodon unimaculatus	5	KO1	4	101.22			
CF	Chaetodon quadrimaculatus	5	KO1	2	50.61			
CF	Chaetodon multicinctus	5	KO1	2	45.11			
CF	Chaetodon multicinctus	5	KO1	8	104.24	16	301.18	1.8
H	Scarus sordidus	5	KO1	3	420.02			
H	Scarus sordidus	5	KO1	1	775.07			
H	Scarus sordidus	5	KO1	7	251.96			
H	Scarus sordidus	5	KO1	1	544.57			
H	Scarus psittacus	5	KO1	1	241.42			
H	Acanthurus triostegus	5	KO1	1	17.17			
H	Acanthurus leucopareius	5	KO1	1	374.06			
H	Acanthurus leucopareius	5	KO1	1	15.69			
H	Acanthurus leucopareius	5	KO1	1	232.68			
H	Acanthurus nigrofuscus	5	KO1	7	99.49			
H	Acanthurus nigrofuscus	5	KO1	51	1218.75			
H	Acanthurus olivaceus	5	KO1	2	523.33			
H	Acanthurus olivaceus	5	KO1	3	1689.51			
H	Acanthurus blochii	5	KO1	1	453.59			
H	Ctenochaetus strigosus	5	KO1	18	2378.41			
H	Ctenochaetus strigosus	5	KO1	43	2832.19			
H	Ctenochaetus strigosus	5	KO1	35	939.54			
H	Naso lituratus	5	KO1	1	622.36	178	13629.81	80.8
O	Stegastes fasciolatus	5	KO1	18	265.74			
O	Melichthys niger	5	KO1	1	248.03			
O	Canthigaster jactator	5	KO1	5	17.81	24	531.58	3.1
	TOTAL	5	KO1	266	16877.37	266	16877.37	100
C	Fistularia commersoni	6	KO2	1	100.51			
C	Parupeneus multifasciatus	6	KO2	5	135.58			
C	Parupeneus multifasciatus	6	KO2	2	108.80			
C	Parupeneus bifasciatus	6	KO2	1	270.20			
C	Forcipiger flavissimus	6	KO2	3	27.45			
C	Plectroglyphidodon johnstonianu	6	KO2	2	3.44			
C	Paracirrhites arcatus	6	KO2	1	16.35			
C	Labroides phthirophagus	6	KO2	3	1.88			
C	Thalassoma duperrey	6	KO2	10	549.49			
C	Thalassoma duperrey	6	KO2	9	246.51			
C	Thalassoma duperrey	6	KO2	5	485.26			
C	Thalassoma ballieui	6	KO2	1	167.53			
C	Sufflamen bursa	6	KO2	2	171.75	45	2284.76	8.4
CF	Chaetodon unimaculatus	6	KO2	4	101.22			
CF	Chaetodon ornatissimus	6	KO2	2	273.78			
CF	Chaetodon multicinctus	6	KO2	6	78.18	12	453.18	1.7
H	Scarus psittacus	6	KO2	1	241.42			
H	Scarus psittacus	6	KO2	4	151.49			
H	Scarus psittacus	6	KO2	5	73.07			
H	Scarus rubroviolaceus	6	KO2	1	1814.37			
H	Acanthurus triostegus	6	KO2	6	600.09			
H	Acanthurus triostegus	6	KO2	6	277.89			
H	Acanthurus leucopareius	6	KO2	2	465.35			
H	Acanthurus leucopareius	6	KO2	7	928.90			
H	Acanthurus leucopareius	6	KO2	3	1122.19			
H	Acanthurus nigrofuscus	6	KO2	7	379.77			
H	Acanthurus nigrofuscus	6	KO2	24	341.11			
H	Acanthurus nigrofuscus	6	KO2	19	454.04			
H	Acanthurus nigroris	6	KO2	5	271.26			
H	Acanthurus olivaceus	6	KO2	12	6758.04			
H	Acanthurus olivaceus	6	KO2	16	4186.67			
H	Acanthurus blochii	6	KO2	1	330.67			
H	Acanthurus blochii	6	KO2	3	87.09			
H	Acanthurus blochii	6	KO2	2	311.17			
H	Acanthurus blochii	6	KO2	5	489.88			
H	Acanthurus blochii	6	KO2	6	340.20			
H	Ctenochaetus strigosus	6	KO2	13	348.97			
H	Ctenochaetus strigosus	6	KO2	9	592.78			
H	Ctenochaetus strigosus	6	KO2	10	1321.34			
H	Zebrasoma flavescens	6	KO2	10	94.84			
H	Zebrasoma flavescens	6	KO2	14	364.41			
H	Zebrasoma flavescens	6	KO2	6	319.68			
H	Naso lituratus	6	KO2	2	897.88	199	23564.59	87.0
O	Stegastes fasciolatus	6	KO2	3	44.29			
O	Melichthys niger	6	KO2	1	248.03			
O	Cantherhines sandwichiensis	6	KO2	2	164.10	6	456.42	1.7
P	Abudefduf abdominalis	6	KO2	7	327.96	7	327.96	1.2
	TOTAL	6	KO2	269	27086.91	269	27086.91	100

	06-Jun-14						GROUP	GROUP
GRP	SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	BIOMASS	PERCENT
C	Myripristis amaenus	7	KAHE1D	3	246.25			
C	Myripristis amaenus	7	KAHE1D	5	212.02			
C	Mulloides flavolineatus	7	KAHE1D	23	2996.42			
C	Parupeneus multifasciatus	7	KAHE1D	1	96.08			
C	Parupeneus multifasciatus	7	KAHE1D	2	54.23			
C	Parupeneus multifasciatus	7	KAHE1D	1	54.40			
C	Chaetodon fremblii	7	KAHE1D	1	20.91			
C	Plectroglyphidodon johnstonianu	7	KAHE1D	7	12.05			
C	Plectroglyphidodon imparipennis	7	KAHE1D	1	0.86			
C	Paracirrhites arcatus	7	KAHE1D	4	65.39			
C	Paracirrhites forsteri	7	KAHE1D	1	39.65			
C	Labroides phthirophagus	7	KAHE1D	2	1.26			
C	Thalassoma duperrey	7	KAHE1D	4	44.65			
C	Thalassoma duperrey	7	KAHE1D	20	547.81			
C	Thalassoma duperrey	7	KAHE1D	20	1098.98			
C	Thalassoma duperrey	7	KAHE1D	7	679.36			
C	Gomphosus varius	7	KAHE1D	2	45.20			
C	Gomphosus varius	7	KAHE1D	1	11.04			
C	Zanclus cornutus	7	KAHE1D	2	109.80			
C	Sufflamen bursa	7	KAHE1D	1	45.36	108	6381.72	21.3
CF	Chaetodon quadrimaculatus	7	KAHE1D	2	50.61			
CF	Chaetodon multicinctus	7	KAHE1D	2	26.06	4	76.67	0.3
H	Centropyge potteri	7	KAHE1D	1	4.98			
H	Scarus psittacus	7	KAHE1D	42	613.80			
H	Scarus psittacus	7	KAHE1D	13	492.34			
H	Scarus psittacus	7	KAHE1D	1	79.27			
H	Scarus rubroviolaceus	7	KAHE1D	2	294.05			
H	Acanthurus triostegus	7	KAHE1D	9	416.84			
H	Acanthurus triostegus	7	KAHE1D	17	291.83			
H	Acanthurus nigrofuscus	7	KAHE1D	11	262.87			
H	Acanthurus nigrofuscus	7	KAHE1D	12	170.55			
H	Acanthurus nigrofuscus	7	KAHE1D	10	542.52			
H	Acanthurus olivaceus	7	KAHE1D	2	39.49			
H	Ctenochaetus strigosus	7	KAHE1D	8	526.92			
H	Ctenochaetus strigosus	7	KAHE1D	16	243.18			
H	Ctenochaetus strigosus	7	KAHE1D	11	295.28	155	4273.92	14.3
O	Stegastes fasciolatus	7	KAHE1D	5	73.82			
O	Melichthys niger	7	KAHE1D	111	18130.24			
O	Melichthys vidua	7	KAHE1D	4	796.12			
O	Canthigaster jactator	7	KAHE1D	6	21.37	126	19021.55	63.6
P	Abudefduf abdominalis	7	KAHE1D	4	125.33			
P	Chromis vanderbilti	7	KAHE1D	48	15.16	52	140.49	0.5
	TOTAL	7	KAHE1D	445	29894.36	445	29894.36	100
C	Fistularia commersoni	8	KAHE5B	1	253.56			
C	Parupeneus multifasciatus	8	KAHE5B	2	310.84			
C	Parupeneus multifasciatus	8	KAHE5B	4	217.60			
C	Parupeneus multifasciatus	8	KAHE5B	1	27.12			
C	Parupeneus multifasciatus	8	KAHE5B	2	192.16			
C	Parupeneus multifasciatus	8	KAHE5B	1	3.12			
C	Parupeneus cyclostomus	8	KAHE5B	1	49.96			
C	Plectroglyphidodon johnstonianu	8	KAHE5B	4	6.89			
C	Paracirrhites arcatus	8	KAHE5B	4	65.39			
C	Cirrhitops fasciatus	8	KAHE5B	2	16.45			
C	Thalassoma duperrey	8	KAHE5B	6	582.31			
C	Thalassoma duperrey	8	KAHE5B	7	191.73			
C	Thalassoma duperrey	8	KAHE5B	10	549.49			
C	Coris venusta	8	KAHE5B	1	86.86			
C	Halichoeres ornatissimus	8	KAHE5B	2	19.05			
C	Halichoeres ornatissimus	8	KAHE5B	2	32.90			
C	Rhinecanthus rectangulus	8	KAHE5B	1	85.87			
C	Sufflamen bursa	8	KAHE5B	1	144.65			
C	Sufflamen bursa	8	KAHE5B	1	85.87	53	2921.84	35.7
CF	Chaetodon multicinctus	8	KAHE5B	4	52.12			
CF	Pervagor spilosoma	8	KAHE5B	1	9.75	5	61.87	0.8
H	Scarus psittacus	8	KAHE5B	3	237.80			
H	Scarus psittacus	8	KAHE5B	1	144.94			
H	Acanthurus nigrofuscus	8	KAHE5B	19	454.04			
H	Acanthurus nigrofuscus	8	KAHE5B	17	241.62			
H	Acanthurus olivaceus	8	KAHE5B	3	1689.51			
H	Acanthurus olivaceus	8	KAHE5B	5	1308.34			
H	Acanthurus olivaceus	8	KAHE5B	5	468.84			
H	Ctenochaetus strigosus	8	KAHE5B	4	60.79			
H	Naso lituratus	8	KAHE5B	1	36.34			
H	Naso lituratus	8	KAHE5B	2	16.93	60	4659.16	56.9
O	Stegastes fasciolatus	8	KAHE5B	3	44.29			
O	Melichthys vidua	8	KAHE5B	1	199.03			
O	Canthigaster jactator	8	KAHE5B	4	14.25	8	257.57	3.1
P	Abudefduf abdominalis	8	KAHE5B	7	219.33			
P	Chromis vanderbilti	8	KAHE5B	86	27.17			
P	Naso brevirostris	8	KAHE5B	1	38.92	94	285.42	3.5
	TOTAL	8	KAHE5B	220	8185.86	220	8185.86	100
C	Decapterus macarellus	9	KAHE7B	17	4578.79			
C	Mulloides flavolineatus	9	KAHE7B	1	191.63			
C	Parupeneus pleurostigma	9	KAHE7B	4	392.99			
C	Parupeneus pleurostigma	9	KAHE7B	2	451.26			
C	Parupeneus multifasciatus	9	KAHE7B	1	155.42			
C	Thalassoma duperrey	9	KAHE7B	2	54.78			
C	Thalassoma duperrey	9	KAHE7B	1	97.05			
C	Gomphosus varius	9	KAHE7B	1	39.39			
C	Coris gaimard	9	KAHE7B	1	215.88			
C	Zanclus cornutus	9	KAHE7B	1	54.90			
C	Zanclus cornutus	9	KAHE7B	1	104.16			
C	Sufflamen bursa	9	KAHE7B	4	343.49	36	6679.76	88.2
H	Acanthurus nigrofuscus	9	KAHE7B	1	23.90			
H	Acanthurus olivaceus	9	KAHE7B	1	93.77			
H	Naso lituratus	9	KAHE7B	1	14.90			
H	Naso lituratus	9	KAHE7B	1	36.34			
H	Naso unicornis	9	KAHE7B	1	73.36	5	242.26	3.2
O	Melichthys vidua	9	KAHE7B	3	597.09			
O	Canthigaster coronata	9	KAHE7B	1	22.05			
O	Canthigaster jactator	9	KAHE7B	1	3.56			
O	Canthigaster rivulata	9	KAHE7B	1	22.05	6	644.75	8.5
P	Chaetodon kleini	9	KAHE7B	1	6.56	1	6.56	0.1
	TOTAL	9	KAHE7B	48	7573.34	48	7573.34	100

GRP	06-Jun-14 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Adioryx xantherythrus	10	KAHE7C	12	767.61			
C	Myripristis amaenus	10	KAHE7C	4	563.23			
C	Myripristis amaenus	10	KAHE7C	9	738.75			
C	Aulostomus chinensis	10	KAHE7C	2	38.55			
C	Apogon kallopterus	10	KAHE7C	3	102.50			
C	Mulloides flavolineatus	10	KAHE7C	1	191.63			
C	Parupeneus pleurostigma	10	KAHE7C	1	98.25			
C	Parupeneus pleurostigma	10	KAHE7C	1	225.63			
C	Parupeneus pleurostigma	10	KAHE7C	1	58.01			
C	Parupeneus multifasciatus	10	KAHE7C	2	108.80			
C	Parupeneus multifasciatus	10	KAHE7C	2	192.16			
C	Parupeneus cyclostomus	10	KAHE7C	1	316.39			
C	Forcipiger flavissimus	10	KAHE7C	1	14.92			
C	Forcipiger flavissimus	10	KAHE7C	2	18.30			
C	Plectroglyphidodon johnstonianu	10	KAHE7C	2	1.72			
C	Paracirrhites arcatus	10	KAHE7C	1	8.12			
C	Cirrhitops fasciatus	10	KAHE7C	1	8.23			
C	Labroides phthirophagus	10	KAHE7C	2	1.26			
C	Thalassoma duperrey	10	KAHE7C	4	388.21			
C	Thalassoma duperrey	10	KAHE7C	4	109.56			
C	Macropharyngodon geoffroy	10	KAHE7C	3	55.89			
C	Halichoeres ornatissimus	10	KAHE7C	1	16.45			
C	Zanclus cornutus	10	KAHE7C	1	104.16			
C	Sufflamen bursa	10	KAHE7C	1	144.65			
C	Sufflamen bursa	10	KAHE7C	1	85.87	63	4358.83	32.4
CF	Chaetodon multicinctus	10	KAHE7C	4	26.63			
CF	Pervagor spilosoma	10	KAHE7C	1	16.22	5	42.84	0.3
H	Centropyge potteri	10	KAHE7C	1	4.98			
H	Scarus sordidus	10	KAHE7C	1	234.65			
H	Scarus sordidus	10	KAHE7C	3	2325.21			
H	Scarus sordidus	10	KAHE7C	4	560.02			
H	Acanthurus triostegus	10	KAHE7C	1	187.60			
H	Acanthurus nigrofuscus	10	KAHE7C	4	95.59			
H	Acanthurus nigrofuscus	10	KAHE7C	9	127.91			
H	Acanthurus olivaceus	10	KAHE7C	6	1570.00			
H	Acanthurus olivaceus	10	KAHE7C	14	664.68			
H	Acanthurus olivaceus	10	KAHE7C	13	1218.99			
H	Ctenochaetus strigosus	10	KAHE7C	4	107.38			
H	Naso lituratus	10	KAHE7C	4	59.59			
H	Naso lituratus	10	KAHE7C	4	145.37			
H	Naso unicornis	10	KAHE7C	1	123.12	69	7425.10	55.2
O	Melichthys vidua	10	KAHE7C	2	592.48			
O	Melichthys vidua	10	KAHE7C	1	199.03			
O	Cantherhines sandwichiensis	10	KAHE7C	1	82.05			
O	Canthigaster coronata	10	KAHE7C	1	22.05			
O	Canthigaster jactator	10	KAHE7C	2	7.12	7	902.73	6.7
P	Dascyllus albisella	10	KAHE7C	3	9.26			
P	Chromis vanderbilti	10	KAHE7C	35	11.06			
P	Chromis hanui	10	KAHE7C	3	2.24			
P	Naso brevirostris	10	KAHE7C	18	700.64	59	723.20	5.4
	TOTAL	10	KAHE7C	203	13452.70	203	13452.70	100
C	Scorpaenopsis diabolus	11	KAHE7D	1	78.47			
C	Decapterus macarellus	11	KAHE7D	9	2424.07			
C	Parupeneus multifasciatus	11	KAHE7D	1	27.12			
C	Parupeneus multifasciatus	11	KAHE7D	1	96.08			
C	Thalassoma duperrey	11	KAHE7D	1	27.39			
C	Sufflamen bursa	11	KAHE7D	1	85.87			
C	Sufflamen fraenatus	11	KAHE7D	1	224.79	15	2963.79	90.8
O	Melichthys vidua	11	KAHE7D	1	296.24			
O	Canthigaster jactator	11	KAHE7D	1	3.56	2	299.80	9.2
	TOTAL	11	KAHE7D	17	3263.59	17	3263.59	100
C	Aulostomus chinensis	12	KAHE7E	1	112.28			
C	Aulostomus chinensis	12	KAHE7E	1	27.72			
C	Parupeneus multifasciatus	12	KAHE7E	3	288.24			
C	Parupeneus multifasciatus	12	KAHE7E	32	99.81			
C	Parupeneus multifasciatus	12	KAHE7E	2	54.23			
C	Parupeneus multifasciatus	12	KAHE7E	13	707.19			
C	Parupeneus cyclostomus	12	KAHE7E	2	287.43			
C	Forcipiger flavissimus	12	KAHE7E	1	9.15			
C	Thalassoma duperrey	12	KAHE7E	1	97.05			
C	Thalassoma duperrey	12	KAHE7E	1	54.95			
C	Coris venusta	12	KAHE7E	2	47.27			
C	Pseudojuloides cerasinus	12	KAHE7E	3	9.45			
C	Pseudojuloides cerasinus	12	KAHE7E	1	11.16			
C	Zanclus cornutus	12	KAHE7E	1	54.90			
C	Sufflamen bursa	12	KAHE7E	3	257.62			
C	Sufflamen fraenatus	12	KAHE7E	1	461.25	68	2579.73	32.2
CF	Chaetodon multicinctus	12	KAHE7E	1	0.83			
CF	Chaetodon multicinctus	12	KAHE7E	5	33.28			
CF	Cantherhines dumerili	12	KAHE7E	1	623.68	7	657.79	8.2
H	Scarus sordidus	12	KAHE7E	1	775.07			
H	Acanthurus triostegus	12	KAHE7E	3	562.81			
H	Acanthurus nigrofuscus	12	KAHE7E	8	60.20			
H	Acanthurus nigrofuscus	12	KAHE7E	3	42.64			
H	Acanthurus nigrofuscus	12	KAHE7E	3	3.13			
H	Acanthurus olivaceus	12	KAHE7E	2	187.54			
H	Acanthurus olivaceus	12	KAHE7E	4	1046.67			
H	Naso lituratus	12	KAHE7E	2	29.80	26	2707.84	33.8
O	Melichthys niger	12	KAHE7E	1	163.34			
O	Melichthys vidua	12	KAHE7E	3	888.72			
O	Canthigaster coronata	12	KAHE7E	1	22.05			
O	Canthigaster jactator	12	KAHE7E	3	10.69	8	1084.79	13.5
P	Chaetodon kleini	12	KAHE7E	3	19.67			
P	Chromis vanderbilti	12	KAHE7E	72	22.74			
P	Naso hexacanthus	12	KAHE7E	1	389.42			
P	Naso brevirostris	12	KAHE7E	2	557.41	78	989.25	12.3
	TOTAL	12	KAHE7E	187	8019.40	187	8019.40	100

	06-Jun-14						GROUP	GROUP
GRP	SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	BIOMASS	PERCENT
C	Selar crumenophthalmus	13	KAHE10	23	14226.66			
C	Lutjanus kasmira	13	KAHE10	225	24740.71			
C	Parupeneus multifasciatus	13	KAHE10	1	155.42			
C	Parupeneus multifasciatus	13	KAHE10	2	192.16			
C	Forcipiger flavissimus	13	KAHE10	1	9.15			
C	Plectroglyphidodon johnstonianu	13	KAHE10	3	5.17			
C	Paracirrhites arcatus	13	KAHE10	4	65.39			
C	Paracirrhites forsteri	13	KAHE10	1	26.28			
C	Cirrhitops fasciatus	13	KAHE10	2	16.45			
C	Thalassoma duperrey	13	KAHE10	7	384.64			
C	Thalassoma duperrey	13	KAHE10	5	136.95			
C	Thalassoma duperrey	13	KAHE10	5	485.26			
C	Stethojulis balteata	13	KAHE10	3	43.23			
C	Stethojulis balteata	13	KAHE10	2	71.53			
C	Macropharyngodon geoffroy	13	KAHE10	1	18.63			
C	Halichoeres ornatissimus	13	KAHE10	1	25.14			
C	Zanclus cornutus	13	KAHE10	2	109.80			
C	Sufflamen bursa	13	KAHE10	1	19.92			
C	Sufflamen bursa	13	KAHE10	3	257.62	292	40990.11	87.3
CF	Chaetodon multicinctus	13	KAHE10	2	26.06	2	26.06	0.1
H	Calotomus carolinus	13	KAHE10	1	499.89			
H	Scarus psittacus	13	KAHE10	1	79.27			
H	Acanthurus leucopareius	13	KAHE10	1	66.74			
H	Acanthurus leucopareius	13	KAHE10	1	27.52			
H	Acanthurus nigrofuscus	13	KAHE10	4	30.10			
H	Acanthurus nigrofuscus	13	KAHE10	7	167.28			
H	Acanthurus nigrofuscus	13	KAHE10	10	142.13			
H	Acanthurus olivaceus	13	KAHE10	4	375.08			
H	Acanthurus olivaceus	13	KAHE10	1	563.17			
H	Acanthurus olivaceus	13	KAHE10	4	1046.67			
H	Acanthurus blochii	13	KAHE10	1	56.70			
H	Acanthurus blochii	13	KAHE10	1	12.25			
H	Naso lituratus	13	KAHE10	4	145.37			
H	Naso lituratus	13	KAHE10	1	72.58			
H	Naso lituratus	13	KAHE10	6	89.39	47	3374.13	7.2
O	Stegastes fasciolatus	13	KAHE10	12	311.76			
O	Melichthys vidua	13	KAHE10	1	199.03			
O	Cantherhines sandwichiensis	13	KAHE10	1	82.05			
O	Canthigaster jactator	13	KAHE10	4	14.25			
O	Canthigaster rivulata	13	KAHE10	1	22.05	19	629.14	1.3
P	Chaetodon miliaris	13	KAHE10	1	21.17			
P	Dascyllus albisella	13	KAHE10	16	49.41			
P	Abudefduf abdominalis	13	KAHE10	20	626.65			
P	Abudefduf vaigensis	13	KAHE10	18	843.33			
P	Chromis vanderbilti	13	KAHE10	21	6.63			
P	Chromis ovalis	13	KAHE10	35	404.59	111	1951.79	4.2
	TOTAL	13	KAHE10	471	46971.23	471	46971.23	100
C	Gymnomuraena zebra	14	NANA1	1	583.54			
C	Parupeneus pleurostigma	14	NANA1	1	153.39			
C	Plectroglyphidodon imparipennis	14	NANA1	1	0.86			
C	Thalassoma duperrey	14	NANA1	1	27.39			
C	Thalassoma duperrey	14	NANA1	1	11.16			
C	Halichoeres ornatissimus	14	NANA1	1	9.52			
C	Rhinecanthus rectangulus	14	NANA1	2	171.75			
C	Arothron hispidis	14	NANA1	1	1136.64	9	2094.25	99.7
O	Canthigaster jactator	14	NANA1	2	7.12	2	7.12	0.3
	TOTAL	14	NANA1	11	2101.38	11	2101.38	100

GRP	06-Jun-14 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Monotaxis grandoculis	15	NANA2	2	27.47			
C	Parupeneus multifasciatus	15	NANA2	2	108.80			
C	Parupeneus multifasciatus	15	NANA2	1	155.42			
C	Chaetodon lunula	15	NANA2	2	71.99			
C	Plectroglyphidodon johnstonianu	15	NANA2	1	1.72			
C	Paracirrhites forsteri	15	NANA2	1	39.65			
C	Thalassoma duperrey	15	NANA2	3	33.49			
C	Thalassoma duperrey	15	NANA2	3	291.16			
C	Thalassoma duperrey	15	NANA2	9	246.51			
C	Thalassoma duperrey	15	NANA2	5	274.74			
C	Stethojulis balteata	15	NANA2	2	28.82			
C	Halichoeres ornatissimus	15	NANA2	2	32.90			
C	Sufflamen bursa	15	NANA2	2	171.75	35	1484.42	7.3
CF	Chaetodon unimaculatus	15	NANA2	2	50.61			
CF	Chaetodon multicinctus	15	NANA2	3	19.97	5	70.58	0.3
H	Calotomus carolinus	15	NANA2	1	1288.03			
H	Acanthurus triostegus	15	NANA2	6	600.09			
H	Acanthurus leucopareius	15	NANA2	5	1870.32			
H	Acanthurus leucopareius	15	NANA2	19	4420.83			
H	Acanthurus leucopareius	15	NANA2	21	2786.71			
H	Acanthurus leucopareius	15	NANA2	1	27.52			
H	Acanthurus nigrofuscus	15	NANA2	3	71.69			
H	Acanthurus nigrofuscus	15	NANA2	2	28.43			
H	Acanthurus olivaceus	15	NANA2	14	5504.94			
H	Acanthurus blochii	15	NANA2	3	992.01			
H	Ctenochaetus strigosus	15	NANA2	5	75.99			
H	Zebrasoma flavescens	15	NANA2	3	5.06			
H	Zebrasoma flavescens	15	NANA2	3	28.45			
H	Zebrasoma flavescens	15	NANA2	4	213.12			
H	Zebrasoma flavescens	15	NANA2	1	26.03	91	17939.22	88.3
O	Stegastes fasciolatus	15	NANA2	4	59.05			
O	Melichthys niger	15	NANA2	3	744.09			
O	Canthigaster jactator	15	NANA2	5	17.81	12	820.96	4.0
P	Chromis vanderbilti	15	NANA2	9	2.84	9	2.84	0.01
	TOTAL	15	NANA2	152	20318.02	152	20318.02	100
C	Aulostomus chinensis	16	PIPE	1	27.72			
C	Lutjanus kasmira	16	PIPE	75	1939.30			
C	Lutjanus kasmira	16	PIPE	35	2007.34			
C	Mulloides flavolineatus	16	PIPE	21	4024.30			
C	Mulloides vanicolensis	16	PIPE	1	90.54			
C	Parupeneus multifasciatus	16	PIPE	4	621.69			
C	Forcipiger flavissimus	16	PIPE	3	27.45			
C	Chaetodon fremblii	16	PIPE	1	20.91			
C	Paracirrhites arcatus	16	PIPE	9	1046.21			
C	Cheilio inermis	16	PIPE	1	618.55			
C	Thalassoma duperrey	16	PIPE	2	109.90			
C	Thalassoma duperrey	16	PIPE	2	194.10			
C	Gomphosus varius	16	PIPE	2	182.11			
C	Gomphosus varius	16	PIPE	3	186.09			
C	Coris venusta	16	PIPE	1	48.38			
C	Coris venusta	16	PIPE	1	86.86			
C	Zanclus cornutus	16	PIPE	2	208.32			
C	Zanclus cornutus	16	PIPE	1	54.90			
C	Sufflamen bursa	16	PIPE	2	171.75	167	11666.41	23.1
CF	Chaetodon multicinctus	16	PIPE	4	26.63			
CF	Exallias brevis	16	PIPE	1	29.55	5	56.18	0.1
H	Calotomus carolinus	16	PIPE	1	218.67			
H	Scarus sordidus	16	PIPE	12	1680.07			
H	Scarus sordidus	16	PIPE	24	1824.32			
H	Scarus sordidus	16	PIPE	3	2325.21			
H	Scarus sordidus	16	PIPE	7	251.96			
H	Scarus sordidus	16	PIPE	3	1101.06			
H	Scarus psittacus	16	PIPE	3	237.80			
H	Acanthurus nigrofuscus	16	PIPE	12	170.55			
H	Acanthurus nigrofuscus	16	PIPE	29	693.01			
H	Ctenochaetus strigosus	16	PIPE	12	322.13			
H	Naso lituratus	16	PIPE	1	14.90	107	8839.69	17.5
O	Stegastes fasciolatus	16	PIPE	7	181.86			
O	Melichthys niger	16	PIPE	27	2690.69			
O	Canthigaster jactator	16	PIPE	6	21.37	40	2893.92	5.7
P	Chaetodon miliaris	16	PIPE	9	190.51			
P	Dascyllus albisella	16	PIPE	12	37.06			
P	Abudefduf abdominalis	16	PIPE	120	3759.91			
P	Abudefduf vaigensis	16	PIPE	265	12415.75			
P	Chromis vanderbilti	16	PIPE	50	15.79			
P	Chromis ovalis	16	PIPE	40	797.55			
P	Chromis ovalis	16	PIPE	55	635.78			
P	Naso hexacanthus	16	PIPE	36	1401.28			
P	Naso brevirostris	16	PIPE	45	5540.31			
P	Naso brevirostris	16	PIPE	32	2347.45	664	27141.41	53.6
	TOTAL	16	PIPE	983	50597.61	983	50597.61	100

26 SEPTEMBER 2014 FIELD DATA

26-Sep-14

GRP	SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Caranx melampygus	1	EAST1		1034.95	8		
C	Caranx melampygus	1	EAST1		407.97	5		
C	Caranx melampygus	1	EAST1		1503.30	4		
C	Caranx melampygus	1	EAST1		1360.78	2		
C	Lutjanus fulvus	1	EAST1		886.23	4		
C	Parupeneus multifasciatus	1	EAST1		340.44	1		
C	Chaetodon lunula	1	EAST1		107.98	3		
C	Paracirrhites arcatus	1	EAST1		24.35	3		
C	Labroides phthirophagus	1	EAST1		1.26	2		
C	Thalassoma duperrey	1	EAST1		582.31	6		
C	Thalassoma duperrey	1	EAST1		219.12	8		
C	Thalassoma duperrey	1	EAST1		549.49	10		
C	Coris gaimard	1	EAST1		215.88	1		
C	Coris gaimard	1	EAST1		819.52	1		
C	Zanclus cornutus	1	EAST1	59	24.04	1	8077.63	12.0
CF	Chaetodon unimaculatus	1	EAST1	2	50.61	2	50.61	0.1
H	Calotomus carolinus	1	EAST1		2138.86	1		
H	Acanthurus triostegus	1	EAST1		3900.56	39		
H	Acanthurus triostegus	1	EAST1		326.16	19		
H	Acanthurus triostegus	1	EAST1		2362.07	51		
H	Acanthurus triostegus	1	EAST1		59.33	14		
H	Acanthurus nigrofuscus	1	EAST1		255.83	18		
H	Acanthurus nigrofuscus	1	EAST1		525.73	22		
H	Acanthurus nigrofuscus	1	EAST1		922.29	17		
H	Acanthurus nigrofuscus	1	EAST1		398.80	53		
H	Acanthurus olivaceus	1	EAST1		1312.76	14		
H	Acanthurus olivaceus	1	EAST1		6213.62	38		
H	Acanthurus olivaceus	1	EAST1		17458.28	31		
H	Acanthurus dussumieri	1	EAST1		1306.38	4		
H	Acanthurus blochii	1	EAST1		3483.60	15		
H	Acanthurus blochii	1	EAST1		174.18	6		
H	Acanthurus blochii	1	EAST1		9525.47	21		
H	Acanthurus blochii	1	EAST1		8712.63	7		
H	Naso lituratus	1	EAST1		21.19	5		
H	Naso unicornis	1	EAST1	380	27.18	5	59124.95	87.9
O	Canthigaster jactator	1	EAST1	3	10.69	3	10.69	0.02
P	Chromis vanderbilti	1	EAST1	38	12.00	38	12.00	0.02
	TOTAL	1	EAST1	482	67275.87	482	67275.87	100
C	Monotaxis grandoculis	2	EAST2		7.62	1		
C	Monotaxis grandoculis	2	EAST2		3.71	1		
C	Parupeneus multifasciatus	2	EAST2		54.40	1		
C	Parupeneus multifasciatus	2	EAST2		27.12	1		
C	Plectroglyphidodon johnstonianu	2	EAST2		3.03	1		
C	Plectroglyphidodon imparipennis	2	EAST2		0.86	1		
C	Paracirrhites arcatus	2	EAST2		65.39	4		
C	Paracirrhites arcatus	2	EAST2		16.24	2		
C	Pseudocheilinus tetrataenia	2	EAST2		4.00	1		
C	Thalassoma duperrey	2	EAST2		879.18	16		
C	Thalassoma duperrey	2	EAST2		547.81	20		
C	Thalassoma duperrey	2	EAST2		679.36	7		
C	Rhinecanthus rectangulus	2	EAST2		85.87	1		
C	Rhinecanthus rectangulus	2	EAST2		45.36	1		
C	Sufflamen bursa	2	EAST2		144.65	1		
C	Ostracion meleagris	2	EAST2	60	6.76	1	2571.37	13.5
CF	Chaetodon unimaculatus	2	EAST2	6	42.16	6	42.16	0.2
H	Calotomus carolinus	2	EAST2		34.69	1		
H	Scarus rubroviolaceus	2	EAST2		232.75	1		
H	Acanthurus nigrofuscus	2	EAST2		298.47	21		
H	Acanthurus nigrofuscus	2	EAST2		286.76	12		
H	Acanthurus nigrofuscus	2	EAST2		354.64	107		
H	Acanthurus olivaceus	2	EAST2		5631.70	10		
H	Acanthurus olivaceus	2	EAST2		8896.68	34		
H	Acanthurus olivaceus	2	EAST2		94.95	2		
H	Ctenochaetus strigosus	2	EAST2		3.49	4		
H	Naso lituratus	2	EAST2	203	19.11	11	15853.25	83.0
O	Stegastes fasciolatus	2	EAST2		14.78	2		
O	Melichthys vidua	2	EAST2		592.48	2		
O	Canthigaster jactator	2	EAST2	9	17.81	5	625.07	3.3
P	Chromis vanderbilti	2	EAST2	14	4.42	14	4.42	0.02
	TOTAL	2	EAST2	292	19096.28	292	19096.28	100

GRP	26-Sep-14 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Parupeneus multifasciatus	3	EAST3		27.12	1		
C	Parupeneus cyclostomus	3	EAST3		49.59	2		
C	Plectroglyphidodon johnstonianu	3	EAST3		9.09	3		
C	Paracirrhites arcatus	3	EAST3		81.74	5		
C	Paracirrhites forsteri	3	EAST3		39.65	1		
C	Labroides phthirophagus	3	EAST3		0.63	1		
C	Thalassoma duperrey	3	EAST3		82.17	3		
C	Thalassoma duperrey	3	EAST3		291.16	3		
C	Thalassoma duperrey	3	EAST3		219.80	4		
C	Gomphosus varius	3	EAST3		45.20	2		
C	Stethojulis balteata	3	EAST3		35.76	1		
C	Sufflamen bursa	3	EAST3		85.87	1		
C	Sufflamen fraenatus	3	EAST3		224.79	1		
C	Sufflamen fraenatus	3	EAST3	29	329.34	1	1521.91	29.1
CF	Chaetodon multicinctus	3	EAST3	4	26.63	4	26.63	0.5
H	Acanthurus nigrofuscus	3	EAST3		334.56	14		
H	Acanthurus nigrofuscus	3	EAST3		17.74	17		
H	Acanthurus nigrofuscus	3	EAST3		368.71	49		
H	Acanthurus olivaceus	3	EAST3		261.67	1		
H	Ctenochaetus strigosus	3	EAST3		348.97	13		
H	Ctenochaetus strigosus	3	EAST3		13.07	15		
H	Ctenochaetus strigosus	3	EAST3		121.22	16		
H	Zebrasoma flavescens	3	EAST3	126	1.69	1	1467.62	28.1
O	Stegastes fasciolatus	3	EAST3		66.53	9		
O	Melichthys niger	3	EAST3		2123.36	13		
O	Canthigaster jactator	3	EAST3	25	10.69	3	2200.58	42.1
P	Chromis vanderbilti	3	EAST3		7.90	25		
P	Chromis ovalis	3	EAST3	26	2.51	1	10.41	0.2
	TOTAL	3	EAST3	210	5227.14	210	5227.14	100
C	Gymnothorax undulatus	4	EAST4		870.15	1		
C	Cephalopholis argus	4	EAST4		1676.50	1		
C	Parupeneus pleurostigma	4	EAST4		58.01	1		
C	Parupeneus pleurostigma	4	EAST4		121.75	4		
C	Parupeneus multifasciatus	4	EAST4		54.23	2		
C	Plectroglyphidodon imparipennis	4	EAST4		0.86	1		
C	Paracirrhites arcatus	4	EAST4		16.24	2		
C	Bodianus bilunulatus	4	EAST4		1141.37	1		
C	Thalassoma duperrey	4	EAST4		970.52	10		
C	Thalassoma duperrey	4	EAST4		879.18	16		
C	Thalassoma duperrey	4	EAST4		684.76	25		
C	Coris venusta	4	EAST4		23.64	1		
C	Coris gaimard	4	EAST4		45.99	1		
C	Stethojulis balteata	4	EAST4		71.53	2		
C	Stethojulis balteata	4	EAST4		72.39	1		
C	Halichoeres ornatissimus	4	EAST4		16.45	1		
C	Halichoeres ornatissimus	4	EAST4		9.52	1		
C	Zanclus cornutus	4	EAST4		312.47	3		
C	Rhinecanthus rectangulus	4	EAST4		85.87	1		
C	Sufflamen fraenatus	4	EAST4		329.34	1		
C	Sufflamen fraenatus	4	EAST4		224.79	1		
C	Ostracion meleagris	4	EAST4	78	6.76	1	7672.34	23.0
CF	Chaetodon ornatissimus	4	EAST4		138.00	2		
CF	Chaetodon ornatissimus	4	EAST4		8.22	1		
CF	Chaetodon ornatissimus	4	EAST4		28.53	1		
CF	Chaetodon quadrimaculatus	4	EAST4		28.45	2		
CF	Chaetodon multicinctus	4	EAST4	10	26.63	4	229.82	0.7
H	Scarus psittacus	4	EAST4		37.87	1		
H	Acanthurus nigrofuscus	4	EAST4		180.59	24		
H	Acanthurus nigrofuscus	4	EAST4		262.87	11		
H	Acanthurus nigrofuscus	4	EAST4		188.92	57		
H	Acanthurus olivaceus	4	EAST4		7326.68	28		
H	Acanthurus olivaceus	4	EAST4		14079.26	25		
H	Acanthurus dussumieri	4	EAST4		564.35	1		
H	Acanthurus blochii	4	EAST4		907.19	2		
H	Ctenochaetus strigosus	4	EAST4		9.26	3		
H	Ctenochaetus strigosus	4	EAST4		6.97	8		
H	Zebrasoma flavescens	4	EAST4		3.38	2		
H	Zebrasoma flavescens	4	EAST4		106.56	2		
H	Naso lituratus	4	EAST4		36.34	1		
H	Naso lituratus	4	EAST4	169	16.95	4	23727.20	71.0
O	Melichthys niger	4	EAST4		490.01	3		
O	Melichthys vidua	4	EAST4		1184.95	4		
O	Canthigaster coronata	4	EAST4		7.59	1		
O	Canthigaster jactator	4	EAST4	11	10.69	3	1693.24	5.1
P	Chaetodon miliaris	4	EAST4		42.34	2		
P	Chromis vanderbilti	4	EAST4	141	43.91	139	86.24	0.3
	TOTAL	4	EAST4	409	33408.85	409	33408.85	100

GRP	26-Sep-14 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Aulostomus chinensis	5	KO1		4.76	1		
C	Lutjanus fulvus	5	KO1		155.61	1		
C	Lutjanus kasmira	5	KO1		1334.53	7		
C	Lutjanus kasmira	5	KO1		439.83	4		
C	Monotaxis grandoculis	5	KO1		3.71	1		
C	Parupeneus multifasciatus	5	KO1		54.40	1		
C	Parupeneus bifasciatus	5	KO1		107.31	1		
C	Parupeneus cyclostomus	5	KO1		74.39	3		
C	Plectroglyphidodon johnstonianu	5	KO1		6.89	4		
C	Labroides phthirophagus	5	KO1		0.63	1		
C	Thalassoma duperrey	5	KO1		384.64	7		
C	Thalassoma duperrey	5	KO1		485.26	5		
C	Thalassoma duperrey	5	KO1		219.12	8		
C	Zanclus cornutus	5	KO1		48.09	2		
C	Sufflamen bursa	5	KO1		144.65	1		
C	Sufflamen bursa	5	KO1	50	257.62	3	3721.43	17.4
CF	Chaetodon unimaculatus	5	KO1		28.45	2		
CF	Chaetodon ornatissimus	5	KO1		138.00	2		
CF	Chaetodon multicinctus	5	KO1	10	78.18	6	244.63	1.1
H	Calotomus carolinus	5	KO1		131.69	1		
H	Scarus sordidus	5	KO1		287.96	8		
H	Scarus sordidus	5	KO1		1468.09	4		
H	Scarus psittacus	5	KO1		1437.46	1		
H	Scarus psittacus	5	KO1		396.34	5		
H	Acanthurus triostegus	5	KO1		360.50	21		
H	Acanthurus triostegus	5	KO1		1991.55	43		
H	Acanthurus leucopareius	5	KO1		928.90	7		
H	Acanthurus leucopareius	5	KO1		533.92	8		
H	Acanthurus nigrofuscus	5	KO1		693.01	29		
H	Acanthurus nigrofuscus	5	KO1		308.51	41		
H	Acanthurus nigrofuscus	5	KO1		66.29	20		
H	Acanthurus olivaceus	5	KO1		375.08	4		
H	Acanthurus olivaceus	5	KO1		1308.13	8		
H	Acanthurus olivaceus	5	KO1		189.91	4		
H	Acanthurus blochii	5	KO1		1393.44	6		
H	Ctenochaetus strigosus	5	KO1		483.19	18		
H	Ctenochaetus strigosus	5	KO1		2173.54	33		
H	Zebrasoma flavescens	5	KO1		1.69	1		
H	Zebrasoma flavescens	5	KO1		159.84	3		
H	Zebrasoma flavescens	5	KO1		78.09	3		
H	Naso lituratus	5	KO1	271	12.72	3	14779.84	69.0
O	Stegastes fasciolatus	5	KO1		25.98	1		
O	Stegastes fasciolatus	5	KO1		29.57	4		
O	Melichthys niger	5	KO1		1984.25	8		
O	Melichthys vidua	5	KO1		296.24	1		
O	Canthigaster jactator	5	KO1	18	14.25	4	2350.28	11.0
P	Abudefduf abdominalis	5	KO1	10	313.33	10	313.33	1.5
	TOTAL	5	KO1	359	21409.51	359	21409.51	100
C	Monotaxis grandoculis	6	KO2		13.74	1		
C	Parupeneus multifasciatus	6	KO2		96.08	1		
C	Parupeneus multifasciatus	6	KO2		54.40	1		
C	Parupeneus multifasciatus	6	KO2		27.12	1		
C	Parupeneus bifasciatus	6	KO2		107.31	1		
C	Plectroglyphidodon johnstonianu	6	KO2		5.17	3		
C	Plectroglyphidodon imparipennis	6	KO2		0.86	1		
C	Labroides phthirophagus	6	KO2		1.26	2		
C	Thalassoma duperrey	6	KO2		679.36	7		
C	Thalassoma duperrey	6	KO2		273.90	10		
C	Thalassoma duperrey	6	KO2		44.65	4		
C	Thalassoma duperrey	6	KO2		384.64	7		
C	Thalassoma ballieui	6	KO2		28.26	1		
C	Gomphosus varius	6	KO2		22.08	2		
C	Sufflamen bursa	6	KO2	45	257.62	3	1996.46	4.7
CF	Chaetodon unimaculatus	6	KO2		28.45	2		
CF	Chaetodon multicinctus	6	KO2	4	26.06	2	54.51	0.1
H	Kyphosus bigibbus	6	KO2		4785.96	1		
H	Kyphosus bigibbus	6	KO2		3481.62	1		
H	Scarus rubroviolaceus	6	KO2		1836.38	1		
H	Acanthurus triostegus	6	KO2		343.33	20		
H	Acanthurus triostegus	6	KO2		1621.03	35		
H	Acanthurus leucopareius	6	KO2		1163.38	5		
H	Acanthurus leucopareius	6	KO2		1194.30	9		
H	Acanthurus leucopareius	6	KO2		266.96	4		
H	Acanthurus nigrofuscus	6	KO2		240.79	32		
H	Acanthurus nigrofuscus	6	KO2		12.52	12		
H	Acanthurus nigrofuscus	6	KO2		382.35	16		
H	Acanthurus olivaceus	6	KO2		1500.30	16		
H	Acanthurus olivaceus	6	KO2		6758.04	12		
H	Acanthurus olivaceus	6	KO2		5233.34	20		
H	Acanthurus blochii	6	KO2		226.80	4		
H	Acanthurus blochii	6	KO2		2333.74	15		
H	Acanthurus blochii	6	KO2		2314.69	7		
H	Ctenochaetus strigosus	6	KO2		1189.20	9		
H	Ctenochaetus strigosus	6	KO2		107.38	4		
H	Ctenochaetus strigosus	6	KO2		987.97	15		
H	Ctenochaetus strigosus	6	KO2		68.18	9		
H	Zebrasoma flavescens	6	KO2		639.36	12		
H	Zebrasoma flavescens	6	KO2	271	20.26	12	36707.89	86.7
O	Melichthys niger	6	KO2		2728.34	11		
O	Melichthys vidua	6	KO2		592.48	2		
O	Canthigaster jactator	6	KO2	18	17.81	5	3338.63	7.9
P	Abudefduf abdominalis	6	KO2		219.33	7		
P	Chromis vanderbilti	6	KO2	33	8.21	26	227.54	0.5
	TOTAL	6	KO2	371	42325.02	371	42325.02	100

GRP	26-Sep-14 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Aulostomus chinensis	7	KAHE1D		4.76	1		
C	Aulostomus chinensis	7	KAHE1D		12.84	1		
C	Fistularia commersoni	7	KAHE1D		8.09	1		
C	Caranx melampygus	7	KAHE1D		58.05	19		
C	Mulloides flavolineatus	7	KAHE1D		1251.67	15		
C	Mulloides flavolineatus	7	KAHE1D		2299.60	12		
C	Parupeneus multifasciatus	7	KAHE1D		108.80	2		
C	Plectroglyphidodon johnstonianu	7	KAHE1D		5.17	3		
C	Plectroglyphidodon imparipennis	7	KAHE1D		1.72	2		
C	Paracirrhites arcatus	7	KAHE1D		16.24	2		
C	Cirrhitus pinnulatus	7	KAHE1D		90.86	1		
C	Labroides phthirophagus	7	KAHE1D		0.63	1		
C	Thalassoma duperrey	7	KAHE1D		178.61	16		
C	Thalassoma duperrey	7	KAHE1D		328.69	12		
C	Thalassoma duperrey	7	KAHE1D		1263.82	23		
C	Thalassoma duperrey	7	KAHE1D		3493.87	36		
C	Gomphosus varius	7	KAHE1D		33.12	3		
C	Gomphosus varius	7	KAHE1D		22.60	1		
C	Stethojulis balteata	7	KAHE1D		107.29	3		
C	Zanclus cornutus	7	KAHE1D		72.13	3		
C	Rhinecanthus rectangulus	7	KAHE1D		85.87	1		
C	Sufflamen bursa	7	KAHE1D	160	39.85	2	9484.28	31.7
CF	Chaetodon unimaculatus	7	KAHE1D		14.05	2		
CF	Chaetodon unimaculatus	7	KAHE1D		14.22	1		
CF	Chaetodon ornatissimus	7	KAHE1D	4	8.22	1	36.49	0.1
H	Scarus psittacus	7	KAHE1D		1768.33	121		
H	Scarus psittacus	7	KAHE1D		3863.01	102		
H	Acanthurus triostegus	7	KAHE1D		190.71	45		
H	Acanthurus triostegus	7	KAHE1D		875.50	51		
H	Acanthurus nigrofuscus	7	KAHE1D		1147.06	48		
H	Acanthurus nigrofuscus	7	KAHE1D		263.36	35		
H	Ctenochaetus strigosus	7	KAHE1D		724.79	27		
H	Ctenochaetus strigosus	7	KAHE1D		257.58	34		
H	Ctenochaetus strigosus	7	KAHE1D		131.73	2		
H	Zebrasoma flavescens	7	KAHE1D		8.44	5		
H	Zebrasoma flavescens	7	KAHE1D		28.45	3		
H	Naso lituratus	7	KAHE1D		1.74	1		
H	Naso unicornis	7	KAHE1D		21.74	4		
H	Naso unicornis	7	KAHE1D	481	2.28	3	9284.72	31.0
O	Stegastes fasciolatus	7	KAHE1D		36.96	5		
O	Stegastes fasciolatus	7	KAHE1D		51.96	2		
O	Melichthys niger	7	KAHE1D		10616.81	65		
O	Canthigaster jactator	7	KAHE1D	75	10.69	3	10716.41	35.8
P	Chromis vanderbilti	7	KAHE1D		9.79	31		
P	Chromis ovalis	7	KAHE1D	96	385.57	65	395.36	1.3
	TOTAL	7	KAHE1D	816	29917.26	816	29917.26	100
C	Aulostomus chinensis	8	KAHE5B		52.00	1		
C	Aulostomus chinensis	8	KAHE5B		9.52	2		
C	Aulostomus chinensis	8	KAHE5B		210.62	1		
C	Parupeneus multifasciatus	8	KAHE5B		108.80	2		
C	Parupeneus multifasciatus	8	KAHE5B		96.08	1		
C	Plectroglyphidodon johnstonianu	8	KAHE5B		12.05	7		
C	Plectroglyphidodon imparipennis	8	KAHE5B		0.86	1		
C	Paracirrhites arcatus	8	KAHE5B		16.35	1		
C	Paracirrhites arcatus	8	KAHE5B		32.47	4		
C	Paracirrhites forsteri	8	KAHE5B		26.28	1		
C	Cirrhitops fasciatus	8	KAHE5B		3.75	1		
C	Thalassoma duperrey	8	KAHE5B		388.21	4		
C	Thalassoma duperrey	8	KAHE5B		329.69	6		
C	Thalassoma duperrey	8	KAHE5B		82.17	3		
C	Coris gaimard	8	KAHE5B		8.57	1		
C	Halichoeres ornatissimus	8	KAHE5B		9.52	1		
C	Halichoeres ornatissimus	8	KAHE5B		16.45	1		
C	Zanclus cornutus	8	KAHE5B		72.13	3		
C	Zanclus cornutus	8	KAHE5B		208.32	2		
C	Sufflamen bursa	8	KAHE5B		171.75	2		
C	Sufflamen bursa	8	KAHE5B	58	259.01	13	2114.59	57.9
CF	Chaetodon unimaculatus	8	KAHE5B		0.79	1		
CF	Chaetodon multicinctus	8	KAHE5B		26.63	4		
CF	Pervagor melanocephalus	8	KAHE5B	6	5.23	1	32.64	0.9
H	Acanthurus leucopareius	8	KAHE5B		3.25	1		
H	Acanthurus nigrofuscus	8	KAHE5B		355.32	25		
H	Acanthurus nigrofuscus	8	KAHE5B		519.20	69		
H	Ctenochaetus strigosus	8	KAHE5B		11.33	13		
H	Naso lituratus	8	KAHE5B		42.39	10		
H	Naso unicornis	8	KAHE5B		5.44	1		
H	Naso unicornis	8	KAHE5B	120	38.92	1	975.85	26.7
O	Stegastes fasciolatus	8	KAHE5B		103.92	4		
O	Melichthys vidua	8	KAHE5B		199.03	1		
O	Cantherhines sandwichiensis	8	KAHE5B		164.10	2		
O	Canthigaster jactator	8	KAHE5B	11	14.25	4	481.30	13.2
P	Chaetodon miliaris	8	KAHE5B		6.56	1		
P	Chromis vanderbilti	8	KAHE5B		5.37	17		
P	Naso brevirostris	8	KAHE5B	19	38.92	1	50.85	1.4
	TOTAL	8	KAHE5B	214	3655.23	214	3655.23	100

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GRP	SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Lutjanus kasmira	9	KAHE7B		111.11	12		
C	Monotaxis grandoculis	9	KAHE7B		34.79	1		
C	Parupeneus pleurostigma	9	KAHE7B		58.01	1		
C	Parupeneus pleurostigma	9	KAHE7B		60.88	2		
C	Parupeneus multifasciatus	9	KAHE7B		54.23	2		
C	Parupeneus multifasciatus	9	KAHE7B		96.08	1		
C	Forcipiger flavissimus	9	KAHE7B		7.59	3		
C	Thalassoma duperrey	9	KAHE7B		27.39	1		
C	Thalassoma duperrey	9	KAHE7B		194.10	2		
C	Rhinecanthus rectangulus	9	KAHE7B		6.25	1		
C	Sufflamen bursa	9	KAHE7B		85.87	1		
C	Sufflamen bursa	9	KAHE7B	38	68.73	11	805.03	52.8
CF	Chaetodon multicinctus	9	KAHE7B	2	26.06	2	26.06	1.7
H	Centropyge potteri	9	KAHE7B		4.98	1		
H	Acanthurus nigrofuscus	9	KAHE7B		95.59	4		
H	Acanthurus nigrofuscus	9	KAHE7B		97.82	13		
H	Acanthurus nigrofuscus	9	KAHE7B		14.21	1		
H	Acanthurus olivaceus	9	KAHE7B		327.03	2		
H	Ctenochaetus strigosus	9	KAHE7B		1.74	2		
H	Zebrasoma flavescens	9	KAHE7B		1.69	1		
H	Naso lituratus	9	KAHE7B		12.72	3		
H	Naso lituratus	9	KAHE7B	35	13.90	8	569.68	37.3
O	Melichthys vidua	9	KAHE7B	1	124.35	1	124.35	8.1
P	Chaetodon kleini	9	KAHE7B	1	0.88	1	0.88	0.1
	TOTAL	9	KAHE7B	77	1526.01	77	1526.01	100
C	Gymnothorax flavimarginatus	10	KAHE7C		1814.37	1		
C	Aulostomus chinensis	10	KAHE7C		9.52	2		
C	Monotaxis grandoculis	10	KAHE7C		34.79	1		
C	Parupeneus pleurostigma	10	KAHE7C		121.75	4		
C	Parupeneus multifasciatus	10	KAHE7C		189.82	7		
C	Parupeneus multifasciatus	10	KAHE7C		235.75	1		
C	Parupeneus multifasciatus	10	KAHE7C		192.16	2		
C	Forcipiger flavissimus	10	KAHE7C		9.15	1		
C	Forcipiger flavissimus	10	KAHE7C		7.59	3		
C	Paracirrhites arcatus	10	KAHE7C		24.35	3		
C	Thalassoma duperrey	10	KAHE7C		164.85	3		
C	Anampses chrysocephalus	10	KAHE7C		2.63	1		
C	Zanclus cornutus	10	KAHE7C		416.63	4		
C	Sufflamen bursa	10	KAHE7C		6.25	1		
C	Sufflamen bursa	10	KAHE7C	38	343.49	4	3573.10	88.2
CF	Chaetodon unimaculatus	10	KAHE7C		2.83	1		
CF	Chaetodon multicinctus	10	KAHE7C		3.31	4		
CF	Pervagor spilosoma	10	KAHE7C	6	9.75	1	15.89	0.4
H	Acanthurus triostegus	10	KAHE7C		8.48	2		
H	Acanthurus nigrofuscus	10	KAHE7C		142.97	19		
H	Ctenochaetus strigosus	10	KAHE7C		3.49	4		
H	Zebrasoma flavescens	10	KAHE7C		5.06	3		
H	Naso lituratus	10	KAHE7C		12.16	7		
H	Naso lituratus	10	KAHE7C		16.95	4		
H	Naso lituratus	10	KAHE7C		29.80	2		
H	Naso unicornis	10	KAHE7C	42	5.44	1	224.34	5.5
O	Melichthys vidua	10	KAHE7C		199.03	1		
O	Canthigaster jactator	10	KAHE7C	3	7.12	2	206.15	5.1
P	Chaetodon kleini	10	KAHE7C		2.65	3		
P	Chaetodon miliaris	10	KAHE7C		11.42	4		
P	Dascyllus albisella	10	KAHE7C		3.21	4		
P	Chromis vanderbilti	10	KAHE7C	63	16.43	52	33.72	0.8
	TOTAL	10	KAHE7C	152	4053.20	152	4053.20	100
C	Parupeneus pleurostigma	11	KAHE7D		58.01	1		
C	Parupeneus multifasciatus	11	KAHE7D		54.23	2		
C	Forcipiger flavissimus	11	KAHE7D		12.65	5		
C	Chaetodon fremblii	11	KAHE7D		2.92	1		
C	Plectroglyphidodon johnstonianu	11	KAHE7D		0.86	1		
C	Paracirrhites arcatus	11	KAHE7D		16.24	2		
C	Thalassoma duperrey	11	KAHE7D		384.64	7		
C	Thalassoma duperrey	11	KAHE7D		291.16	3		
C	Thalassoma duperrey	11	KAHE7D		27.39	1		
C	Halichoeres ornatissimus	11	KAHE7D		2.55	1		
C	Sufflamen bursa	11	KAHE7D		62.48	10		
C	Sufflamen bursa	11	KAHE7D	35	85.87	1	999.01	92.2
CF	Chaetodon ornatissimus	11	KAHE7D		0.98	1		
CF	Chaetodon multicinctus	11	KAHE7D	4	2.48	3	3.46	0.3
H	Centropyge potteri	11	KAHE7D		1.72	1		
H	Acanthurus nigrofuscus	11	KAHE7D		30.10	4		
H	Ctenochaetus strigosus	11	KAHE7D		2.61	3		
H	Zebrasoma flavescens	11	KAHE7D		1.69	1		
H	Naso lituratus	11	KAHE7D		15.64	9		
H	Naso unicornis	11	KAHE7D	21	7.20	3	58.96	5.4
O	Cantherhines sandwichiensis	11	KAHE7D	1	7.65	1	7.65	0.7
P	Chaetodon kleini	11	KAHE7D		1.77	2		
P	Chaetodon miliaris	11	KAHE7D	16	12.39	14	14.16	1.3
	TOTAL	11	KAHE7D	77	1083.22	77	1083.22	100

GRP	26-Sep-14 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Aulostomus chinensis	12	KAHE7E		14.27	3		
C	Aulostomus chinensis	12	KAHE7E		210.62	1		
C	Caranx melampygus	12	KAHE7E		81.59	1		
C	Lutjanus kasmira	12	KAHE7E		185.07	85		
C	Parupeneus pleurostigma	12	KAHE7E		58.01	1		
C	Parupeneus multifasciatus	12	KAHE7E		677.91	25		
C	Parupeneus multifasciatus	12	KAHE7E		235.75	1		
C	Parupeneus multifasciatus	12	KAHE7E		272.00	5		
C	Parupeneus multifasciatus	12	KAHE7E		11.05	1		
C	Parupeneus multifasciatus	12	KAHE7E		88.41	8		
C	Parupeneus cyclostomus	12	KAHE7E		2342.33	3		
C	Forcipiger flavissimus	12	KAHE7E		54.90	6		
C	Plectroglyphidodon johnstonianu	12	KAHE7E		3.45	4		
C	Paracirrhites arcatus	12	KAHE7E		24.35	3		
C	Paracirrhites forsteri	12	KAHE7E		39.65	1		
C	Bodianus bilunulatus	12	KAHE7E		37.87	1		
C	Labroides phthirophagus	12	KAHE7E		0.63	1		
C	Pseudocheilinus octotaenia	12	KAHE7E		43.23	3		
C	Thalassoma duperrey	12	KAHE7E		291.16	3		
C	Thalassoma duperrey	12	KAHE7E		54.95	1		
C	Thalassoma duperrey	12	KAHE7E		274.74	5		
C	Thalassoma duperrey	12	KAHE7E		11.16	1		
C	Stethojulis balteata	12	KAHE7E		71.53	2		
C	Zanclus cornutus	12	KAHE7E		96.17	4		
C	Sufflamen bursa	12	KAHE7E		257.62	3		
C	Sufflamen bursa	12	KAHE7E		99.97	16		
C	Sufflamen fraenatus	12	KAHE7E	189	224.79	1	5763.19	60.7
CF	Chaetodon multicinctus	12	KAHE7E		9.09	11		
CF	Pervagor melanocephalus	12	KAHE7E	14	15.70	3	24.79	0.3
H	Centropyge potteri	12	KAHE7E		3.43	2		
H	Acanthurus nigrofuscus	12	KAHE7E		308.51	41		
H	Ctenochaetus strigosus	12	KAHE7E		19.17	22		
H	Zebrasoma flavescens	12	KAHE7E		18.57	11		
H	Naso lituratus	12	KAHE7E		22.59	13		
H	Naso lituratus	12	KAHE7E		36.34	1		
H	Naso unicornis	12	KAHE7E	92	10.87	2	419.49	4.4
O	Melichthys niger	12	KAHE7E		381.04	7		
O	Melichthys niger	12	KAHE7E		1960.03	12		
O	Melichthys vidua	12	KAHE7E		597.09	3		
O	Canthigaster coronata	12	KAHE7E		7.59	1		
O	Canthigaster jactator	12	KAHE7E	26	10.69	3	2956.43	31.1
P	Chaetodon kleini	12	KAHE7E		12.39	14		
P	Chaetodon miliaris	12	KAHE7E		19.46	22		
P	Chromis vanderbilti	12	KAHE7E		77.39	245		
P	Chromis hanui	12	KAHE7E		8.96	12		
P	Naso hexacanthus	12	KAHE7E		65.23	12		
P	Naso hexacanthus	12	KAHE7E	314	154.75	9	338.19	3.6
	TOTAL	12	KAHE7E	635	9502.09	635	9502.09	100

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GRP	SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Aulostomus chinensis	13	KAHE10		4.76	1		
C	Aulostomus chinensis	13	KAHE10		88.50	1		
C	Fistularia commersoni	13	KAHE10		37.69	1		
C	Priacanthus cruentatus	13	KAHE10		96.86	3		
C	Monotaxis grandoculis	13	KAHE10		3.71	1		
C	Mulloides flavolineatus	13	KAHE10		413.63	16		
C	Mulloides vanicolensis	13	KAHE10		1768.14	35		
C	Parupeneus pleurostigma	13	KAHE10		60.88	2		
C	Parupeneus multifasciatus	13	KAHE10		216.93	8		
C	Parupeneus bifasciatus	13	KAHE10		87.60	3		
C	Forcipiger flavissimus	13	KAHE10		7.59	3		
C	Plectroglyphidodon johnstonianu	13	KAHE10		4.31	5		
C	Paracirrhites arcatus	13	KAHE10		24.35	3		
C	Thalassoma duperrey	13	KAHE10		219.12	8		
C	Thalassoma duperrey	13	KAHE10		1843.99	19		
C	Thalassoma duperrey	13	KAHE10		934.13	17		
C	Thalassoma duperrey	13	KAHE10		33.49	3		
C	Thalassoma purpureum	13	KAHE10		946.59	1		
C	Stethojulis balteata	13	KAHE10		35.76	1		
C	Halichoeres ornatissimus	13	KAHE10		25.14	1		
C	Zanclus cornutus	13	KAHE10		96.17	4		
C	Zanclus cornutus	13	KAHE10		312.47	3		
C	Sufflamen bursa	13	KAHE10		31.24	5		
C	Sufflamen bursa	13	KAHE10		257.62	3		
C	Ostracion meleagris	13	KAHE10	148	6.76	1	7557.44	29.1
CF	Chaetodon ornatissimus	13	KAHE10		6.79	2		
CF	Chaetodon multicinctus	13	KAHE10		52.12	4		
CF	Pervagor spilosoma	13	KAHE10		9.75	1		
CF	Cantherhines dumerili	13	KAHE10	8	117.96	1	186.63	0.7
H	Calotomus carolinus	13	KAHE10		4889.53	1		
H	Scarus psittacus	13	KAHE10		1448.55	6		
H	Acanthurus triostegus	13	KAHE10		1389.45	30		
H	Acanthurus nigrofuscus	13	KAHE10		213.19	15		
H	Acanthurus nigrofuscus	13	KAHE10		248.31	33		
H	Acanthurus nigrofuscus	13	KAHE10		7052.82	130		
H	Acanthurus olivaceus	13	KAHE10		1471.65	9		
H	Acanthurus dussumieri	13	KAHE10		112.02	1		
H	Ctenochaetus strigosus	13	KAHE10		7.58	1		
H	Zebrasoma flavescens	13	KAHE10		11.82	7		
H	Naso lituratus	13	KAHE10		22.59	13		
H	Naso lituratus	13	KAHE10		29.80	2		
H	Naso unicornis	13	KAHE10	265	661.72	17	17559.02	67.6
O	Stegastes fasciolatus	13	KAHE10		207.84	8		
O	Canthigaster jactator	13	KAHE10		14.25	4		
O	Canthigaster rivulata	13	KAHE10	13	7.59	1	229.68	0.9
P	Dascyllus albisella	13	KAHE10		86.47	28		
P	Abudefduf abdominalis	13	KAHE10		344.66	11		
P	Chromis ovalis	13	KAHE10	51	8.96	12	440.09	1.7
	TOTAL	13	KAHE10	485	25972.86	485	25972.86	100

GRP	26-Sep-14 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Monotaxis grandoculis	14	NANA1		27.47	2		
C	Parupeneus pleurostigma	14	NANA1		30.44	1		
C	Parupeneus multifasciatus	14	NANA1		163.20	3		
C	Parupeneus multifasciatus	14	NANA1		244.05	9		
C	Parupeneus cyclostomus	14	NANA1		74.39	3		
C	Thalassoma duperrey	14	NANA1		82.17	3		
C	Thalassoma duperrey	14	NANA1		219.80	4		
C	Thalassoma duperrey	14	NANA1		291.16	3		
C	Thalassoma purpureum	14	NANA1		111.97	2		
C	Zanclus cornutus	14	NANA1		24.04	1		
C	Sufflamen bursa	14	NANA1		0.86	1		
C	Sufflamen bursa	14	NANA1	33	6.25	1	1275.79	53.5
CF	Pervagor spilosoma	14	NANA1	2	19.50	2	19.50	0.8
H	Acanthurus leucopareius	14	NANA1		7.89	1		
H	Acanthurus nigrofuscus	14	NANA1		511.66	36		
H	Acanthurus nigrofuscus	14	NANA1		489.10	65		
H	Naso lituratus	14	NANA1		12.16	7		
H	Naso lituratus	14	NANA1	111	8.48	2	1029.29	43.2
O	Melichthys niger	14	NANA1		54.43	1		
O	Canthigaster jactator	14	NANA1	2	3.56	1	58.00	2.4
	TOTAL	14	NANA1	148	2382.58	148	2382.58	100
C	Gymnothorax eurostus	15	NANA2		68.06	1		
C	Aulostomus chinensis	15	NANA2		88.50	1		
C	Lutjanus fulvus	15	NANA2		104.24	1		
C	Monotaxis grandoculis	15	NANA2		34.79	1		
C	Mulloides vanicolensis	15	NANA2		1262.95	25		
C	Parupeneus pleurostigma	15	NANA2		30.44	1		
C	Parupeneus multifasciatus	15	NANA2		27.12	1		
C	Parupeneus bifasciatus	15	NANA2		394.35	1		
C	Forcipiger flavissimus	15	NANA2		2.53	1		
C	Forcipiger flavissimus	15	NANA2		9.15	1		
C	Chaetodon auriga	15	NANA2		97.08	1		
C	Paracirrhites forsteri	15	NANA2		39.65	1		
C	Thalassoma duperrey	15	NANA2		329.69	6		
C	Thalassoma duperrey	15	NANA2		136.95	5		
C	Thalassoma duperrey	15	NANA2		44.65	4		
C	Gomphosus varius	15	NANA2		11.04	1		
C	Halichoeres ornatissimus	15	NANA2		50.27	2		
C	Halichoeres ornatissimus	15	NANA2		9.52	1		
C	Zanclus cornutus	15	NANA2		208.32	2		
C	Rhinecanthus rectangulus	15	NANA2		85.87	1		
C	Sufflamen bursa	15	NANA2		85.87	1		
C	Sufflamen bursa	15	NANA2	60	6.25	1	3127.31	10.6
CF	Chaetodon ornatissimus	15	NANA2		69.00	1		
CF	Chaetodon ornatissimus	15	NANA2	3	6.79	2	75.80	0.3
H	Acanthurus triostegus	15	NANA2		926.30	20		
H	Acanthurus triostegus	15	NANA2		900.13	9		
H	Acanthurus leucopareius	15	NANA2		3981.01	30		
H	Acanthurus leucopareius	15	NANA2		5816.88	25		
H	Acanthurus nigrofuscus	15	NANA2		95.59	4		
H	Acanthurus nigrofuscus	15	NANA2		113.70	8		
H	Acanthurus nigrofuscus	15	NANA2		225.74	30		
H	Acanthurus olivaceus	15	NANA2		3663.34	14		
H	Acanthurus olivaceus	15	NANA2		8447.55	15		
H	Acanthurus glaucopareius	15	NANA2		8.42	1		
H	Ctenochaetus strigosus	15	NANA2		90.91	12		
H	Ctenochaetus strigosus	15	NANA2		22.66	26		
H	Zebrasoma flavescens	15	NANA2		53.28	1		
H	Zebrasoma flavescens	15	NANA2	201	10.13	6	24355.64	82.2
O	Stegastes fasciolatus	15	NANA2		103.92	4		
O	Stegastes fasciolatus	15	NANA2		7.39	1		
O	Melichthys niger	15	NANA2		1960.03	12		
O	Canthigaster jactator	15	NANA2	20	10.69	3	2082.03	7.0
	TOTAL	15	NANA2	284	29640.77	284	29640.77	100

26-Sep-14

GRP	SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Aulostomus chinensis	16	PIPE		155.99	3		
C	Aulostomus chinensis	16	PIPE		19.03	4		
C	Aulostomus chinensis	16	PIPE		51.35	4		
C	Aulostomus chinensis	16	PIPE		631.85	3		
C	Decapterus macarellus	16	PIPE		9119.54	70		
C	Aphareus furcatus	16	PIPE		13.44	1		
C	Lutjanus kasmira	16	PIPE		1991.01	77		
C	Lutjanus kasmira	16	PIPE		2351.45	41		
C	Lutjanus kasmira	16	PIPE		638.85	69		
C	Mulloides flavolineatus	16	PIPE		2197.42	85		
C	Mulloides vanicolensis	16	PIPE		1484.18	60		
C	Parupeneus multifasciatus	16	PIPE		81.35	3		
C	Parupeneus multifasciatus	16	PIPE		108.80	2		
C	Forcipiger flavissimus	16	PIPE		7.59	3		
C	Plectroglyphidodon johnstonianu	16	PIPE		13.77	8		
C	Labroides phthirophagus	16	PIPE		0.63	1		
C	Thalassoma duperrey	16	PIPE		1013.45	37		
C	Thalassoma duperrey	16	PIPE		2857.34	52		
C	Thalassoma duperrey	16	PIPE		1649.88	17		
C	Gomphosus varius	16	PIPE		67.80	3		
C	Gomphosus varius	16	PIPE		62.03	1		
C	Coris venusta	16	PIPE		145.14	3		
C	Macropharyngodon geoffroy	16	PIPE		214.52	5		
C	Halichoeres ornatissimus	16	PIPE		25.14	1		
C	Zanclus cornutus	16	PIPE		216.39	9		
C	Sufflamen bursa	16	PIPE		171.75	2		
C	Sufflamen bursa	16	PIPE	569	99.62	5	25389.33	59.1
CF	Chaetodon ornatissimus	16	PIPE		32.87	4		
CF	Chaetodon multicinctus	16	PIPE		52.12	4		
CF	Pervagor melanocephalus	16	PIPE	9	9.75	1	94.74	0.2
H	Scarus sordidus	16	PIPE		431.94	12		
H	Scarus sordidus	16	PIPE		1633.71	3		
H	Scarus sordidus	16	PIPE		2111.84	9		
H	Scarus sordidus	16	PIPE		684.12	9		
H	Acanthurus nigrofuscus	16	PIPE		908.09	38		
H	Acanthurus nigrofuscus	16	PIPE		813.79	15		
H	Acanthurus nigrofuscus	16	PIPE		90.30	12		
H	Acanthurus olivaceus	16	PIPE		284.86	6		
H	Acanthurus glaucopareius	16	PIPE		8.42	1		
H	Ctenochaetus strigosus	16	PIPE		121.22	16		
H	Ctenochaetus strigosus	16	PIPE		751.63	28		
H	Naso lituratus	16	PIPE	154	21.19	5	7861.09	18.3
O	Stegastes fasciolatus	16	PIPE		129.90	5		
O	Melichthys niger	16	PIPE		163.34	1		
O	Melichthys vidua	16	PIPE		199.03	1		
O	Melichthys vidua	16	PIPE		248.69	2		
O	Canthigaster jactator	16	PIPE	13	14.25	4	755.21	1.8
P	Chaetodon miliaris	16	PIPE		39.35	6		
P	Chaetodon miliaris	16	PIPE		84.67	4		
P	Dascyllus albisella	16	PIPE		18.53	6		
P	Abudefduf abdominalis	16	PIPE		657.98	21		
P	Abudefduf vaigensis	16	PIPE		2600.60	83		
P	Chromis ovalis	16	PIPE		4334.88	375		
P	Naso brevirostris	16	PIPE		515.84	30		
P	Naso brevirostris	16	PIPE	540	583.87	15	8835.72	20.6
	TOTAL	16	PIPE	1285	42936.09	1285	42936.09	100

27 FEBRUARY 2015 FIELD DATA

27-Feb-15

GRP	SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Lutjanus fulvus	1	EAST1		622.43	4		
C	Lutjanus fulvus	1	EAST1		262.59	4		
C	Parupeneus multifasciatus	1	EAST1		1021.33	3		
C	Parupeneus multifasciatus	1	EAST1		466.27	3		
C	Bodianus bilunulatus	1	EAST1		1141.37	1		
C	Thalassoma duperrey	1	EAST1		246.51	9		
C	Thalassoma duperrey	1	EAST1		1098.98	20		
C	Thalassoma duperrey	1	EAST1		970.52	10		
C	Coris gaimard	1	EAST1		83.79	1		
C	Stethojulis balteata	1	EAST1		35.76	1		
C	Rhinecanthus rectangulus	1	EAST1		136.09	3		
C	Sufflamen bursa	1	EAST1		45.36	1		
C	Sufflamen fraenatus	1	EAST1	61	144.65	1	6275.64	20.5
H	Acanthurus triostegus	1	EAST1		240.33	14		
H	Acanthurus triostegus	1	EAST1		1300.19	13		
H	Acanthurus triostegus	1	EAST1		1343.14	29		
H	Acanthurus nigrofuscus	1	EAST1		108.50	2		
H	Acanthurus nigrofuscus	1	EAST1		167.28	7		
H	Acanthurus nigrofuscus	1	EAST1		298.47	21		
H	Acanthurus nigroris	1	EAST1		184.77	13		
H	Acanthurus olivaceus	1	EAST1		6018.34	23		
H	Acanthurus olivaceus	1	EAST1		843.92	9		
H	Acanthurus dussumieri	1	EAST1		564.35	1		
H	Acanthurus blochii	1	EAST1		881.79	9		
H	Acanthurus blochii	1	EAST1		3019.12	13		
H	Acanthurus blochii	1	EAST1		3175.16	7		
H	Acanthurus blochii	1	EAST1		3919.05	5		
H	Naso lituratus	1	EAST1		1869.69	6		
H	Naso lituratus	1	EAST1		290.34	4		
H	Naso lituratus	1	EAST1	179	44.69	3	24269.12	79.4
O	Canthigaster jactator	1	EAST1	1	3.56	1	3.56	0.01
P	Chromis vanderbilti	1	EAST1	23	7.27	23	7.27	0.02
	TOTAL	1	EAST1	264	30555.59	264	30555.59	100
C	Cephalopholis argus	2	EAST2		471.73	1		
C	Parupeneus multifasciatus	2	EAST2		96.08	1		
C	Parupeneus multifasciatus	2	EAST2		235.75	1		
C	Parupeneus cyclostomus	2	EAST2		440.45	1		
C	Paracirrhites arcatus	2	EAST2		24.35	3		
C	Labroides phthirophagus	2	EAST2		0.63	1		
C	Thalassoma duperrey	2	EAST2		388.21	4		
C	Thalassoma duperrey	2	EAST2		78.14	7		
C	Thalassoma duperrey	2	EAST2		383.47	14		
C	Thalassoma duperrey	2	EAST2		494.54	9		
C	Gomphosus varius	2	EAST2		11.04	1		
C	Zanclus cornutus	2	EAST2		24.04	1		
C	Zanclus cornutus	2	EAST2		104.16	1		
C	Rhinecanthus rectangulus	2	EAST2		136.09	3		
C	Rhinecanthus rectangulus	2	EAST2		257.62	3		
C	Sufflamen fraenatus	2	EAST2	52	329.34	1	3475.64	9.6
CF	Chaetodon unimaculatus	2	EAST2		101.22	4		
CF	Chaetodon ornatissimus	2	EAST2		138.00	2		
CF	Chaetodon quadrimaculatus	2	EAST2		101.22	4		
CF	Chaetodon multicinctus	2	EAST2	12	26.06	2	366.50	1.0
H	Acanthurus triostegus	2	EAST2		3200.46	32		
H	Acanthurus triostegus	2	EAST2		1250.51	27		
H	Acanthurus nigrofuscus	2	EAST2		810.13	57		
H	Acanthurus nigrofuscus	2	EAST2		669.69	89		
H	Acanthurus olivaceus	2	EAST2		10137.06	18		
H	Acanthurus olivaceus	2	EAST2		9158.35	35		
H	Acanthurus olivaceus	2	EAST2		6291.36	16		
H	Acanthurus blochii	2	EAST2		97.98	1		
H	Acanthurus blochii	2	EAST2		29.03	1		
H	Zebrasoma flavescens	2	EAST2	277	53.28	1	31697.84	87.1
O	Melichthys niger	2	EAST2		326.67	2		
O	Melichthys vidua	2	EAST2		296.24	1		
O	Melichthys vidua	2	EAST2		199.03	1		
O	Canthigaster jactator	2	EAST2	6	7.12	2	829.06	2.3
P	Chromis vanderbilti	2	EAST2	13	4.11	13	4.11	0.01
	TOTAL	2	EAST2	360	36373.14	360	36373.14	100

GRP	27-Feb-15 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Gymnothorax meleagris	3	EAST3		92.10	1		
C	Parupeneus multifasciatus	3	EAST3		192.16	2		
C	Parupeneus multifasciatus	3	EAST3		54.40	1		
C	Plectroglyphidodon johnstonian	3	EAST3		8.61	5		
C	Paracirrhites arcatus	3	EAST3		24.35	3		
C	Paracirrhites forsteri	3	EAST3		78.83	1		
C	Bodianus bilunulatus	3	EAST3		324.75	1		
C	Labroides phthirophagus	3	EAST3		0.63	1		
C	Thalassoma duperrey	3	EAST3		291.16	3		
C	Thalassoma duperrey	3	EAST3		82.17	3		
C	Thalassoma duperrey	3	EAST3		329.69	6		
C	Gomphosus varius	3	EAST3		22.08	2		
C	Gomphosus varius	3	EAST3		22.60	1		
C	Stethojulis balteata	3	EAST3		71.53	2		
C	Halichoeres ornatissimus	3	EAST3		9.52	1		
C	Sufflamen bursa	3	EAST3		171.75	2		
C	Sufflamen bursa	3	EAST3	36	45.36	1	1821.69	7.1
CF	Chaetodon ornatissimus	3	EAST3		276.01	4		
CF	Chaetodon quadrimaculatus	3	EAST3		50.61	2		
CF	Chaetodon multicinctus	3	EAST3		26.63	4		
CF	Chaetodon multicinctus	3	EAST3	12	26.06	2	379.30	1.5
H	Scarus sordidus	3	EAST3		1468.09	4		
H	Scarus psittacus	3	EAST3		1437.46	1		
H	Acanthurus triostegus	3	EAST3		300.04	3		
H	Acanthurus nigrofuscus	3	EAST3		376.23	50		
H	Acanthurus nigrofuscus	3	EAST3		156.34	11		
H	Acanthurus nigroris	3	EAST3		90.30	12		
H	Acanthurus olivaceus	3	EAST3		9158.35	35		
H	Acanthurus olivaceus	3	EAST3		4219.60	45		
H	Acanthurus olivaceus	3	EAST3		817.58	5		
H	Ctenochaetus strigosus	3	EAST3		536.88	20		
H	Ctenochaetus strigosus	3	EAST3		75.76	10		
H	Ctenochaetus strigosus	3	EAST3		30.88	10		
H	Zebrasoma flavescens	3	EAST3		53.28	1		
H	Naso lituratus	3	EAST3	208	127.73	1	18848.52	73.7
O	Stegastes fasciolatus	3	EAST3		59.05	4		
O	Melichthys niger	3	EAST3		163.34	1		
O	Melichthys vidua	3	EAST3		888.72	3		
O	Melichthys vidua	3	EAST3		398.06	2		
O	Cantherhines sandwichiensis	3	EAST3	11	82.05	1	1591.21	6.2
P	Chaetodon miliaris	3	EAST3		21.17	1		
P	Naso brevirostris	3	EAST3	76	2919.33	75	2940.50	11.5
	TOTAL	3	EAST3	343	25581.23	343	25581.23	100
C	Aulostomus chinensis	4	EAST4		52.00	1		
C	Cephalopholis argus	4	EAST4		638.29	1		
C	Parupeneus multifasciatus	4	EAST4		54.40	1		
C	Parupeneus multifasciatus	4	EAST4		54.23	2		
C	Parupeneus cyclostomus	4	EAST4		780.78	1		
C	Forcipiger flavissimus	4	EAST4		9.15	1		
C	Chaetodon lunula	4	EAST4		35.99	1		
C	Plectroglyphidodon johnstonian	4	EAST4		1.72	1		
C	Paracirrhites arcatus	4	EAST4		24.35	3		
C	Paracirrhites forsteri	4	EAST4		39.65	1		
C	Labroides phthirophagus	4	EAST4		0.63	1		
C	Thalassoma duperrey	4	EAST4		1164.62	12		
C	Thalassoma duperrey	4	EAST4		493.03	18		
C	Thalassoma duperrey	4	EAST4		989.08	18		
C	Coris gaimard	4	EAST4		278.26	2		
C	Pseudojuloides cerasinus	4	EAST4		9.45	3		
C	Zanclus cornutus	4	EAST4		104.16	1		
C	Rhinecanthus rectangulus	4	EAST4		85.87	1		
C	Sufflamen fraenatus	4	EAST4	70	623.45	1	5439.12	15.5
CF	Chaetodon ornatissimus	4	EAST4		138.00	2		
CF	Chaetodon multicinctus	4	EAST4	4	13.31	2	151.32	0.4
H	Scarus psittacus	4	EAST4		79.27	1		
H	Scarus psittacus	4	EAST4		75.75	2		
H	Acanthurus nigrofuscus	4	EAST4		397.96	28		
H	Acanthurus nigrofuscus	4	EAST4		601.97	80		
H	Acanthurus nigrofuscus	4	EAST4		1362.13	57		
H	Acanthurus nigroris	4	EAST4		135.44	18		
H	Acanthurus olivaceus	4	EAST4		19147.79	34		
H	Acanthurus blochii	4	EAST4		340.20	6		
H	Acanthurus blochii	4	EAST4		3628.75	8		
H	Acanthurus blochii	4	EAST4		2178.16	14		
H	Zebrasoma flavescens	4	EAST4		213.12	4		
H	Naso lituratus	4	EAST4		14.90	1		
H	Naso lituratus	4	EAST4	254	448.94	1	28624.37	81.6
O	Melichthys vidua	4	EAST4		398.06	2		
O	Melichthys vidua	4	EAST4		418.08	1		
O	Canthigaster jactator	4	EAST4	11	28.50	8	844.64	2.4
P	Chromis vanderbilti	4	EAST4	100	31.59	100	31.59	0.1
	TOTAL	4	EAST4	439	35091.03	439	35091.03	100

27-Feb-15

GRP	SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Decapterus macarellus	5	KO1		11725.12	90		
C	Monotaxis grandoculis	5	KO1		671.12	1		
C	Monotaxis grandoculis	5	KO1		143.05	2		
C	Monotaxis grandoculis	5	KO1		636.19	3		
C	Parupeneus bifasciatus	5	KO1		214.62	2		
C	Parupeneus bifasciatus	5	KO1		29.20	1		
C	Parupeneus cyclostomus	5	KO1		24.80	1		
C	Forcipiger flavissimus	5	KO1		9.15	1		
C	Thalassoma duperrey	5	KO1		824.23	15		
C	Thalassoma duperrey	5	KO1		465.64	17		
C	Thalassoma duperrey	5	KO1		776.42	8		
C	Thalassoma ballieui	5	KO1		167.53	1		
C	Gomphosus varius	5	KO1		11.04	1		
C	Zanclus cornutus	5	KO1		164.70	3		
C	Zanclus cornutus	5	KO1	148	208.32	2	16071.10	66.5
CF	Chaetodon unimaculatus	5	KO1		50.61	2		
CF	Chaetodon ornatissimus	5	KO1		138.00	2		
CF	Chaetodon multicinctus	5	KO1	9	65.15	5	253.76	1.0
H	Scarus sordidus	5	KO1		140.01	1		
H	Scarus sordidus	5	KO1		35.99	1		
H	Scarus psittacus	5	KO1		475.61	6		
H	Scarus psittacus	5	KO1		375.61	1		
H	Acanthurus leucopareius	5	KO1		82.55	3		
H	Acanthurus nigrofuscus	5	KO1		286.76	12		
H	Acanthurus nigrofuscus	5	KO1		255.84	34		
H	Acanthurus nigrofuscus	5	KO1		271.26	5		
H	Acanthurus nigroris	5	KO1		67.72	9		
H	Acanthurus olivaceus	5	KO1		327.03	2		
H	Ctenochaetus strigosus	5	KO1		644.25	24		
H	Ctenochaetus strigosus	5	KO1		53.03	7		
H	Ctenochaetus strigosus	5	KO1		3622.57	55		
H	Zebrasoma flavescens	5	KO1		1.69	1		
H	Zebrasoma flavescens	5	KO1		53.28	1		
H	Naso lituratus	5	KO1	163	36.34	1	6729.55	27.8
O	Stegastes fasciolatus	5	KO1		118.11	8		
O	Melichthys niger	5	KO1		248.03	1		
O	Melichthys niger	5	KO1		326.67	2		
O	Melichthys vidua	5	KO1	12	296.24	1	989.05	4.1
P	Abudefduf abdominalis	5	KO1	4	125.33	4	125.33	0.5
	TOTAL	5	KO1	336	24168.80	336	24168.80	100
C	Monotaxis grandoculis	6	KO2		955.06	2		
C	Parupeneus multifasciatus	6	KO2		340.44	1		
C	Forcipiger flavissimus	6	KO2		18.30	2		
C	Chaetodon ephippium	6	KO2		96.78	2		
C	Plectroglyphidodon johnstonian	6	KO2		3.44	2		
C	Cirrhitus pinnulatus	6	KO2		90.86	1		
C	Labroides phthirophagus	6	KO2		0.63	1		
C	Thalassoma duperrey	6	KO2		776.42	8		
C	Thalassoma duperrey	6	KO2		384.64	7		
C	Thalassoma duperrey	6	KO2		219.12	8		
C	Gomphosus varius	6	KO2		22.60	1		
C	Stethojulis balteata	6	KO2		35.76	1		
C	Zanclus cornutus	6	KO2		208.32	2		
C	Sufflamen bursa	6	KO2	42	343.49	4	3495.87	16.8
CF	Chaetodon ornatissimus	6	KO2	2	138.00	2	138.00	0.7
H	Scarus psittacus	6	KO2		786.15	1		
H	Acanthurus triostegus	6	KO2		1528.40	33		
H	Acanthurus nigrofuscus	6	KO2		85.28	6		
H	Acanthurus nigrofuscus	6	KO2		270.89	36		
H	Acanthurus nigrofuscus	6	KO2		95.59	4		
H	Acanthurus nigroris	6	KO2		716.91	30		
H	Acanthurus olivaceus	6	KO2		281.31	3		
H	Acanthurus olivaceus	6	KO2		5631.70	10		
H	Acanthurus olivaceus	6	KO2		3140.00	12		
H	Acanthurus blochii	6	KO2		232.24	8		
H	Acanthurus blochii	6	KO2		777.91	5		
H	Ctenochaetus strigosus	6	KO2		660.67	5		
H	Ctenochaetus strigosus	6	KO2		563.72	21		
H	Ctenochaetus strigosus	6	KO2		53.03	7		
H	Ctenochaetus strigosus	6	KO2		658.65	10		
H	Zebrasoma flavescens	6	KO2		66.39	7		
H	Zebrasoma flavescens	6	KO2		104.12	4		
H	Naso lituratus	6	KO2	203	311.61	1	15964.57	76.8
O	Stegastes fasciolatus	6	KO2		59.05	4		
O	Melichthys niger	6	KO2		744.09	3		
O	Melichthys niger	6	KO2		163.34	1		
O	Melichthys vidua	6	KO2		199.03	1		
O	Canthigaster jactator	6	KO2	13	14.25	4	1179.76	5.7
	TOTAL	6	KO2	260	20778.21	260	20778.21	100

GRP	27-Feb-15 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Aulostomus chinensis	7	KAHE1D		27.72	1		
C	Caranx melampygus	7	KAHE1D		375.82	1		
C	Monotaxis grandoculis	7	KAHE1D		13.74	1		
C	Mulloides flavolineatus	7	KAHE1D		5590.79	67		
C	Parupeneus multifasciatus	7	KAHE1D		235.75	1		
C	Parupeneus multifasciatus	7	KAHE1D		96.08	1		
C	Chaetodon fremblii	7	KAHE1D		20.91	1		
C	Chaetodon lunula	7	KAHE1D		35.99	1		
C	Plectroglyphidodon johnstonian	7	KAHE1D		5.17	3		
C	Paracirrhites arcatus	7	KAHE1D		16.24	2		
C	Paracirrhites forsteri	7	KAHE1D		39.65	1		
C	Thalassoma duperrey	7	KAHE1D		989.08	18		
C	Thalassoma duperrey	7	KAHE1D		2911.56	30		
C	Thalassoma duperrey	7	KAHE1D		246.51	9		
C	Macropharyngodon geoffroy	7	KAHE1D		32.94	3		
C	Zanclus cornutus	7	KAHE1D		48.09	2		
C	Sufflamen bursa	7	KAHE1D		39.85	2		
C	Ostracion meleagris	7	KAHE1D	145	13.75	1	10739.63	25.0
CF	Chaetodon ornatissimus	7	KAHE1D		138.00	2		
CF	Chaetodon quadrimaculatus	7	KAHE1D	4	50.61	2	188.61	0.4
H	Scarus sordidus	7	KAHE1D		35.99	1		
H	Scarus psittacus	7	KAHE1D		1704.27	45		
H	Acanthurus triostegus	7	KAHE1D		1974.16	115		
H	Acanthurus triostegus	7	KAHE1D		1852.60	40		
H	Acanthurus leucopareius	7	KAHE1D		15.79	2		
H	Acanthurus nigrofuscus	7	KAHE1D		466.53	62		
H	Acanthurus nigrofuscus	7	KAHE1D		406.25	17		
H	Acanthurus nigroris	7	KAHE1D		617.02	82		
H	Acanthurus nigroris	7	KAHE1D		7455.88	312		
H	Acanthurus olivaceus	7	KAHE1D		2531.76	27		
H	Acanthurus olivaceus	7	KAHE1D		1091.97	23		
H	Ctenochaetus strigosus	7	KAHE1D		563.72	21		
H	Ctenochaetus strigosus	7	KAHE1D		401.53	53		
H	Zebrasoma flavescens	7	KAHE1D		18.97	2		
H	Naso lituratus	7	KAHE1D	803	622.36	1	19758.78	46.0
O	Stegastes fasciolatus	7	KAHE1D		295.26	20		
O	Melichthys niger	7	KAHE1D		11923.49	73		
O	Cantherhines sandwichiensis	7	KAHE1D		82.05	1		
O	Canthigaster jactator	7	KAHE1D	97	10.69	3	12311.49	28.6
	TOTAL	7	KAHE1D	1049	42998.51	1049	42998.51	100
C	Parupeneus pleurostigma	8	KAHE5B		0.55	1		
C	Parupeneus pleurostigma	8	KAHE5B		225.63	1		
C	Plectroglyphidodon johnstonian	8	KAHE5B		3.44	2		
C	Plectroglyphidodon imparipenni	8	KAHE5B		0.86	1		
C	Paracirrhites arcatus	8	KAHE5B		24.35	3		
C	Cirrhitops fasciatus	8	KAHE5B		8.23	1		
C	Thalassoma duperrey	8	KAHE5B		82.17	3		
C	Thalassoma duperrey	8	KAHE5B		109.90	2		
C	Gomphosus varius	8	KAHE5B		11.04	1		
C	Gomphosus varius	8	KAHE5B		22.60	1		
C	Zanclus cornutus	8	KAHE5B		24.04	1		
C	Zanclus cornutus	8	KAHE5B		208.32	2		
C	Rhinecanthus rectangulus	8	KAHE5B		19.92	1		
C	Rhinecanthus rectangulus	8	KAHE5B		171.75	2		
C	Sufflamen bursa	8	KAHE5B		79.70	4		
C	Sufflamen bursa	8	KAHE5B	27	85.87	1	1078.38	8.4
CF	Chaetodon multicinctus	8	KAHE5B	4	26.63	4	26.63	0.2
H	Scarus sordidus	8	KAHE5B		1835.11	5		
H	Scarus sordidus	8	KAHE5B		1120.05	8		
H	Scarus sordidus	8	KAHE5B		775.07	1		
H	Scarus sordidus	8	KAHE5B		1064.19	14		
H	Acanthurus triostegus	8	KAHE5B		416.84	9		
H	Acanthurus nigrofuscus	8	KAHE5B		113.70	8		
H	Acanthurus nigrofuscus	8	KAHE5B		158.02	21		
H	Acanthurus olivaceus	8	KAHE5B		2943.30	18		
H	Acanthurus olivaceus	8	KAHE5B	91	2752.47	7	11178.73	87.1
O	Stegastes fasciolatus	8	KAHE5B		73.82	5		
O	Melichthys niger	8	KAHE5B		163.34	1		
O	Melichthys vidua	8	KAHE5B		124.35	1		
O	Cantherhines sandwichiensis	8	KAHE5B		164.10	2		
O	Canthigaster jactator	8	KAHE5B	10	3.56	1	529.16	4.1
P	Chromis vanderbilti	8	KAHE5B	62	19.59	62	19.59	0.2
	TOTAL	8	KAHE5B	194	12832.48	194	12832.48	100

GRP	27-Feb-15 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Parupeneus multifasciatus	9	KAHE7B		54.40	1		
C	Parupeneus multifasciatus	9	KAHE7B		155.42	1		
C	Parupeneus multifasciatus	9	KAHE7B		192.16	2		
C	Zanclus cornutus	9	KAHE7B		24.04	1		
C	Sufflamen bursa	9	KAHE7B		429.37	5		
C	Sufflamen bursa	9	KAHE7B	12	39.85	2	895.24	56.6
CF	Pervagor melanocephalus	9	KAHE7B	1	16.22	1	16.22	1.0
H	Acanthurus olivaceus	9	KAHE7B		562.61	6		
H	Naso lituratus	9	KAHE7B	7	14.90	1	577.51	36.5
O	Cantherhines sandwichiensis	9	KAHE7B		82.05	1		
O	Canthigaster jactator	9	KAHE7B	2	3.56	1	85.61	5.4
P	Chaetodon kleini	9	KAHE7B		6.56	1		
P	Chromis vanderbilti	9	KAHE7B	4	0.95	3	7.51	0.5
	TOTAL	9	KAHE7B	26	1582.09	26	1582.09	100
C	Paracirrhites arcatus	10	KAHE7C		8.12	1		
C	Sufflamen bursa	10	KAHE7C		19.92	1		
C	Sufflamen bursa	10	KAHE7C		601.11	7		
C	Sufflamen fraenatus	10	KAHE7C	10	19.92	1	649.08	99.5
O	Canthigaster jactator	10	KAHE7C	1	3.56	1	3.56	0.5
	TOTAL	10	KAHE7C	11	652.64	11	652.64	100
CF	Chaetodon multicinctus	11	KAHE7D	2	13.31	2	13.31	9.6
C	Paracirrhites arcatus	11	KAHE7D		32.70	2		
C	Sufflamen bursa	11	KAHE7D	3	85.87	1	118.57	85.3
O	Canthigaster jactator	11	KAHE7D	2	7.12	2	7.12	5.1
	TOTAL	11	KAHE7D	7	139.01	7	139.01	100
C	Parupeneus multifasciatus	12	KAHE7E		235.75	1		
C	Parupeneus multifasciatus	12	KAHE7E		192.16	2		
C	Forcipiger flavissimus	12	KAHE7E		2.53	1		
C	Paracirrhites arcatus	12	KAHE7E		16.24	2		
C	Zanclus cornutus	12	KAHE7E		54.90	1		
C	Zanclus cornutus	12	KAHE7E		208.32	2		
C	Sufflamen bursa	12	KAHE7E		578.60	4		
C	Sufflamen fraenatus	12	KAHE7E		623.45	1		
C	Diodon hystrix	12	KAHE7E	15	1980.76	1	3892.70	58.6
CF	Chaetodon ornatissimus	12	KAHE7E		8.22	1		
CF	Chaetodon multicinctus	12	KAHE7E	3	13.31	2	21.53	0.3
H	Acanthurus olivaceus	12	KAHE7E		750.15	8		
H	Acanthurus olivaceus	12	KAHE7E		490.55	3		
H	Naso lituratus	12	KAHE7E	16	74.49	5	1315.19	19.8
O	Melichthys vidua	12	KAHE7E		199.03	1		
O	Canthigaster coronata	12	KAHE7E		7.59	1		
O	Canthigaster jactator	12	KAHE7E	3	3.56	1	210.18	3.2
P	Heniochus diphreutes	12	KAHE7E		1081.93	45		
P	Chaetodon kleini	12	KAHE7E		26.23	4		
P	Chaetodon miliaris	12	KAHE7E		6.56	1		
P	Chromis vanderbilti	12	KAHE7E		9.79	31		
P	Naso hexacanthus	12	KAHE7E	83	77.85	2	1202.36	18.1
	TOTAL	12	KAHE7E	120	6641.96	120	6641.96	100

GRP	27-Feb-15 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Aulostomus chinensis	13	KAHE10		27.72	1		
C	Lutjanus kasmira	13	KAHE10		4948.14	45		
C	Monotaxis grandoculis	13	KAHE10		41.21	3		
C	Mulloides flavolineatus	13	KAHE10		37368.53	195		
C	Mulloides vanicolensis	13	KAHE10		44735.63	135		
C	Parupeneus multifasciatus	13	KAHE10		54.40	1		
C	Parupeneus cyclostomus	13	KAHE10		49.96	1		
C	Forcipiger flavissimus	13	KAHE10		9.15	1		
C	Paracirrhites arcatus	13	KAHE10		48.71	6		
C	Thalassoma duperrey	13	KAHE10		1746.94	18		
C	Thalassoma duperrey	13	KAHE10		246.51	9		
C	Thalassoma duperrey	13	KAHE10		329.69	6		
C	Thalassoma purpureum	13	KAHE10		946.59	1		
C	Zanclus cornutus	13	KAHE10		104.16	1		
C	Rhinecanthus rectangulus	13	KAHE10		85.87	1		
C	Sufflamen bursa	13	KAHE10		39.85	2		
C	Sufflamen bursa	13	KAHE10	427	85.87	1	90868.94	96.5
CF	Chaetodon unimaculatus	13	KAHE10		14.05	2		
CF	Chaetodon multicinctus	13	KAHE10		26.63	4		
CF	Exallias brevis	13	KAHE10		16.35	1		
CF	Pervagor melanocephalus	13	KAHE10		16.22	1		
CF	Cantherhines dumerili	13	KAHE10	9	623.68	1	696.93	0.7
H	Acanthurus triostegus	13	KAHE10		34.33	2		
H	Acanthurus nigrofuscus	13	KAHE10		501.84	21		
H	Acanthurus nigrofuscus	13	KAHE10		165.54	22		
H	Acanthurus nigrofuscus	13	KAHE10		355.32	25		
H	Acanthurus olivaceus	13	KAHE10		93.77	1		
H	Naso lituratus	13	KAHE10		89.39	6		
H	Naso lituratus	13	KAHE10		8.48	2		
H	Naso unicornis	13	KAHE10	80	38.92	1	1287.59	1.4
O	Stegastes fasciolatus	13	KAHE10		181.86	7		
O	Melichthys niger	13	KAHE10		163.34	1		
O	Canthigaster jactator	13	KAHE10	12	14.25	4	359.45	0.4
P	Dascyllus albisella	13	KAHE10		95.74	31		
P	Abudefduf abdominalis	13	KAHE10		188.00	6		
P	Abudefduf vaigensis	13	KAHE10		281.99	9		
P	Chromis ovalis	13	KAHE10	77	358.35	31	924.08	1.0
	TOTAL	13	KAHE10	605	94136.98	605	94136.98	100
C	Parupeneus multifasciatus	14	NANA1		54.40	1		
C	Parupeneus multifasciatus	14	NANA1		288.24	3		
C	Parupeneus multifasciatus	14	NANA1		27.12	1		
C	Thalassoma lutescens	14	NANA1		54.95	1		
C	Thalassoma duperrey	14	NANA1		54.95	1		
C	Thalassoma duperrey	14	NANA1		27.39	1		
C	Thalassoma duperrey	14	NANA1		97.05	1		
C	Thalassoma purpureum	14	NANA1		55.99	1		
C	Zanclus cornutus	14	NANA1		48.09	2		
C	Rhinecanthus rectangulus	14	NANA1		85.87	1		
C	Sufflamen bursa	14	NANA1	15	39.85	2	833.89	49.8
H	Acanthurus triostegus	14	NANA1		188.83	11		
H	Acanthurus nigrofuscus	14	NANA1		142.13	10		
H	Acanthurus nigrofuscus	14	NANA1		310.66	13		
H	Acanthurus nigrofuscus	14	NANA1		22.57	3		
H	Naso lituratus	14	NANA1	42	74.49	5	738.68	44.1
O	Melichthys niger	14	NANA1		99.66	1		
O	Canthigaster jactator	14	NANA1	2	3.56	1	103.22	6.2
	TOTAL	14	NANA1	59	1675.79	59	1675.79	100

GRP	27-Feb-15 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Aulostomus chinensis	15	NANA2		27.72	1		
C	Paracirrhites forsteri	15	NANA2		39.65	1		
C	Thalassoma duperrey	15	NANA2		291.16	3		
C	Thalassoma duperrey	15	NANA2		164.85	3		
C	Gomphosus varius	15	NANA2		11.04	1		
C	Halichoeres ornatissimus	15	NANA2		16.45	1		
C	Zanclus cornutus	15	NANA2		104.16	1		
C	Sufflamen bursa	15	NANA2		257.62	3		
C	Sufflamen bursa	15	NANA2	15	19.92	1	932.56	3.5
CF	Chaetodon ornatissimus	15	NANA2		16.43	2		
CF	Chaetodon ornatissimus	15	NANA2	4	138.00	2	154.44	0.6
H	Scarus psittacus	15	NANA2		241.42	1		
H	Acanthurus triostegus	15	NANA2		68.67	4		
H	Acanthurus triostegus	15	NANA2		500.07	5		
H	Acanthurus triostegus	15	NANA2		92.63	2		
H	Acanthurus leucopareius	15	NANA2		7212.93	31		
H	Acanthurus leucopareius	15	NANA2		137.58	5		
H	Acanthurus leucopareius	15	NANA2		3052.11	23		
H	Acanthurus nigrofuscus	15	NANA2		238.97	10		
H	Acanthurus nigrofuscus	15	NANA2		22.57	3		
H	Acanthurus olivaceus	15	NANA2		6758.04	12		
H	Acanthurus olivaceus	15	NANA2		2943.30	18		
H	Acanthurus olivaceus	15	NANA2		2906.83	31		
H	Ctenochaetus strigosus	15	NANA2		107.38	4		
H	Ctenochaetus strigosus	15	NANA2		113.64	15		
H	Zebrasoma flavescens	15	NANA2		6.75	4		
H	Zebrasoma flavescens	15	NANA2	172	213.12	4	24616.02	92.7
O	Stegastes fasciolatus	15	NANA2		25.98	1		
O	Melichthys niger	15	NANA2	6	816.68	5	842.66	3.2
	TOTAL	15	NANA2	197	26545.67	197	26545.67	100
C	Aulostomus chinensis	16	PIPE		55.44	2		
C	Caranx melampygus	16	PIPE		770.26	75		
C	Lutjanus kasmira	16	PIPE		1680.73	65		
C	Lutjanus kasmira	16	PIPE		5497.94	50		
C	Lutjanus kasmira	16	PIPE		12283.46	40		
C	Monotaxis grandoculis	16	PIPE		13.74	1		
C	Parupeneus bifasciatus	16	PIPE		59.77	1		
C	Forcipiger flavissimus	16	PIPE		36.60	4		
C	Thalassoma duperrey	16	PIPE		5143.75	53		
C	Thalassoma duperrey	16	PIPE		1208.88	22		
C	Thalassoma purpureum	16	PIPE		946.59	1		
C	Gomphosus varius	16	PIPE		310.15	5		
C	Gomphosus varius	16	PIPE		67.80	3		
C	Macropharyngodon geoffroy	16	PIPE		43.92	4		
C	Anampses cuvier	16	PIPE		31.59	1		
C	Halichoeres ornatissimus	16	PIPE		150.82	6		
C	Zanclus cornutus	16	PIPE		312.47	3		
C	Sufflamen bursa	16	PIPE		343.49	4		
C	Sufflamen bursa	16	PIPE	346	272.17	6	29229.57	37.9
CF	Chaetodon unimaculatus	16	PIPE		50.61	2		
CF	Chaetodon multicinctus	16	PIPE		90.23	4		
CF	Chaetodon multicinctus	16	PIPE		59.91	9		
CF	Pervagor spilosoma	16	PIPE	19	64.87	4	265.61	0.3
H	Scarus sordidus	16	PIPE		13176.16	17		
H	Scarus sordidus	16	PIPE		836.15	11		
H	Scarus sordidus	16	PIPE		2581.14	11		
H	Scarus psittacus	16	PIPE		786.15	1		
H	Scarus psittacus	16	PIPE		241.42	1		
H	Scarus psittacus	16	PIPE		1437.46	1		
H	Acanthurus nigrofuscus	16	PIPE		836.40	35		
H	Acanthurus nigrofuscus	16	PIPE		203.16	27		
H	Ctenochaetus strigosus	16	PIPE		1020.07	38		
H	Zebrasoma flavescens	16	PIPE		104.12	4		
H	Naso lituratus	16	PIPE		14.90	1		
H	Naso lituratus	16	PIPE	153	435.51	6	21672.64	28.1
O	Stegastes fasciolatus	16	PIPE		415.68	16		
O	Melichthys niger	16	PIPE		1960.03	12		
O	Melichthys vidua	16	PIPE	34	1194.18	6	3569.89	4.6
P	Heniochus diphreutes	16	PIPE		1514.70	63		
P	Chaetodon kleini	16	PIPE		98.37	15		
P	Chaetodon miliaris	16	PIPE		423.36	20		
P	Dascyllus albisella	16	PIPE		30.88	10		
P	Abudefduf abdominalis	16	PIPE		5953.19	190		
P	Abudefduf vaigensis	16	PIPE		10026.42	320		
P	Chromis vanderbilti	16	PIPE		14.22	45		
P	Chromis ovalis	16	PIPE	1043	4392.67	380	22453.82	29.1
	TOTAL	16	PIPE	1595	77191.54	1595	77191.54	100