CIP GENERATION PROJECT

2017 COMMUNITY BENEFITS PROGRAM

REEF FISH MONITORING PROJECT

YEAR 10 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 tenth annual report for this effort covering the period from December 2007 through December 2017 with a focus on the surveys completed in 2017. 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 16 monitoring stations are in waters from 5 to 12 m in depth and thus are subject to impact from high surf events.

Survey work in 2017 was hampered by inclement weather. The 2017 surveys were completed on 18 May (1st quarter), 17 June (2nd quarter), 17 August (3rd quarter) and 21 December (4th quarter). The first quarter work could not be completed in a timely fashion due to poor weather conditions. Record high ocean water temperatures, due to the protracted El Nino event, created a record number of major storms (15 in all) which generated prolonged high surf events as they passed by the Hawaiian Islands in 2015. The El Nino weather influence continued through much of 2016 and continued to generate storms elsewhere and ultimately generating surf which impacted Hawaiian shorelines. As a result the fourth quarter 2016 field work was completed on 15 March 2017 which moved the first quarter 2017 fieldwork well into the second quarter. To avoid confusion with the 2016 and 2017 surveys below, the last (4th quarter) 2016 survey is included in the 2016 quarterly work.

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 Station (KGS) 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 forty surveys conducted between 2007-2017, 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 153 species of fishes encountered in the forty surveys, twenty-six species are herbivores, fifteen are planktivores, seven are omnivores, eight are coral feeders and 97 are carnivores. Fifteen of the sixteen monitored locations are established on natural substratum where 88.7% of the fish standing crop is comprised of herbivores and carnivores. However, at one station established on the KGS 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 tenth years (2010-2017) 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 CIP (Station nos. 1-4), three stations seaward of Ko'Olina Resort (nos. 5-7), five stations fronting the KGS (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 2007-2017 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 is 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 six stations (numbers 1, 2, 9, 10, 11 and 14) where the number of fish species was significantly less than all other stations which is due to (1) the lack of three-dimensional structure providing shelter space for fishes at these stations and (2) the short transect length used at station 11 (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 previous 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 (2007-2017) 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 41 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 2007-2017 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.

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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 2017. 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), 2014 in Brock (2015), 2015 in Brock (2016), 2016 in Brock (2017) and the continuing operational phase data for 2017 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 tenth annual report since monitoring began for the CIP Generating Station and the eighth 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 non-equilibrium 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).

In 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). Non-parametric statistical procedures are primarily 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 KGS 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 2017 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, 2014 and 2015. 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 2015, field surveys were carried out on 6 April, 18 June, 21 October 2015 and the fourth quarter was carried out on 8 April 2016. Due to extremely poor water clarity on 21 October 2015 offshore of Campbell Industrial Park (visibility approximately four feet), the four CIP stations (Stations 1 - 4) were not sampled despite numerous attempts throughout the survey.

In 2016, quarterly surveys were carried out on 15 April, 5 July, 18 August and once again due to inclement weather the fourth quarter 2016 survey was not completed until 15 March 2017. The 2017 surveys were conducted on 18 May, 2 June, 29 August and 21 December. In this report, the four 2014 surveys are referred to as having been completed in 2014 and similarly, the four 2015 and four 2016 surveys are again referred to having been completed in their respective sample year to reduce confusion when viewing the data.

Survey work in 2015 and 2016 were hampered by inclement weather. As noted above, the 2015 surveys were completed on 6 April, 18 June and 21 October and the fourth quarter field work was completed on 6 April 2016. Commencing in July 2015 and continuing until the end of October 2015, the Hawaiian Islands experienced the greatest number of major storm events (15 in total) on record. Although many of these storm events passed near the islands creating high surf conditions on exposed coastlines, the tracks are never predictable thus precluding any sampling while a storm is in proximity. Similarly in 2016, the quarterly field work could not be carried out on schedule again due to poor weather conditions; the first quarter work was completed on 15 April, second quarter was carried out on 5 July, the third quarter was done on 18 August (on schedule) but the fourth quarter work could not be completed until 15 March

2017. Similarly, the first quarter 2017 survey was not done until 18 May due to inclement weather.

The record number of storm events passing through Hawaiian waters in 2015 and continuing into 2016 are related to major weather patterns and global warming. In 2015, the Pacific Ocean has been influenced by an El Nino weather system that has formed along the equator and another unusually persistent body of water lies offshore of the North American coast. The warmer-than-usual water is impacting marine life across the Pacific rim and creating storms that have caused widespread problems for coastlines and people in the Pacific region. The body of warm water offshore of North America (sometimes referred to as "the blob") may be related to a longer-term cycle of heating and cooling known as the Pacific Decadal Oscillation (PDO) which may be switching from a cooling phase to a warming phase. The PDO is a long period (spanning decades) of relatively cooler or warmer water. Additionally, the input of pollutants to the atmosphere from human activities continues to contribute to the heating of the world's oceans and atmosphere. Each of these phenomena operate on different time scales but presently they appear to be synchronized and their collective effects may be powerful.

Since about year 2000, the PDO has been in a cool state, which has allowed the ocean to soak up considerable heat generated by greenhouse gases as part of climate change. This may have kept global average surface temperatures from rising. Presently, the PDO appears to be entering a warming phase and some believe that strong El Ninos tend to nudge the cycle into a new phase to provide a larger boost to global warming. These phenomena appear to have increased ocean water temperatures and as a result have impacted coral reefs causing massive coral bleaching events as well as increasing the number and magnitude of tropical storm events which Hawaii experienced in 2015. Because of the poor weather conditions which continued throughout 2016, the fourth quarter 2015 monitoring was carried out on 8 April 2016 and the first quarter 2016 survey could not be completed until 15 April 2016. Again as done in 2014 and noted above, despite carrying out field work outside of the normal quarter/year due to poor weather conditions, the resulting data are assigned to the quarter and year in which data collection was to occur to reduce confusion in the analyses below. The 2017 data are presented below along with a comparative analysis of all data collected to date.

The complete data set from the four 2017 surveys is given in Appendix 1 and this information is summarized in Table 2 along with the earlier (2007-2016) information. Drawing on 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 documented 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 forty 2007-2017 sample periods?" To address this question two non-parametric 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 forty 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 forty 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 is permitted to discharge up to 861 million gallons per day (mgd) of thermally-heated seawater at its terminus. The topographical relief afforded by the steel and basalt rock substratum as well as coverage by corals is considerably more conducive habitat for many fishes than the nearby surrounding natural reefs and the discharge of thermally-elevated water additionally 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 the fifteen natural substratum 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 forty (2007-2017) 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 eight years covering the operational phase of the facility, there were 109 species of fishes recorded at the sixteen sites in 2010, 106 species in 2011, 100 species in 2012, 107 species in 2013, 110 species in 2014, 109 species in 2015, 110 species in 2016 and in the four surveys covering 2017 there were 100 species observed at the sixteen sites. In total among the forty surveys, 153 species of fishes have been recorded among the sixteen survey sites. Forty-six percent or 71 species encountered were in common among the forty surveys carried out over the ten-year period. These data suggest a reasonable level of stability in these fish communities.

Of the 153 species of fishes recorded over the forty surveys, 63.4% (97 species) are carnivores, 17.0% (26 species) are herbivores, 9.9% (or 15 species) are planktivores, 4.6% (7 species) are omnivores and 5.2% (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, 2014, 2015, 2016 and 2017) for species encountered on each transect during 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 88.7%) 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 25.6%) but carnivores remain important at Station 16 (54.7%) as they are elsewhere. The large volume of thermally-elevated water (up to 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 had decreased to 27%, in 2015 to 7%, in 2016 back up to 28% and in 2017 it had decreased to 4% of the total estimated standing crop.

5. 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 (CIP) 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 KGS 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 2007-17 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 (Table 5). Furthermore with the mean number of fish species and mean number of individual fishes censused, the East , Nanakuli and Kahe station groups were related due to overlap thus the data were not statistically separable. However, the mean standing crop data for both the East and Nanakuli station groups was significantly greater than found with the Kahe group of stations (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 trends are apparent. First, there is no statistical separation among the Nanakuli, Kahe and CIP station groups for the mean number of fish species or mean number individuals but as noted above, the Nanakuli and CIP mean standing crops per transect are significantly greater than found at the Kahe group of stations) and secondly the Nanakuli group of stations ranked second to the Ko'Olina group of stations for two of the three measures (i.e., mean number of fish species per transect and mean number of individual fish per transect). 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 2007-2017 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 2007-2017?” 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 Stations 1, 2, 9, 10, 11 and 14 where the mean number of fish species is significantly less than at all other stations. Stations 11 and 14 also have the least mean number of individual fish (non-significant) and the lowest mean standing crop (not statistically separable). These low numbers are probably related to the poorly developed coral community at both Station 11 and 14 resulting in little shelter present and most importantly, to the short transect length (10.5 m) at Station 11 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.

6. Fishery Resources

Appendix 1 in this report as well as in Brock (2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017) provides lists of all fish species observed over the forty 2007-2017 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 KGS 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 5, 6, 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).

In the 2015 surveys we encountered the bigeye scad or akule (adult) halalu (juveniles; *Selar crumenophthalmus*) at Station 13 (offshore of "Tracks") on two surveys. The akule is an important species to the local inshore fishery. In the June 2015 survey a portion of a large school entered the transect area where ~150 individuals were censused that made up 52% of the overall standing crop at this station which was estimated at 600 g/m^2. On the 21 October 2015 survey as we approached Station 13, a group of net fishermen moved in and rapidly deployed their net on a school of akule. When they were finished and had left, we carried out our census where a group of ~250 remaining akule crossed through the transect contributing 65% to the estimated standing crop which was 161 g/m^2 which served to maintain the relatively high standing crop of fish frequently encountered at this station.

As noted above, the fourth quarter 2015 survey was carried out on 8 April 2016 where at Station 6 (Ko'Olina 2), the estimated standing crop of fishes was 45 g/m^2. The overall grand mean standing crop for this station from 2008 to 8 April 2016 was 164 g/m^2. Missing were many larger individuals of the usually seen surgeonfish (manini, maiko, pualo, palani, na'ena'e, maikoiko) and parrotfish species (uhu, palukaluka, uhu-uliuli, etc.). Returning to this station for the first quarter 2016 survey seven days later at 0945 hours, we encountered a vessel with four divers who were in the process of netting fish at this location. We returned about 4.5 hours later to conduct the visual fish census at Station 6 and found an estimated fish standing crop of 45 g/m^2. The second quarter 2016 survey (5 July 2016) at Station 6 noted the estimated standing crop had increased to 173 g/m^2 and by the third quarter (18 August 2016) survey, it was up to 245 g/m^2 where na'ena'e comprised 33% of the total weight and maiko made up an additional 22% to the total biomass of fishes present at this station. As mentioned elsewhere, cover or shelter space is relatively well-developed at Ko'Olina 2 which suggests that when removal of many individual adult fish occurs in such an area as through fishing activities, they are replaced by others seeking this appropriate habitat. This observation is well-known to many fishermen and has been noted on other natural substratum areas (Brock, *et al.* 1979) as well as on artificial reefs (Brock and Norris, 1989 and see below).

The above observations are supported by the data from the Kahe warm-water discharge. 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 episodically 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 (*Heteropriacanthus 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 observed on several occasions in the 2007-2017 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 black-lipped 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.

7. 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.

The 6 April 2015 first quarter survey noted an estimated standing crop of 231 g/m^2 at Station 1 (CIP-1) where 63% of this biomass was comprised of the na'ena'e (*Acanthurus olivaceus*). At Station 7 (1-D) the standing crop was estimated to be 229 g/m^2 and the humuhumu ele'ele (*Melichthys niger*) contributed 56% to this total. Station 13 (Kahe 10) also had a high biomass of fish present (313 g/m^2) and the resident school of weke (*Mulloidichthys flavolineatus*) comprised 85% of that standing crop. Finally at Station 16 (KGS pipe), the standing crop was estimated to be 254 g/m^2 and both weke (*Mulloidichthys flavolineatus*) contributed 23% and the hinalea lauwili (*Thalassoma duperrey*) added 20% to this standing crop. The second quarter 2015 survey was conducted on 18 June where high standing crops were encountered at three stations; Station 4 (CIP-4) had an estimated standing crop of 248 g/m^2 where the na'ena'e (*Acanthurus olivaceus*) made up 80% of the weight present. At Station 13 (Kahe-10) the standing crop was estimated to be 600 g/m^2 and the akule (*Selar crumenophthalmus*) contributed 52% to this total and the weke (*Mulloidichthys flavolineatus*) made up 24% of the biomass present. Finally at Station 16 (KGS pipe), the biomass was estimated to be 506 g/m^2 where the weke (*Mulloidichthys flavolineatus*) comprised 45% of the total and the ta'ape (*Lutjanus kasmira*) made up 35% of the biomass present. The third quarter 2015 survey was carried out on 21 October 2015 and the biomass was elevated at three stations: Station 5 (Ko'Olina-1) where the standing crop was estimated to be 1,196 g/m^2 and the ta'ape (*Lutjanus kasmira*) made up 66%, at Station 15 (Nanakuli-2) where it was 280 g/m^2 and the maikoiko (*Acanthurus leucoparieus*) contributed 30% along with the na'ena'e (*Acanthurus olivaceus*) adding 25% and at Station 16 (KGS pipe) where the standing crop was estimated to be 559 g/m^2 and the weke (*Mulloidichthys flavolineatus*) comprised 34% of this along with the ta'ape (*Lutjanus kasmira*) adding 38% to the total. As noted above, the fourth quarter 2015 field survey was not undertaken until 28 April 2016 when the weather cooperated. In this fourth quarter survey three stations all had elevated standing crops; these were Station 2 (CIP-2) where the biomass was estimated to be 291 g/m^2 and the na'ena'e (*Acanthurus olivaceus*) made up 86% of it, at Station 5 (Ko'Olina-1) where the standing crop was 517 g/m^2 and the ta'ape (*Lutjanus kasmira*) comprised 69% of the total and at Station 16 (KGS pipe) where the biomass was estimated to be 281 g/m^2 and the uhu (*Scarus sordidus*) added 32% to the total and the hinalea lauwili (*Thalassoma duperrey*) contributed 25% to the total.

In the first quarter (15 April) 2016 survey, elevated standing crops were present at five of the sixteen stations: Station 2 (CIP-2) the standing crop was estimated to be 395 g/m^2 and the na'ena'e (*Acanthurus olivaceus*) comprised 70% while the manini (*Acanthurus triostegus*) added 12%. The estimated standing crop was 256 g/m^2 at Station 3 (CIP-3) where the na'ena'e (*Acanthurus olivaceus*) comprised 62% of the total and the ringtail surgeonfish or pualu (*Acanthurus blochii*) added 16% to the total biomass at this station. Station-5 (Ko'Olina 1) the biomass was estimated to be 969 g/m^2 and the ta'ape (*Lutjanus kasmira*) made up 87% of the total present. At Station 13 (Kahe-10) the standing crop was estimated to be 400 g/m^2 and again the ta'ape contributed 63% while the weke (*Mulloidichthys flavolineatus*) added 15% to the total. Station 16 (KGS pipe) had a estimated standing crop of 719 g/m^2 in the first quarter 2016 survey and two species were responsible for much of the biomass present; these were the ta'ape (*Lutjanus kasmira*) contributing 34% and the weke'ula (*Mulloidichthys vanicolensis*) adding 39% to the total at this station. The second quarterly 2016 survey was carried out on 5 July where once again the na'ena'e (*Acanthurus olivaceus*) added 41% and the pualu (*Acanthurus blochii*) contributed 15% to the estimated 379 g/m^2 at Station 1 (CIP-1). The standing crop at Station 5 (Ko'Olina-1) was estimated to be 385 g/m^2 and the ta'ape (*Lutjanus kasmira*) made up 74% of the total at this station. The standing crop was elevated at Station 15 (Nanakuli-2) in the July 2016 survey (319 g/m^2). Three species contributed heavily to this biomass; these were the ta'ape adding 17%, the emperor or mu (*Monotaxis grandoculis*) contributing 22% and the maiko (*Acanthurus nigroris*) providing 25% to the total at this station. Again in the July 2016 survey the standing crop was high on Station 16 (KGS pipe - 802 g/m^2) and the weke (*Mulloidichthys flavolineatus*) added 36% to the total, the weke'ula (*Mulloidichthys vanicolensis*) provided 25% and the ta'ape (*Lutjanus kasmira*) contributed 10% to the total at this station. The third quarter 2016 survey carried out on 18 August where the standing crop at Station 1 (CIP-1) was estimated to be 334 g/m^2 and the na'ena'e (*Acanthurus olivaceus*) comprised 64% of the total present. At Station 5 (Ko'Olina-1) the standing crop was 210 g/m^2 and the ta'ape (*Lutjanus kasmira*) made up 67% of the biomass present while at Station 6 (Ko'Olina-2) where the estimated biomass was 245 g/m^2, the na'ena'e (*Acanthurus olivaceus*) contributed 33% and the maiko (*Acanthurus nigroris*) added 22% to the total. The fourth quarterly survey was carried out on 15 March 2017 where Station 2 (CIP-2) had a standing crop estimated to be 243 g/m^2 and the na'ena'e (*Acanthurus olivaceus*) made up 74% of the biomass present. The standing crop at Station 15 (Nanakuli-2) was estimated to be 213 g/m^2 and the mu (*Monotaxis grandoculis*) comprised 41% and the whitebar surgeonfish or maikoiko (*Acanthurus leucoparieus*) made up 39% of the total biomass present. Finally, the estimated standing crop at Station 16 (KGS pipe) was 810 g/m^2 where the ta'ape (*Lutjanus kasmira*) contributed 21% and the weke'ula (*Mulloidichthys vanicolensis*) added 57% to the total at this station.

In the four 2017 surveys, the yellowfin goatfish or weke'ula (*Mulliodichthys vanicolensis*) contributed significantly to the estimated standing crop at the Kahe warm-water discharge (Station 16). In May a school of weke'ula contributed 57% of the total standing crop (estimated to be 1,010 g/m^2), in June, they added 32% to the total estimated standing crop at 702 g/m^2, August it was 26% of an estimated total of 650 g/m^2 and in December 33% where the total was estimated to be 1,042 g/m^2. Also in the December survey a related species (the yellowstripe

goatfish or weke - *Mulloidichthys flavolineatus*) added 52% to the total estimated standing crop at this station. In the August 2017 survey many adult bullethead parrotfishes or uhu (*Scarus sordidus*) were present on the warm-water discharge contributing 53% to the estimated standing crop; these fish were possibly aggregated for spawning.

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. Reasons for this include the fact that many species forage over relatively large areas thus often appear and cross through the transect area while a census is in progress and secondly some species such as the ta'ape (*Lutjanus kasmira*), the weke (*Mulloidichthys flavolineatus*) and weke'ula (*Mulloidichthys vanicolensis*) aggregate and rest during the daylight hours and forage after dark. These resting species often do so in areas where considerable vertical relief (shelter) is present as at Station 16 (KGS pipe). Diurnal foraging species that have contributed heavily to the standing crops in this study include 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*). 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 as noted above, ta'ape (*Lutjanus kasmira*) and weke'ula (*Mulloidichthys vanicolensis*).

8. Comparative Analysis of Hawaiian Electric’s Early Biological Data to the 2007-2017 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 early 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 2007-2017 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-1 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 2007-2017 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 censused per transect or the number of individual fish observed 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 (2007-2017) 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 2007-2017 dataset. Despite the mean estimated standing crop (here 64 g/m^2) being greater in 2007-2017 than in 1984 (26 g/m^2), the Wilcoxon Two-Sample Test failed to find any statistically significant differences ($p>0.16$, 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 41-year period (1976-2017) 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.

9. 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 twenty-five of the forty 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 and this same Station 8 depression was occupied by an ~70 cm turtle on 15 April 2016 survey. The 18 May 2017 survey noted one small (~50 cm) turtle resting in the same depression and during the 2 June 2017 survey, a small 50 cm turtle swam alongside of the census taker at Station 8 for the length of the 50 m transect. This latter turtle may be the same individual encountered on many other occasions at this station.

Turtles have been encountered elsewhere around the sixteen stations sampled in this study. 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). Green turtles observed in the 2015 quarterly surveys on 6 April at Station 3 (~40 cm individual) on 18 June at Station 13 (~65 cm individual) and on 8 April 2016 fourth quarter survey an ~ 65 cm turtle was observed at Station 10. In the April 2016 survey at Station 5 (Ko'Olina 1) a ~60 cm was seen swimming north, at Station 8 another ~60 cm turtle was seen swimming south. On the 5 July 2016 survey at Station 16 (KGS pipe) a ~60 cm turtle was seen swimming alongside of the discharge pipe on the western side in a seaward direction and on 18 August 2016 a ~75 cm individual was observed swimming in a northwest direction at Station 13 (Kahe-10). 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 observed very often around the main Hawaiian Islands probably because much of the population was located in the Northwest Hawaiian Islands. However over time, the population numbers of this species have declined but despite this, in recent years an increasing number of Hawaiian monk seals are now present 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 observed by us 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, 27 February 2015 and 15 March 2017 (for the 4th quarter 2016) 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 traveling northwest seaward of Stations 5 and 6. On the 18 December 2013 survey a small pod of spinner porpoises (estimated 15 individuals), were observed 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.

10. 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 40 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 41 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 4, 5, 6 and 16. The second survey on 4 April 2008 missed station 16 while surveys carried out subsequently 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 forty surveys over the 2007 - 2017 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 and that Stations 1-4 were not samples on 21 October 2015 due to poor water clarity.

					% Total Biomass (g)				
Sample Date	Transect No.	No. Species	No. Individuals	Biomass g/m2	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
06-Apr-15	1	19	400	231	89		0	11	
	2	20	278	160	89	0	2	8	1
	3	24	283	93	44	0	9	46	1
	4	37	310	142	80	0	10	8	1
	5	31	275	59	52	1	20	22	4
	6	29	381	96	58	4	16	17	6
	7	20	677	229	17		62	21	0
	8	27	146	31	18	0	10	66	6
	9	17	81	11	58	1		40	1
	10	19	47	16	67	2		31	1
	11	3	5	5			2	98	
	12	22	137	16	38	13	18	30	1
	13	26	612	313	5	1	1	93	0
	14	15	85	15	52			43	5
	15	23	174	53	73	0	11	15	1
	16	43	1246	254	24	19	2	55	0
18-Jun-15	1	19	277	129	83	0	1	16	
	2	16	249	92	84	0	2	14	0
	3	20	160	18	36	0	34	28	2
	4	19	386	248	90	0	3	7	0
	5	29	284	68	28	2	12	56	2
	6	28	190	72	63	1	13	19	4
	7	28	587	123	22	5	49	23	0
	8	25	183	39	66	7	5	21	2
	9	21	121	34	66	1	4	29	0
	10	11	43	21	62	21		16	1
	11	7	15	20	55	2	23	20	
	12	25	179	68	17	1	8	74	0
	13	25	901	600	1	3	0	96	0
	14	13	73	9	81	0		19	
	15	21	235	95	16	5	5	73	1
	16	29	1435	506	1	11	3	86	0

TABLE 2. Continued

Sample Date	Transect No.	No. Species	No. Individuals	Biomass g/m2	% Total Biomass (g) Herb.	Plankt.	Omni	Carni	CF
21-Oct-15	1	Not sampled							
	2	Not sampled							
	3	Not sampled							
	4	Not sampled							
	5	37	1734	1196	29	0	1	69	0
	6	30	379	112	77		5	17	1
	7	24	348	159	49		30	20	1
	8	27	348	74	72	2	4	20	2
	9	19	106	26	60	1	7	32	1
	10	17	45	26	45	0	4	52	
	11	8	22	16		0	20	76	4
	12	29	546	58	20	10	14	57	0
	13	26	457	161	6	4	15	75	0
	14	14	197	60	87	0	0	11	1
	15	31	316	280	68	1	0	30	0
	16	35	978	559	7	8	3	81	0
08-Apr-16	1	21	245	107	83		1	15	1
	2	25	262	291	93	0	1	5	1
	3	20	236	157	88	0	1	11	0
	4	24	370	145	74	6	4	15	0
	5	22	678	517	12	1	1	85	0
	6	22	158	45	54		13	29	4
	7	21	398	87	45		30	21	3
	8	20	410	97	86	2	1	11	0
	9	18	127	132	7	0	0	93	0
	10	14	43	22	64	2	7	27	
	11	6	10	6		0	3	97	
	12	23	651	29	15	3	48	32	1
	13	27	406	146	10	5	3	82	0
	14	15	95	43	94	0		6	
	15	21	185	151	93		0	6	0
	16	25	1039	281	36	21	13	31	0
15-Apr-16	1	21	155	171	94	0	0	5	1
	2	27	369	395	91	0	1	7	0
	3	26	209	256	89		3	7	0
	4	29	253	180	85	2	2	10	0
	5	25	1162	969	8		1	91	0
	6	20	188	48	35		42	20	3
	7	30	365	70	29	0	20	50	1
	8	26	344	62	75	0	3	19	2
	9	12	53	10	57	0	7	35	1
	10	17	57	84	16		1	83	0
	11	4	6	16	66			34	
	12	29	225	43	14	15	35	36	0
	13	34	661	400	11	2	2	85	0
	14	8	34	2	23	0		73	3
	15	21	123	80	87		5	6	2
	16	31	1722	719	3	14	1	83	0

TABLE 2. Continued

Sample Date	Transect No.	No. Species	No. Individuals	Biomass g/m2	% Total Biomass (g) Herb.	Plankt.	Omni	Carni	CF
05-Jul-16	1	27	370	379	87	0	0	13	0
	2	14	171	167	88		0	11	1
	3	16	123	32	42		2	52	4
	4	20	269	190	62	9	17	11	1
	5	24	921	385	6		3	90	1
	6	22	251	173	92		4	3	1
	7	19	334	71	37	0	33	28	2
	8	27	273	34	51	4	5	38	2
	9	18	120	11	40	2		56	1
	10	7	35	6	14	1		86	
	11	2	3	7				100	
	12	24	584	19	21	4	38	36	1
	13	29	354	90	23	3	8	65	1
	14	11	65	51	94			6	0
	15	29	292	319	54	0	4	41	0
	16	38	1543	802	5	13	2	79	1
18-Aug-16	1	23	302	334	93	0	0	7	0
	2	19	219	37	46	0	0	48	5
	3	21	178	102	60	0	3	36	1
	4	20	139	26	48		6	42	4
	5	22	486	210	15		5	79	1
	6	22	337	245	90	1	4	4	1
	7	26	289	81	29		40	28	2
	8	27	352	62	72	0	2	25	0
	9	18	233	79	11	0	1	88	0
	10	14	50	9	47	1	7	44	1
	11	2	3	4				100	
	12	26	815	41	12	3	26	59	0
	13	26	363	138	11	3	2	84	0
	14	10	86	8	13	1		78	8
	15	23	164	160	83	0	2	15	0
	16	39	1552	797	5	6	2	87	0
15-Mar-17	1	23	215	134	89	0	1	10	0
	2	24	461	243	96	0	0	2	1
	3	26	225	118	75	0	7	17	1
	4	20	309	197	88	0	8	4	0
	5	19	424	137	11	0	1	88	0
	6	23	168	141	66	0	2	31	0
	7	21	525	159	30	1	22	46	0
	8	28	206	27	65	2	9	22	2
	9	21	97	12	14	4		81	1
	10	11	43	19	65	0		35	
	11	4	6	4			6	94	
	12	28	235	24	43	3	13	40	1
	13	25	306	122	11	4	11	74	1
	14	13	86	6	27	1	0	72	
	15	29	235	213	52	0	1	47	0
	16	29	1204	810	2	6	0	92	0

TABLE 2. Continued

Sample Date	Transect No.	No. Species	No. Individuals	Biomass g/m2	% Total Biomass (g) Herb.	Plankt.	Omni	Carni	CF
18-May-17	1	19	327	201	79	0	4	16	0
	2	22	385	108	82	0	2	15	1
	3	25	228	117	76	0	9	14	0
	4	19	298	69	67	0	7	26	
	5	25	837	250	22	0	2	75	0
	6	19	242	198	91		2	7	1
	7	20	352	103	23		27	50	1
	8	22	424	120	70	5	1	24	0
	9	16	133	44	27	1		71	0
	10	15	71	18	41	1	0	57	0
	11	3	5	14	27		1	72	
	12	13	125	12	33	1	39	27	0
	13	26	724	248	5	3	6	86	0
	14	12	57	6	22	0		78	
	15	22	215	214	94	0	1	4	1
	16	39	985	1010	34	1	1	64	0
02-Jun-17	1	26	400	222	90	0	1	9	0
	2	20	225	145	77	0	1	21	1
	3	20	163	30	34	0	11	54	1
	4	20	421	150	70	0	19	10	0
	5	21	817	410	16	0	3	80	0
	6	24	201	50	57	0	21	20	2
	7	17	534	180	29		32	39	1
	8	18	189	32	53	0	5	41	0
	9	13	36	10	35	0	0	65	
	10	16	39	19	68	1	0	30	1
	11	5	6	9	12		2	86	
	12	24	284	29	23	31	24	20	1
	13	27	554	216	7	3	9	82	0
	14	5	31	6	37			63	
	15	21	138	69	66		9	24	1
	16	32	1635	703	18	7	2	72	0
29-Aug-17	1	28	288	209	94	0	1	4	0
	2	21	166	78	74	0	0	24	2
	3	26	275	81	73	0	8	18	1
	4	20	902	196	80	1	8	11	0
	5	22	388	128	24	6	5	65	0
	6	30	206	112	72	1	6	20	2
	7	17	584	165	35		30	35	0
	8	29	242	33	39	2	13	43	3
	9	17	72	14	22	0		78	
	10	18	70	31	60		1	38	
	11	6	8	22	26		2	71	
	12	30	555	39	14	1	16	68	1
	13	27	1171	258	7	3	3	86	0
	14	12	89	2	24	4	7	66	
	15	19	160	179	85		0	14	0
	16	33	1313	650	54	4	0	42	0

TABLE 2. Continued

Sample Date	Transect No.	No. Species	No. Individuals	Biomass g/m2	% Total Biomass (g) Herb.	Plankt.	Omni	Carni	CF
21-Dec-17	1	17	319	241	95	0	0	5	
	2	21	536	183	87	0	0	13	0
	3	20	182	124	86	0	2	10	1
	4	23	357	90	78	0	9	12	0
	5	20	221	44	47		6	43	4
	6	34	314	233	67	2	6	23	2
	7	22	769	330	14		8	77	0
	8	24	233	22	46	1	13	39	1
	9	15	279	344	2	0		98	0
	10	12	56	26	22	0	0	77	
	11	9	34	88	20	0	5	74	
	12	26	374	22	30	2	5	62	1
	13	31	931	389	4	3	2	90	0
	14	11	47	4			42	54	4
	15	25	184	158	77	0	2	20	1
	16	29	1455	1042	1	8	0	91	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, 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 forty 2007-2017 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. Bolded dates represent 2017 quarterly survey periods.

1. Mean Number of Fish Species Per Transect (p>0.23, 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
Oct-15	11	23.8	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
bApr-16	15	21.9	A
Apr-15	15	21.6	A
Aug-17	**15**	**21.5**	**A**
Jun-14	15	21.3	A
Mar-17	15	21.0	A
Mar-09	15	20.9	A
May-09	15	20.9	A
Dec-17	**15**	**20.7**	**A**
Jun-15	15	20.3	A
Apr-08	15	20.3	A
Feb-15	15	20.1	A
Aug-16	15	19.9	A
Apr-16	15	19.9	A
Jul-16	15	19.3	A
May-14	15	19.2	A
bMay-12	15	19.0	A
May-13	15	18.8	A
May-17	**15**	**18.5**	**A**
Jun-17	**15**	**18.5**	**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 forty sample periods.

TABLE 3. Continued.

2. Mean Number of Individual Fish Per Transect (p>0.88. n.s.)

YEAR	[n]	Mean	SNK Grouping
Oct-15	11	409	A
Jul-09	15	355	A
Aug-17	**15**	**345**	**A**
Sep-14	15	334	A
Dec-17	**15**	**322**	**A**
Nov-11	15	313	A
May-17	**15**	**295**	**A**
Apr-16	15	285	A
Feb-15	15	285	A
bApr-16	15	280	A
Jul-16	15	278	A
Jun-11	15	275	A
Jul-11	15	274	A
Aug-08	15	270	A
Jun-17	**15**	**269**	**A**
Aug-16	15	268	A
Nov-08	15	265	A
Nov-12	15	262	A
Oct-10	15	260	A
Apr-15	15	259	A
Jun-15	15	259	A
Apr-08	15	255	A
Sep-13	15	250	A
Aug-10	15	246	A
Dec-07	15	285	A
Mar-17	15	236	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 individual fish found per transect over the forty sample periods.

3. Mean Standing Crop of Fish in g/m2 Per Transect (p>0.72, n.s.)

YEAR	[n]	Mean	SNK Grouping
Sep-13	15	190	A
bApr-16	15	186	A
Dec-17	**15**	**153**	**A**
Dec-07	15	137	A
Apr-16	15	132	A
Jul-16	15	129	A
Nov-11	15	123	A
Feb-15	15	120	A
Oct-10	12	118	A
May-17	**15**	**115**	**A**
Jun-15	15	109	A
Oct-15	11	106	A
Jun-17	**15**	**105**	**A**
Mar-17	15	104	A
Aug-17	**15**	**103**	**A**
Aug-16	15	103	A
Sep-14	15	100	A
Jul-11	15	100	A
Apr-15	15	98	A
Jul-09	15	98	A
May-13	15	93	A
Nov-12	15	92	A
Jun-14	15	88	A
Jun-13	15	85	A
Jun-11	15	84	A
May-10	15	84	A
Dec-13	15	83	A
Aug-10	15	83	A
Apr-08	15	80	A
Nov-08	15	72	A
May-12	15	72	A
May-09	15	70	A
May-14	15	68	A
Jul-12	15	62	A
Mar-10	15	59	A
Mar-09	15	59	A
Aug-08	15	57	A
May-08	15	54	A
Feb-11	15	48	A
bMay-12	15	48	A

Interpretation: Despite the range in the estimated total standing crop per station over the forty 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 forty 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 (n=38). In the body of the table are given the percent contribution by weight for each trophic category. Note that the December 2007 survey did not sample three of the fifteen stations and October 2015 did not sample four of fifteen stations. Data summarized from Table 2.

PART A. Stations 1 - 15:

Date	[n]	Herbivore	Planktivore	Omnivore	Coral Feeder	Carnivore
		Mean Percent by Weight				
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
06-Apr-15	15	53	2	14	2	37
18-Jun-15	15	51	3	12	1	34
21-Oct-15	11	51	2	9	1	42
08-Apr-16	15	59	2	8	1	36
15-Apr-16	15	52	2	9	1	37
05-Jul-16	15	51	3	10	1	43
18-Aug-16	15	45	1	8	2	49
15-Mar-17	15	52	1	6	1	44
18-May-17	15	51	1	8	0	41
02-Jun-17	15	45	3	10	1	43
29-Aug-17	15	49	2	7	1	43
21-Dec-17	15	48	1	7	1	47
	Grand Means	45.9	2.7	9.4	1.5	42.8

PART B. Stations 16 (Outfall Pipe) Only:

Date	[n]	Herbivore	Planktivore	Omnivore	Coral Feeder	Carnivore
		Mean Percent by Weight				
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
06-Apr-15	1	24	19	2	>1	55
18-Jun-15	1	1	11	3	>1	86
21-Oct-15	1	7	8	3	>1	81
08-Apr-16	1	36	21	13	>1	31
15-Apr-16	1	3	14	1	>1	83
05-Jul-16	1	5	13	2	>1	79
18-Aug-16	1	5	6	2	>1	87
15-Mar-17	1	2	6	>1	>1	92
18-May-17	1	34	1	1	>1	64
02-Jun-17	1	18	7	2	>1	72
29-Aug-17	1	54	4	>1	>1	42
21-Dec-17	1	1	8	>1	>1	91
	Grand Means	16.7	25.9	2.9	0.1	54.7

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 2007-2017 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). Note that the four CIP stations were not sampled in the October 2015 survey. 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	118	27.3	A
Nanakuli	120	21.4	B
CIP	155	20.8	B C
Kahe	200	19.4	C

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 forty 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	118	377	A
Nanakuli	120	260	B
CIP	155	237	B C
Kahe	200	193	C

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 forty 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	118	148	A
CIP	155	106	B
Nanakuli	120	105	B
Kahe	200	54	C

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. Both the CIP and Nanakuli station groups had a statistically greater mean standing crop than was present at the Kahe group of stations.

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 forty periods in 2007-2017?" 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 2007-17 (p < 0.0001, Significant)

Station Group	[n]	Mean	SNK Grouping			
16 (Pipe)	38	34	A			
13 (HECO 10C)	40	30		B		
6 (Ko'Olina 2)	39	30		B		
5 (Ko'Olina 1)	39	28		B	C	
12 (HECO 7E)	40	27			C	D
8 (HECO 5B)	40	26	E		C	D
7 (HECO 1D)	40	24	E	F		D
4 (East 4)	38	23	E	F		
3 (East 3)	39	23	E	F		
15 (Nana-2)	40	22		F		
2 (East 2)	39	19			G	
9 (HECO 7B)	40	19			G	
1 (East 1)	39	18			G	
10 (HECO 7C)	40	17			G	
14 (Nana-1)	40	13				H
11 (HECO 7D)	40	9			I	

Interpretation:
The Kruskal-Wallis ANOVA noted significant differences in the mean number of fish species per transect at 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 notes that station 1, 2, 9, 10, 11 and 14 have significantly fewer species present due to the poor development of topographical relief that provides shelter space at all stations and a shorter transect length (10.5m versus 50m) at Station 11.

TABLE 6. Continued.

2. Mean Number of Individual Fish Censused Per Station in 2007-17 (p < 0.0001, Significant)

Station Group	[n]	Mean	Grouping			
16 (Pipe)	38	1233	A			
13 (HECO 10C)	40	508		B		
5 (Ko'Olina 1)	39	432		B	C	
7 (HECO 1D)	40	430		B	C	
12 (HECO 7E)	40	385			C	D
8 (HECO 5B)	40	322	E			D
4 (East 4)	38	321	E			D
6 (Ko'Olina 2)	39	271	E	F		
2 (East 2)	39	239	E	F	G	
1 (East 1)	39	197		F	G	
3 (East 3)	39	189		F	G	
15 (Nana-2)	40	186		F	G	
9 (HECO 7B)	40	142			G	H
10 (HECO 7C)	40	88	I			H
14 (Nana-1)	40	86	I			H
11 (HECO 7D)	40	28	I			

Interpretation:
The Kruskal-Wallis ANOVA noted statistically significant differences in the mean number of individual fish censused among the 16 transects over the forty surveys in 2007-17. 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 2007-17 (p < 0.0001, Significant)

Station Group	[n]	Mean	Grouping			
16 (Pipe)	38	419	A			
13 (HECO 10C)	40	181		B		
5 (Ko'Olina 1)	40	173		B		
6 (Ko'Olina 2)	39	149		B	C	
7 (HECO 1D)	40	123		B	C	D
15 (Nana-2)	40	122		B	C	D
9 (HECO 7B)	40	120		B	C	D
2 (East 2)	39	114	E	B	C	D
1 (East 1)	39	114	E	B	C	D
4 (East 4)	38	107	E	B	C	D
3 (East 3)	39	88	E	F	C	D
8 (HECO 5B)	40	58	E	F	G	D
12 (HECO 7E)	40	41	E	F	G	
10 (HECO 7C)	40	26		F	G	
11 (HECO 7D)	40	24		F	G	
14 (Nana-1)	40	12			G	

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.

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 KGS 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
NĀNĀKULI
HONOULIU
MAKAKILO CITY
Kahe Point
Milo Cove
Barbers Point Harbor
CORAL PIT
KALAELOA AIRPORT
Kalaeloa
Map created with TOPO! ©2006 National Geographic
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
TN MN
10°
05/13/09

APPENDIX 1. Results of fish censuses carried out on each of four 2017 surveys conducted on 18 May (first quarter), 2 June (for the second quarter), 29 August (third quarter) and 21 December 2017 (fourth quarter). 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), sixth annual report (Brock 2014), seventh annual report (Brock 2015), the eighth annual report (Brock 2016) and ninth (Brock 2017). 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).

18 MAY 2017 FIELD DATA

GRP	18-May-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Lutjanus fulvus	1	EAST1	7	729.71			
C	Lutjanus fulvus	1	EAST1	12	2658.69			
C	Forcipiger flavissimus	1	EAST1	2	18.30			
C	Plectroglyphidodon imparipennis	1	EAST1	1	0.86			
C	Paracirrhites arcatus	1	EAST1	2	32.70			
C	Labroides phthirophagus	1	EAST1	2	1.26			
C	Thalassoma duperrey	1	EAST1	7	78.14			
C	Thalassoma duperrey	1	EAST1	7	679.36			
C	Thalassoma duperrey	1	EAST1	13	714.34			
C	Thalassoma duperrey	1	EAST1	7	191.73			
C	Coris gaimard	1	EAST1	1	45.99			
C	Rhinecanthus rectangulus	1	EAST1	2	90.72			
C	Rhinecanthus rectangulus	1	EAST1	3	257.62			
C	Sufflamen fraenatus	1	EAST1	2	922.50			
C	Sufflamen fraenatus	1	EAST1	1	144.65	69	6566.58	16.3
CF	Chaetodon unimaculatus	1	EAST1	2	50.61	2	50.61	0.1
H	Acanthurus triostegus	1	EAST1	12	555.78			
H	Acanthurus triostegus	1	EAST1	7	1313.21			
H	Acanthurus triostegus	1	EAST1	21	2100.30			
H	Acanthurus nigrofuscus	1	EAST1	10	238.97			
H	Acanthurus nigrofuscus	1	EAST1	20	1085.05			
H	Acanthurus nigroris	1	EAST1	13	9604.88			
H	Acanthurus olivaceus	1	EAST1	18	4710.01			
H	Acanthurus olivaceus	1	EAST1	19	10700.23			
H	Acanthurus dussumieri	1	EAST1	3	1693.06	123	32001.50	79.4
O	Melichthys niger	1	EAST1	5	816.68			
O	Melichthys vidua	1	EAST1	4	796.12			
O	Canthigaster jactator	1	EAST1	3	22.77	12	1635.57	4.1
P	Chromis vanderbilti	1	EAST1	121	38.22	121	38.22	0.1
	TOTAL	1	EAST1	327	40292.48	327	40292.48	100
C	Cephalopholis argus	2	EAST2	1	229.32			
C	Parupeneus multifasciatus	2	EAST2	2	108.80			
C	Parupeneus multifasciatus	2	EAST2	3	81.35			
C	Plectroglyphidodon johnstonianu	2	EAST2	2	6.06			
C	Paracirrhites arcatus	2	EAST2	4	65.39			
C	Paracirrhites arcatus	2	EAST2	3	24.35			
C	Bodianus bilunulatus	2	EAST2	1	214.67			
C	Thalassoma duperrey	2	EAST2	16	879.18			
C	Thalassoma duperrey	2	EAST2	14	156.29			
C	Thalassoma duperrey	2	EAST2	19	520.42			
C	Gomphosus varius	2	EAST2	7	77.29			
C	Rhinecanthus rectangulus	2	EAST2	1	85.87			
C	Rhinecanthus rectangulus	2	EAST2	1	45.36			
C	Sufflamen bursa	2	EAST2	1	45.36			
C	Sufflamen fraenatus	2	EAST2	1	85.87			
C	Sufflamen fraenatus	2	EAST2	1	329.34			
C	Sufflamen fraenatus	2	EAST2	1	224.79			
C	Ostracion meleagris	2	EAST2	1	6.76	79	3186.49	14.8
CF	Chaetodon ornatissimus	2	EAST2	2	138.00			
CF	Chaetodon quadrimaculatus	2	EAST2	1	25.30	3	163.31	0.8
H	Acanthurus triostegus	2	EAST2	48	4800.68			
H	Acanthurus leucopareius	2	EAST2	3	398.10			
H	Acanthurus nigrofuscus	2	EAST2	34	255.84			
H	Acanthurus nigrofuscus	2	EAST2	17	406.25			
H	Acanthurus nigroris	2	EAST2	2	534.70			
H	Acanthurus nigroris	2	EAST2	1	102.47			
H	Acanthurus olivaceus	2	EAST2	7	656.38			
H	Acanthurus olivaceus	2	EAST2	7	1831.67			
H	Acanthurus olivaceus	2	EAST2	15	8447.55			
H	Zebrasoma flavescens	2	EAST2	3	159.84	137	17593.49	81.8
O	Stegastes fasciolatus	2	EAST2	3	22.18			
O	Melichthys niger	2	EAST2	3	490.01	6	512.18	2.4
P	Chromis vanderbilti	2	EAST2	160	50.54	160	50.54	0.2
	TOTAL	2	EAST2	385	21506.01	385	21506.01	100

GRP	18-May-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Cephalopholis argus	3	EAST3	1	638.29			
C	Parupeneus multifasciatus	3	EAST3	1	27.12			
C	Plectroglyphidodon johnstonianu	3	EAST3	4	6.89			
C	Paracirrhites arcatus	3	EAST3	4	65.39			
C	Paracirrhites arcatus	3	EAST3	1	8.12			
C	Cirrhitops fasciatus	3	EAST3	1	8.23			
C	Labroides phthirophagus	3	EAST3	1	0.63			
C	Thalassoma duperrey	3	EAST3	10	549.49			
C	Thalassoma duperrey	3	EAST3	4	388.21			
C	Thalassoma duperrey	3	EAST3	14	383.47			
C	Gomphosus varius	3	EAST3	1	39.39			
C	Gomphosus varius	3	EAST3	6	66.25			
C	Pseudojuloides cerasinus	3	EAST3	1	27.39			
C	Stethojulis balteata	3	EAST3	2	71.53			
C	Zanclus cornutus	3	EAST3	1	104.16			
C	Sufflamen bursa	3	EAST3	2	171.75			
C	Sufflamen fraenatus	3	EAST3	1	224.79			
C	Sufflamen fraenatus	3	EAST3	1	461.25	56	3242.33	13.9
CF	Chaetodon multicinctus	3	EAST3	8	104.24	8	104.24	0.4
H	Scarus sordidus	3	EAST3	3	4282.71			
H	Scarus sordidus	3	EAST3	1	234.65			
H	Scarus sordidus	3	EAST3	14	10850.96			
H	Scarus sordidus	3	EAST3	1	76.01			
H	Scarus psittacus	3	EAST3	1	786.15			
H	Scarus rubroviolaceus	3	EAST3	1	85.39			
H	Acanthurus nigrofuscus	3	EAST3	18	135.44			
H	Acanthurus nigrofuscus	3	EAST3	25	597.43			
H	Ctenochaetus strigosus	3	EAST3	19	288.77			
H	Ctenochaetus strigosus	3	EAST3	16	429.50			
H	Naso lituratus	3	EAST3	1	127.73	100	17894.75	76.5
O	Stegastes fasciolatus	3	EAST3	8	59.14			
O	Melichthys niger	3	EAST3	9	1470.02			
O	Melichthys vidua	3	EAST3	3	597.09			
O	Canthigaster jactator	3	EAST3	4	14.25	24	2140.49	9.1
P	Chromis vanderbilti	3	EAST3	40	12.64	40	12.64	0.1
	TOTAL	3	EAST3	228	23394.45	228	23394.45	100
C	Cephalopholis argus	4	EAST4	1	471.73			
C	Forcipiger flavissimus	4	EAST4	4	36.60			
C	Paracirrhites arcatus	4	EAST4	4	65.39			
C	Paracirrhites forsteri	4	EAST4	1	39.65			
C	Bodianus bilunulatus	4	EAST4	1	1141.37			
C	Bodianus bilunulatus	4	EAST4	1	133.12			
C	Thalassoma duperrey	4	EAST4	2	194.10			
C	Thalassoma duperrey	4	EAST4	11	604.44			
C	Thalassoma duperrey	4	EAST4	23	256.75			
C	Thalassoma duperrey	4	EAST4	13	356.08			
C	Coris gaimard	4	EAST4	1	8.57			
C	Halichoeres ornatissimus	4	EAST4	1	9.52			
C	Plagiotremus ewaensis	4	EAST4	2	1.90			
C	Rhinecanthus rectangulus	4	EAST4	1	85.87			
C	Sufflamen fraenatus	4	EAST4	1	144.65	67	3549.75	25.6
H	Acanthurus nigrofuscus	4	EAST4	14	334.56			
H	Acanthurus nigrofuscus	4	EAST4	11	82.77			
H	Acanthurus olivaceus	4	EAST4	10	2616.67			
H	Acanthurus olivaceus	4	EAST4	9	5068.53			
H	Naso lituratus	4	EAST4	3	217.75			
H	Naso lituratus	4	EAST4	3	934.84	50	9255.13	66.6
O	Melichthys niger	4	EAST4	5	816.68			
O	Melichthys vidua	4	EAST4	1	199.03			
O	Canthigaster coronata	4	EAST4	1	7.59			
O	Canthigaster jactator	4	EAST4	3	10.69	10	1033.98	7.4
P	Chromis vanderbilti	4	EAST4	171	54.02	171	54.02	0.4
	TOTAL	4	EAST4	298	13892.88	298	13892.88	100

GRP	18-May-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Cephalopholis argus	5	KO1	1	336.42			
C	Lutjanus kasmira	5	KO1	600	34411.52			
C	Lutjanus kasmira	5	KO1	5	953.23			
C	Parupeneus bifasciatus	5	KO1	1	270.20			
C	Parupeneus cyclostomus	5	KO1	4	354.29			
C	Forcipiger flavissimus	5	KO1	3	27.45			
C	Plectroglyphidodon johnstonianu	5	KO1	1	3.03			
C	Paracirrhites arcatus	5	KO1	2	32.70			
C	Thalassoma duperrey	5	KO1	3	164.85			
C	Thalassoma duperrey	5	KO1	1	97.05			
C	Thalassoma duperrey	5	KO1	17	465.64			
C	Zanclus cornutus	5	KO1	1	24.04			
C	Sufflamen bursa	5	KO1	4	343.49	643	37483.91	75.1
CF	Chaetodon ornatissimus	5	KO1	2	138.00			
CF	Chaetodon quadrimaculatus	5	KO1	1	25.30			
CF	Chaetodon multicinctus	5	KO1	4	52.12	7	215.43	0.4
H	Scarus sordidus	5	KO1	1	140.01			
H	Scarus psittacus	5	KO1	1	554.69			
H	Acanthurus triostegus	5	KO1	3	300.04			
H	Acanthurus nigrofuscus	5	KO1	29	693.01			
H	Acanthurus nigrofuscus	5	KO1	12	90.30			
H	Acanthurus nigroris	5	KO1	1	738.84			
H	Acanthurus glaucopareius	5	KO1	2	123.06			
H	Ctenochaetus strigosus	5	KO1	56	3688.44			
H	Ctenochaetus strigosus	5	KO1	27	3567.61			
H	Ctenochaetus strigosus	5	KO1	18	483.19			
H	Zebrasoma flavescens	5	KO1	4	37.94			
H	Zebrasoma flavescens	5	KO1	11	586.08			
H	Zebrasoma flavescens	5	KO1	4	104.12	169	11107.32	22.2
O	Stegastes fasciolatus	5	KO1	3	77.94			
O	Melichthys niger	5	KO1	5	816.68			
O	Canthigaster jactator	5	KO1	3	10.69	11	905.30	1.8
P	Abudefduf abdominalis	5	KO1	7	219.33	7	219.33	0.4
	TOTAL	5	KO1	837	49931.29	837	49931.29	100
C	Forcipiger flavissimus	6	KO2	2	18.30			
C	Plectroglyphidodon johnstonianu	6	KO2	4	6.89			
C	Thalassoma duperrey	6	KO2	4	388.21			
C	Thalassoma duperrey	6	KO2	11	604.44			
C	Thalassoma duperrey	6	KO2	13	145.12			
C	Thalassoma duperrey	6	KO2	26	712.15			
C	Gomphosus varius	6	KO2	1	39.39			
C	Gomphosus varius	6	KO2	5	55.21			
C	Stethojulis balteata	6	KO2	3	107.29			
C	Zanclus cornutus	6	KO2	4	416.63			
C	Sufflamen bursa	6	KO2	1	85.87	74	2579.51	6.5
CF	Chaetodon unimaculatus	6	KO2	6	151.82			
CF	Chaetodon multicinctus	6	KO2	6	78.18	12	230.01	0.6
H	Acanthurus triostegus	6	KO2	3	138.95			
H	Acanthurus triostegus	6	KO2	9	900.13			
H	Acanthurus nigrofuscus	6	KO2	5	37.62			
H	Acanthurus nigrofuscus	6	KO2	25	597.43			
H	Acanthurus nigroris	6	KO2	13	7113.50			
H	Acanthurus olivaceus	6	KO2	32	18021.45			
H	Acanthurus olivaceus	6	KO2	6	2359.26			
H	Acanthurus olivaceus	6	KO2	11	2878.34			
H	Acanthurus glaucopareius	6	KO2	1	61.53			
H	Ctenochaetus strigosus	6	KO2	14	922.11			
H	Ctenochaetus strigosus	6	KO2	16	2114.14			
H	Zebrasoma flavescens	6	KO2	5	47.42			
H	Zebrasoma flavescens	6	KO2	2	106.56			
H	Zebrasoma flavescens	6	KO2	6	156.18			
H	Naso lituratus	6	KO2	1	622.36	149	36076.96	91.2
O	Melichthys niger	6	KO2	4	653.34			
O	Canthigaster jactator	6	KO2	3	10.69	7	664.03	1.7
	TOTAL	6	KO2	242	39550.50	242	39550.50	100

GRP	18-May-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Monotaxis grandoculis	7	KAHE1D	1	34.79			
C	Mulloides flavolineatus	7	KAHE1D	48	6253.40			
C	Parupeneus multifasciatus	7	KAHE1D	2	108.80			
C	Plectroglyphidodon johnstonianu	7	KAHE1D	1	3.03			
C	Paracirrhites forsteri	7	KAHE1D	1	39.65			
C	Bodianus bilunulatus	7	KAHE1D	1	37.87			
C	Labroides phthirophagus	7	KAHE1D	1	0.63			
C	Thalassoma duperrey	7	KAHE1D	16	438.25			
C	Thalassoma duperrey	7	KAHE1D	26	1428.67			
C	Thalassoma duperrey	7	KAHE1D	12	1164.62			
C	Gomphosus varius	7	KAHE1D	10	110.42			
C	Gomphosus varius	7	KAHE1D	5	113.00			
C	Zanclus cornutus	7	KAHE1D	1	104.16			
C	Rhinecanthus rectangulus	7	KAHE1D	2	90.72			
C	Sufflamen bursa	7	KAHE1D	1	85.87			
C	Sufflamen bursa	7	KAHE1D	5	226.81	133	10240.70	49.5
CF	Chaetodon ornatissimus	7	KAHE1D	2	138.00			
CF	Chaetodon quadrimaculatus	7	KAHE1D	1	25.30	3	163.31	0.8
H	Scarus psittacus	7	KAHE1D	7	102.30			
H	Scarus psittacus	7	KAHE1D	2	75.75			
H	Acanthurus nigrofuscus	7	KAHE1D	31	233.26			
H	Acanthurus nigrofuscus	7	KAHE1D	68	1625.00			
H	Ctenochaetus strigosus	7	KAHE1D	25	1646.62			
H	Ctenochaetus strigosus	7	KAHE1D	38	1020.07	171	4703.00	22.7
O	Stegastes fasciolatus	7	KAHE1D	3	77.94			
O	Melichthys niger	7	KAHE1D	25	4083.39			
O	Melichthys niger	7	KAHE1D	14	1395.17			
O	Canthigaster jactator	7	KAHE1D	3	10.69	45	5567.19	26.9
	TOTAL	7	KAHE1D	352	20674.19	352	20674.19	100
C	Mulloides flavolineatus	8	KAHE5B	25	3256.98			
C	Parupeneus multifasciatus	8	KAHE5B	1	155.42			
C	Parupeneus multifasciatus	8	KAHE5B	1	235.75			
C	Paracirrhites arcatus	8	KAHE5B	2	16.24			
C	Labroides phthirophagus	8	KAHE5B	1	1.49			
C	Thalassoma duperrey	8	KAHE5B	2	194.10			
C	Thalassoma duperrey	8	KAHE5B	10	549.49			
C	Thalassoma duperrey	8	KAHE5B	9	246.51			
C	Gomphosus varius	8	KAHE5B	2	45.20			
C	Stethojulis balteata	8	KAHE5B	1	72.39			
C	Macropharyngodon geoffroy	8	KAHE5B	1	18.63			
C	Halichoeres ornatissimus	8	KAHE5B	3	75.41			
C	Zanclus cornutus	8	KAHE5B	2	208.32			
C	Rhinecanthus rectangulus	8	KAHE5B	2	171.75			
C	Sufflamen bursa	8	KAHE5B	5	429.37	67	5677.04	23.7
CF	Chaetodon quadrimaculatus	8	KAHE5B	1	25.30			
CF	Chaetodon multicinctus	8	KAHE5B	2	26.06	3	51.36	0.2
H	Scarus sordidus	8	KAHE5B	1	1427.57			
H	Acanthurus nigrofuscus	8	KAHE5B	20	477.94			
H	Acanthurus nigrofuscus	8	KAHE5B	271	14702.42			
H	Naso lituratus	8	KAHE5B	1	205.99	293	16813.92	70.2
O	Stegastes fasciolatus	8	KAHE5B	5	129.90			
O	Cantherhines sandwichiensis	8	KAHE5B	1	82.05			
O	Canthigaster jactator	8	KAHE5B	3	22.77	9	234.73	1.0
P	Chromis vanderbilti	8	KAHE5B	46	14.53			
P	Naso brevirostris	8	KAHE5B	6	1144.46	52	1158.99	4.8
	TOTAL	8	KAHE5B	424	23936.04	424	23936.04	100

GRP	18-May-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Caranx melampygus	9	KAHE7B	1	680.39			
C	Lutjanus kasmira	9	KAHE7B	13	3992.13			
C	Parupeneus multifasciatus	9	KAHE7B	1	27.12			
C	Parupeneus multifasciatus	9	KAHE7B	1	96.08			
C	Thalassoma duperrey	9	KAHE7B	11	301.30			
C	Thalassoma duperrey	9	KAHE7B	1	97.05			
C	Thalassoma duperrey	9	KAHE7B	2	109.90			
C	Coris venusta	9	KAHE7B	2	47.27			
C	Halichoeres ornatissimus	9	KAHE7B	1	16.45			
C	Sufflamen bursa	9	KAHE7B	3	257.62			
C	Sufflamen bursa	9	KAHE7B	4	578.60			
C	Sufflamen fraenatus	9	KAHE7B	1	85.87	41	6289.77	71.5
CF	Chaetodon ornatissimus	9	KAHE7B	1	8.22	1	8.22	0.1
H	Scarus sordidus	9	KAHE7B	1	1427.57			
H	Scarus sordidus	9	KAHE7B	1	544.57			
H	Acanthurus nigrofuscus	9	KAHE7B	2	108.50			
H	Acanthurus olivaceus	9	KAHE7B	2	187.54			
H	Naso lituratus	9	KAHE7B	2	145.17	8	2413.35	27.4
P	Chaetodon kleini	9	KAHE7B	5	32.79			
P	Dascyllus albisella	9	KAHE7B	12	37.06			
P	Chromis vanderbilti	9	KAHE7B	66	20.85	83	90.70	1.0
	TOTAL	9	KAHE7B	133	8802.04	133	8802.04	100
C	Parupeneus multifasciatus	10	KAHE7C	1	96.08			
C	Parupeneus multifasciatus	10	KAHE7C	2	310.84			
C	Parupeneus multifasciatus	10	KAHE7C	4	217.60			
C	Forcipiger flavissimus	10	KAHE7C	1	2.53			
C	Thalassoma duperrey	10	KAHE7C	1	54.95			
C	Thalassoma duperrey	10	KAHE7C	6	582.31			
C	Stethojulis balteata	10	KAHE7C	1	72.39			
C	Zanclus cornutus	10	KAHE7C	1	104.16			
C	Sufflamen bursa	10	KAHE7C	7	601.11	24	2041.98	57.1
CF	Pervagor spilosoma	10	KAHE7C	1	16.22	1	16.22	0.5
H	Acanthurus nigrofuscus	10	KAHE7C	3	162.76			
H	Acanthurus olivaceus	10	KAHE7C	2	786.42			
H	Naso lituratus	10	KAHE7C	1	36.34			
H	Naso lituratus	10	KAHE7C	1	205.99			
H	Naso unicornis	10	KAHE7C	1	278.71	8	1470.22	41.1
O	Canthigaster jactator	10	KAHE7C	1	7.59	1	7.59	0.2
P	Chaetodon kleini	10	KAHE7C	2	13.12			
P	Dascyllus albisella	10	KAHE7C	5	15.44			
P	Chromis vanderbilti	10	KAHE7C	30	9.48	37	38.03	1.1
	TOTAL	10	KAHE7C	71	3574.03	71	3574.03	100
C	Sufflamen bursa	11	KAHE7D	3	433.95	3	433.95	71.7
H	Acanthurus olivaceus	11	KAHE7D	1	163.52	1	163.52	27.0
O	Canthigaster jactator	11	KAHE7D	1	7.59	1	7.59	1.3
	TOTAL	11	KAHE7D	5	605.06	5	605.06	100

GRP	18-May-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Parupeneus multifasciatus	12	KAHE7E	8	216.93			
C	Paracirrhites arcatus	12	KAHE7E	1	3.45			
C	Thalassoma duperrey	12	KAHE7E	3	9.45			
C	Thalassoma duperrey	12	KAHE7E	3	33.49			
C	Thalassoma duperrey	12	KAHE7E	3	82.17			
C	Coris gaimard	12	KAHE7E	1	139.13			
C	Macropharyngodon geoffroy	12	KAHE7E	1	5.75			
C	Sufflamen bursa	12	KAHE7E	2	171.75	22	662.12	27.4
CF	Chaetodon multicinctus	12	KAHE7E	3	2.48	3	2.48	0.1
H	Acanthurus triostegus	12	KAHE7E	7	700.10			
H	Acanthurus nigrofuscus	12	KAHE7E	5	37.62			
H	Acanthurus nigrofuscus	12	KAHE7E	3	3.13			
H	Acanthurus nigrofuscus	12	KAHE7E	2	47.79			
H	Ctenochaetus strigosus	12	KAHE7E	2	1.74	19	790.39	32.7
O	Melichthys niger	12	KAHE7E	5	816.68			
O	Melichthys vidua	12	KAHE7E	1	124.35	6	941.02	38.9
P	Chromis vanderbilti	12	KAHE7E	75	23.69	75	23.69	1.0
	TOTAL	12	KAHE7E	125	2419.70	125	2419.70	100
C	Decapterus macarellus	13	KAHE10	45	5862.56			
C	Lutjanus kasmira	13	KAHE10	240	13764.61			
C	Lutjanus kasmira	13	KAHE10	145	15944.01			
C	Mulloides vanicolensis	13	KAHE10	25	3706.79			
C	Parupeneus multifasciatus	13	KAHE10	1	96.08			
C	Paracirrhites arcatus	13	KAHE10	1	8.12			
C	Labroides phthirophagus	13	KAHE10	1	1.49			
C	Thalassoma duperrey	13	KAHE10	14	1358.73			
C	Thalassoma duperrey	13	KAHE10	8	219.12			
C	Thalassoma duperrey	13	KAHE10	7	384.64			
C	Thalassoma duperrey	13	KAHE10	6	66.98			
C	Zanclus cornutus	13	KAHE10	1	104.16			
C	Rhinecanthus rectangulus	13	KAHE10	2	171.75			
C	Sufflamen bursa	13	KAHE10	8	686.99			
C	Sufflamen fraenatus	13	KAHE10	1	144.65	505	42520.66	85.8
CF	Chaetodon multicinctus	13	KAHE10	2	26.06	2	26.06	0.1
H	Acanthurus triostegus	13	KAHE10	2	92.63			
H	Acanthurus leucopareius	13	KAHE10	1	66.74			
H	Acanthurus nigrofuscus	13	KAHE10	20	1085.05			
H	Acanthurus nigrofuscus	13	KAHE10	14	334.56			
H	Acanthurus olivaceus	13	KAHE10	1	93.77			
H	Acanthurus olivaceus	13	KAHE10	2	523.33			
H	Ctenochaetus strigosus	13	KAHE10	3	80.53			
H	Naso lituratus	13	KAHE10	2	145.17			
H	Naso lituratus	13	KAHE10	1	205.99	46	2627.77	5.3
O	Melichthys niger	13	KAHE10	16	2613.37			
O	Melichthys vidua	13	KAHE10	1	199.03			
O	Canthigaster jactator	13	KAHE10	2	15.18	19	2827.58	5.7
P	Dascyllus albisella	13	KAHE10	45	138.97			
P	Abudefduf abdominalis	13	KAHE10	21	657.98			
P	Abudefduf vaigensis	13	KAHE10	12	375.99			
P	Chromis vanderbilti	13	KAHE10	14	4.42			
P	Chromis ovalis	13	KAHE10	60	355.91	152	1533.28	3.1
	TOTAL	13	KAHE10	724	49535.35	724	49535.35	100

GRP	18-May-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Parupeneus multifasciatus	14	NANA1	1	96.08			
C	Parupeneus multifasciatus	14	NANA1	2	108.80			
C	Parupeneus multifasciatus	14	NANA1	2	54.23			
C	Plectroglyphidodon imparipennis	14	NANA1	8	6.90			
C	Paracirrhites arcatus	14	NANA1	1	3.45			
C	Thalassoma duperrey	14	NANA1	10	111.63			
C	Thalassoma duperrey	14	NANA1	5	274.74			
C	Thalassoma duperrey	14	NANA1	7	191.73			
C	Thalassoma duperrey	14	NANA1	3	9.45			
C	Stethojulis balteata	14	NANA1	1	35.76			
C	Halichoeres ornatissimus	14	NANA1	2	2.36			
C	Plagiotremus ewaensis	14	NANA1	2	1.90	44	897.05	78.2
H	Acanthurus triostegus	14	NANA1	1	4.24			
H	Acanthurus nigrofuscus	14	NANA1	2	15.05			
H	Acanthurus nigrofuscus	14	NANA1	1	54.25			
H	Acanthurus nigrofuscus	14	NANA1	1	23.90			
H	Acanthurus olivaceus	14	NANA1	4	78.97			
H	Naso lituratus	14	NANA1	1	72.58	10	248.99	21.7
P	Chromis vanderbilti	14	NANA1	3	0.95	3	0.95	0.1
	TOTAL	14	NANA1	57	1146.99	57	1146.99	100
C	Lutjanus fulvus	15	NANA2	1	221.56			
C	Lutjanus fulvus	15	NANA2	1	303.92			
C	Monotaxis grandoculis	15	NANA2	1	71.53			
C	Bodianus bilunulatus	15	NANA2	1	133.12			
C	Labroides phthirophagus	15	NANA2	2	2.98			
C	Thalassoma duperrey	15	NANA2	5	485.26			
C	Thalassoma duperrey	15	NANA2	4	219.80			
C	Stethojulis balteata	15	NANA2	4	143.05			
C	Halichoeres ornatissimus	15	NANA2	1	25.14			
C	Sufflamen bursa	15	NANA2	3	257.62			
C	Ostracion meleagris	15	NANA2	1	6.76	24	1870.73	4.4
CF	Chaetodon ornatissimus	15	NANA2	4	276.01	4	276.01	0.6
H	Calotomus carolinus	15	NANA2	1	707.00			
H	Acanthurus triostegus	15	NANA2	6	600.09			
H	Acanthurus leucopareius	15	NANA2	25	3317.51			
H	Acanthurus leucopareius	15	NANA2	40	9307.01			
H	Acanthurus nigrofuscus	15	NANA2	17	922.29			
H	Acanthurus nigrofuscus	15	NANA2	7	167.28			
H	Acanthurus nigroris	15	NANA2	20	5346.97			
H	Acanthurus olivaceus	15	NANA2	35	19710.96			
H	Ctenochaetus strigosus	15	NANA2	3	22.73			
H	Ctenochaetus strigosus	15	NANA2	4	107.38			
H	Ctenochaetus strigosus	15	NANA2	1	65.86	159	40275.08	94.1
O	Chaetodon ephippium	15	NANA2	2	96.78			
O	Stegastes fasciolatus	15	NANA2	1	126.58			
O	Melichthys niger	15	NANA2	1	163.34	4	386.70	0.9
P	Chromis vanderbilti	15	NANA2	23	7.27			
P	Chromis hanui	15	NANA2	1	0.75	24	8.01	0.02
	TOTAL	15	NANA2	215	42816.52	215	42816.52	100

GRP	18-May-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Sargocentron diadema	16	PIPE	7	768.68			
C	Myripristis amaenus	16	PIPE	15	636.05			
C	Aulostomus chinensis	16	PIPE	1	88.50			
C	Lutjanus kasmira	16	PIPE	2	614.17			
C	Mulloides vanicolensis	16	PIPE	250	116060.32			
C	Parupeneus pleurostigma	16	PIPE	1	98.25			
C	Parupeneus multifasciatus	16	PIPE	3	466.27			
C	Parupeneus multifasciatus	16	PIPE	3	163.20			
C	Forcipiger flavissimus	16	PIPE	4	36.60			
C	Chaetodon fremblii	16	PIPE	1	20.91			
C	Plectroglyphidodon johnstonianu	16	PIPE	4	12.12			
C	Paracirrhites arcatus	16	PIPE	6	98.09			
C	Paracirrhites forsteri	16	PIPE	1	39.65			
C	Cirrhitops fasciatus	16	PIPE	4	62.51			
C	Pseudocheilinus octotaenia	16	PIPE	3	107.29			
C	Thalassoma duperrey	16	PIPE	29	1593.52			
C	Thalassoma duperrey	16	PIPE	66	6405.43			
C	Thalassoma duperrey	16	PIPE	7	191.73			
C	Gomphosus varius	16	PIPE	9	203.41			
C	Gomphosus varius	16	PIPE	3	186.09			
C	Macropharyngodon geoffroy	16	PIPE	2	37.26			
C	Halichoeres ornatissimus	16	PIPE	5	82.25			
C	Zanclus cornutus	16	PIPE	3	312.47			
C	Sufflamen bursa	16	PIPE	7	601.11			
C	Sufflamen fraenatus	16	PIPE	1	144.65	437	129030.52	63.9
CF	Chaetodon multicinctus	16	PIPE	4	52.12			
CF	Exallias brevis	16	PIPE	2	98.69			
CF	Pervagor melanocephalus	16	PIPE	5	81.09	11	231.90	0.1
H	Calotomus carolinus	16	PIPE	1	707.00			
H	Scarus sordidus	16	PIPE	45	6300.27			
H	Scarus sordidus	16	PIPE	105	38537.26			
H	Scarus sordidus	16	PIPE	40	9385.96			
H	Scarus sordidus	16	PIPE	12	9300.82			
H	Scarus psittacus	16	PIPE	39	569.96			
H	Acanthurus nigrofuscus	16	PIPE	27	1464.82			
H	Acanthurus nigrofuscus	16	PIPE	62	1481.62			
H	Naso lituratus	16	PIPE	3	934.84	334	68682.54	34.0
O	Stegastes fasciolatus	16	PIPE	14	363.72			
O	Melichthys niger	16	PIPE	5	816.68			
O	Cantherhines sandwichiensis	16	PIPE	1	82.05			
O	Canthigaster jactator	16	PIPE	4	30.36	24	1292.82	0.6
P	Chaetodon kleini	16	PIPE	15	98.37			
P	Chaetodon miliaris	16	PIPE	1	6.56			
P	Chaetodon miliaris	16	PIPE	4	84.67			
P	Dascyllus albisella	16	PIPE	52	160.59			
P	Abudefduf vaigensis	16	PIPE	25	783.31			
P	Chromis ovalis	16	PIPE	75	444.88			
P	Chromis hanui	16	PIPE	7	1108.86	179	2687.25	1.3
	TOTAL	16	PIPE	985	201925.02	985	201925.02	100

2 JUNE 2017 FIELD DATA

GRP	02-Jun-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Parupeneus multifasciatus	1	EAST1	2	471.50			
C	Plectroglyphidodon imparipennis	1	EAST1	2	1.72			
C	Paracirrhites arcatus	1	EAST1	3	49.05			
C	Labroides phthirophagus	1	EAST1	3	4.46			
C	Thalassoma duperrey	1	EAST1	12	328.69			
C	Thalassoma duperrey	1	EAST1	10	970.52			
C	Thalassoma duperrey	1	EAST1	10	31.51			
C	Thalassoma duperrey	1	EAST1	10	111.63			
C	Thalassoma duperrey	1	EAST1	15	824.23			
C	Halichoeres ornatissimus	1	EAST1	2	8.82			
C	Halichoeres ornatissimus	1	EAST1	2	50.27			
C	Plagiotremus goslinei	1	EAST1	1	0.95			
C	Rhinecanthus rectangulus	1	EAST1	8	686.99			
C	Sufflamen fraenatus	1	EAST1	2	289.30			
C	Ostracion meleagris	1	EAST1	1	6.76	83	3836.40	8.6
CF	Chaetodon unimaculatus	1	EAST1	2	50.61			
CF	Chaetodon quadrimaculatus	1	EAST1	3	75.91	5	126.52	0.3
H	Acanthurus triostegus	1	EAST1	98	9801.40			
H	Acanthurus leucopareius	1	EAST1	5	1163.38			
H	Acanthurus leucopareius	1	EAST1	3	1122.19			
H	Acanthurus leucopareius	1	EAST1	5	663.50			
H	Acanthurus nigrofuscus	1	EAST1	15	358.46			
H	Acanthurus nigrofuscus	1	EAST1	33	1790.33			
H	Acanthurus nigroris	1	EAST1	5	6211.34			
H	Acanthurus nigroris	1	EAST1	7	5171.86			
H	Acanthurus olivaceus	1	EAST1	3	2329.81			
H	Acanthurus olivaceus	1	EAST1	14	7884.38			
H	Acanthurus dussumieri	1	EAST1	2	653.19			
H	Acanthurus blochii	1	EAST1	3	2351.43			
H	Ctenochaetus strigosus	1	EAST1	3	80.53			
H	Zebrasoma flavescens	1	EAST1	2	106.56			
H	Naso lituratus	1	EAST1	1	127.73	199	39816.09	89.6
O	Melichthys vidua	1	EAST1	3	597.09			
O	Canthigaster jactator	1	EAST1	4	30.36			
O	Canthigaster rivulata	1	EAST1	1	22.05	8	649.50	1.5
P	Chromis vanderbilti	1	EAST1	105	33.17	105	33.17	0.1
	TOTAL	1	EAST1	400	44461.6859	400	44461.686	100
C	Cephalopholis argus	2	EAST2	1	1676.50			
C	Cephalopholis argus	2	EAST2	1	1077.13			
C	Parupeneus multifasciatus	2	EAST2	1	54.40			
C	Plectroglyphidodon johnstonianus	2	EAST2	1	0.86			
C	Plectroglyphidodon imparipennis	2	EAST2	2	1.72			
C	Paracirrhites arcatus	2	EAST2	1	16.35			
C	Paracirrhites arcatus	2	EAST2	1	8.12			
C	Thalassoma duperrey	2	EAST2	2	194.10			
C	Thalassoma duperrey	2	EAST2	19	1044.03			
C	Thalassoma duperrey	2	EAST2	15	410.86			
C	Thalassoma duperrey	2	EAST2	22	245.59			
C	Gomphosus varius	2	EAST2	3	33.12			
C	Coris gaimard	2	EAST2	1	139.13			
C	Rhinecanthus rectangulus	2	EAST2	2	90.72			
C	Rhinecanthus rectangulus	2	EAST2	4	343.49			
C	Sufflamen bursa	2	EAST2	1	45.36			
C	Sufflamen fraenatus	2	EAST2	1	329.34			
C	Sufflamen fraenatus	2	EAST2	2	289.30	80	6000.14	20.7
CF	Chaetodon ornatissimus	2	EAST2	4	276.01	4	276.01	1.0
H	Acanthurus nigrofuscus	2	EAST2	7	167.28			
H	Acanthurus nigrofuscus	2	EAST2	5	37.62			
H	Acanthurus nigrofuscus	2	EAST2	5	271.26			
H	Acanthurus olivaceus	2	EAST2	17	2779.78			
H	Acanthurus olivaceus	2	EAST2	18	7077.78			
H	Acanthurus olivaceus	2	EAST2	20	11263.41			
H	Ctenochaetus strigosus	2	EAST2	2	53.69			
H	Ctenochaetus strigosus	2	EAST2	3	197.59			
H	Zebrasoma flavescens	2	EAST2	4	213.12			
H	Naso lituratus	2	EAST2	1	311.61	82	22373.15	77.1
O	Melichthys niger	2	EAST2	2	326.67			
O	Canthigaster jactator	2	EAST2	3	22.77	5	349.44	1.2
P	Chromis vanderbilti	2	EAST2	54	17.06	54	17.06	0.1
	TOTAL	2	EAST2	225	29015.7948	225	29015.795	100

GRP	02-Jun-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Parupeneus multifasciatus	3	EAST3	1	27.12			
C	Forcipiger flavissimus	3	EAST3	2	18.30			
C	Plectroglyphidodon johnstonianu	3	EAST3	1	1.72			
C	Paracirrhites arcatus	3	EAST3	2	32.70			
C	Paracirrhites arcatus	3	EAST3	1	3.45			
C	Bodianus bilunulatus	3	EAST3	1	1141.37			
C	Thalassoma duperrey	3	EAST3	20	1098.98			
C	Thalassoma duperrey	3	EAST3	2	194.10			
C	Thalassoma duperrey	3	EAST3	12	133.96			
C	Thalassoma duperrey	3	EAST3	8	219.12			
C	Gomphosus varius	3	EAST3	2	22.08			
C	Gomphosus varius	3	EAST3	1	39.39			
C	Stethojulis balteata	3	EAST3	2	71.53			
C	Macropharyngodon geoffroy	3	EAST3	1	5.75			
C	Halichoeres ornatissimus	3	EAST3	2	50.27			
C	Halichoeres ornatissimus	3	EAST3	1	35.54			
C	Halichoeres ornatissimus	3	EAST3	1	9.52			
C	Sufflamen bursa	3	EAST3	1	85.87	61	3190.79	53.8
CF	Chaetodon multicinctus	3	EAST3	4	52.12	4	52.12	0.9
H	Scarus psittacus	3	EAST3	4	151.49			
H	Scarus rubroviolaceus	3	EAST3	1	85.39			
H	Acanthurus nigrofuscus	3	EAST3	5	271.26			
H	Acanthurus nigrofuscus	3	EAST3	29	693.01			
H	Acanthurus nigrofuscus	3	EAST3	19	142.97			
H	Ctenochaetus strigosus	3	EAST3	2	53.69			
H	Ctenochaetus strigosus	3	EAST3	9	68.18			
H	Naso lituratus	3	EAST3	2	255.47			
H	Naso lituratus	3	EAST3	1	311.61	72	2033.08	34.3
O	Stegastes fasciolatus	3	EAST3	2	51.96			
O	Melichthys vidua	3	EAST3	3	597.09	5	649.05	10.9
P	Chromis vanderbilti	3	EAST3	21	6.63	21	6.63	0.1
	TOTAL	3	EAST3	163	5931.6747	163	5931.6747	100
C	Cephalopholis argus	4	EAST4	1	336.42			
C	Plectroglyphidodon johnstonianu	4	EAST4	3	5.17			
C	Plectroglyphidodon imparipennis	4	EAST4	1	0.86			
C	Paracirrhites arcatus	4	EAST4	5	40.59			
C	Bodianus bilunulatus	4	EAST4	1	467.86			
C	Thalassoma duperrey	4	EAST4	16	438.25			
C	Thalassoma duperrey	4	EAST4	22	245.59			
C	Thalassoma duperrey	4	EAST4	3	291.16			
C	Thalassoma duperrey	4	EAST4	14	769.28			
C	Macropharyngodon geoffroy	4	EAST4	2	11.50			
C	Halichoeres ornatissimus	4	EAST4	4	100.55			
C	Halichoeres ornatissimus	4	EAST4	2	19.05			
C	Plagiotremus ewaensis	4	EAST4	2	1.90			
C	Rhinecanthus rectangulus	4	EAST4	1	85.87			
C	Sufflamen fraenatus	4	EAST4	1	224.79	78	3038.84	10.1
CF	Chaetodon ornatissimus	4	EAST4	2	138.00	2	138.00	0.5
H	Acanthurus triostegus	4	EAST4	18	1800.26			
H	Acanthurus nigrofuscus	4	EAST4	9	67.72			
H	Acanthurus nigrofuscus	4	EAST4	5	271.26			
H	Acanthurus nigrofuscus	4	EAST4	7	167.28			
H	Acanthurus olivaceus	4	EAST4	27	7065.01			
H	Acanthurus olivaceus	4	EAST4	17	9573.89			
H	Acanthurus olivaceus	4	EAST4	3	281.31			
H	Naso lituratus	4	EAST4	4	510.94			
H	Naso lituratus	4	EAST4	14	1016.19			
H	Naso lituratus	4	EAST4	1	311.61	105	21065.47	70.0
O	Melichthys niger	4	EAST4	13	1295.52			
O	Melichthys niger	4	EAST4	25	4083.39			
O	Melichthys vidua	4	EAST4	2	398.06			
O	Canthigaster jactator	4	EAST4	1	7.59	41	5784.55	19.2
P	Chromis vanderbilti	4	EAST4	195	61.60	195	61.60	0.2
	TOTAL	4	EAST4	421	30088.4679	421	30088.468	100

GRP	02-Jun-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Lutjanus kasmira	5	KO1	345	37935.75			
C	Lutjanus kasmira	5	KO1	115	21924.39			
C	Lutjanus kasmira	5	KO1	45	2580.86			
C	Parupeneus multifasciatus	5	KO1	1	155.42			
C	Parupeneus bifasciatus	5	KO1	1	59.77			
C	Parupeneus bifasciatus	5	KO1	1	176.01			
C	Chaetodon ephippium	5	KO1	2	96.78			
C	Plectroglyphidodon johnstonianu	5	KO1	4	12.12			
C	Labroides phthirophagus	5	KO1	1	1.49			
C	Thalassoma duperrey	5	KO1	25	1373.72			
C	Thalassoma duperrey	5	KO1	23	629.98			
C	Thalassoma duperrey	5	KO1	16	178.61			
C	Thalassoma duperrey	5	KO1	5	485.26			
C	Thalassoma ballieui	5	KO1	1	167.53			
C	Gomphosus varius	5	KO1	7	77.29			
C	Sufflamen bursa	5	KO1	1	85.87	593	65940.85	80.4
CF	Chaetodon multicinctus	5	KO1	6	78.18	6	78.18	0.1
H	Scarus sordidus	5	KO1	1	775.07			
H	Scarus sordidus	5	KO1	2	280.01			
H	Scarus sordidus	5	KO1	1	367.02			
H	Scarus rubroviolaceus	5	KO1	1	147.03			
H	Acanthurus leucopareius	5	KO1	2	133.48			
H	Acanthurus leucopareius	5	KO1	3	398.10			
H	Acanthurus nigrofuscus	5	KO1	5	271.26			
H	Acanthurus nigrofuscus	5	KO1	21	158.02			
H	Acanthurus nigrofuscus	5	KO1	73	1744.48			
H	Acanthurus olivaceus	5	KO1	12	4718.52			
H	Ctenochaetus strigosus	5	KO1	22	1449.03			
H	Ctenochaetus strigosus	5	KO1	16	2114.14			
H	Ctenochaetus strigosus	5	KO1	19	510.03			
H	Zebrasoma flavescens	5	KO1	3	28.45			
H	Zebrasoma flavescens	5	KO1	7	372.96	188	13467.61	16.4
O	Stegastes fasciolatus	5	KO1	5	129.90			
O	Melichthys niger	5	KO1	12	1960.03	17	2089.93	2.5
P	Abudefduf abdominalis	5	KO1	13	407.32	13	407.32	0.5
	TOTAL	5	KO1	817	81983.8934	817	81983.893	100
C	Cephalopholis argus	6	KO2	1	471.73			
C	Parupeneus multifasciatus	6	KO2	2	108.80			
C	Plectroglyphidodon johnstonianu	6	KO2	4	12.12			
C	Paracirrhites arcatus	6	KO2	2	32.70			
C	Thalassoma duperrey	6	KO2	2	194.10			
C	Thalassoma duperrey	6	KO2	7	78.14			
C	Thalassoma duperrey	6	KO2	5	136.95			
C	Thalassoma duperrey	6	KO2	7	384.64			
C	Gomphosus varius	6	KO2	2	22.08			
C	Coris gaimard	6	KO2	1	215.88			
C	Stethojulis balteata	6	KO2	1	35.76			
C	Zanclus cornutus	6	KO2	2	208.32			
C	Sufflamen bursa	6	KO2	1	85.87	37	1987.11	20.0
CF	Chaetodon unimaculatus	6	KO2	4	101.22			
CF	Chaetodon quadrimaculatus	6	KO2	2	50.61			
CF	Chaetodon multicinctus	6	KO2	2	26.06	8	177.89	1.8
H	Scarus psittacus	6	KO2	1	786.15			
H	Scarus rubroviolaceus	6	KO2	1	147.03			
H	Acanthurus nigrofuscus	6	KO2	71	1696.69			
H	Acanthurus nigrofuscus	6	KO2	5	271.26			
H	Acanthurus nigrofuscus	6	KO2	21	158.02			
H	Acanthurus olivaceus	6	KO2	3	1179.63			
H	Acanthurus glaucopareius	6	KO2	2	123.06			
H	Ctenochaetus strigosus	6	KO2	7	187.91			
H	Ctenochaetus strigosus	6	KO2	2	131.73			
H	Ctenochaetus strigosus	6	KO2	6	792.80			
H	Naso lituratus	6	KO2	1	205.99	120	5680.26	57.2
O	Melichthys niger	6	KO2	9	1470.02			
O	Melichthys vidua	6	KO2	3	597.09			
O	Canthigaster jactator	6	KO2	1	3.56	13	2070.67	20.9
P	Chromis vanderbilti	6	KO2	23	7.27	23	7.27	0.1
	TOTAL	6	KO2	201	9923.1938	201	9923.1938	100

GRP	02-Jun-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Myripristis amaenus	7	KAHE1D	18	763.26			
C	Mulloides flavolineatus	7	KAHE1D	50	6513.95			
C	Forcipiger flavissimus	7	KAHE1D	2	18.30			
C	Plectroglyphidodon johnstonianu	7	KAHE1D	4	12.12			
C	Paracirrhites arcatus	7	KAHE1D	3	24.35			
C	Cirrhitus pinnulatus	7	KAHE1D	1	17.81			
C	Thalassoma duperrey	7	KAHE1D	10	111.63			
C	Thalassoma duperrey	7	KAHE1D	28	766.93			
C	Thalassoma duperrey	7	KAHE1D	33	3202.72			
C	Thalassoma duperrey	7	KAHE1D	31	1703.42			
C	Gomphosus varius	7	KAHE1D	8	88.33			
C	Zanclus cornutus	7	KAHE1D	3	312.47			
C	Sufflamen bursa	7	KAHE1D	5	429.37	196	13964.67	38.7
CF	Chaetodon ornatissimus	7	KAHE1D	2	138.00			
CF	Cantherhines dumerili	7	KAHE1D	1	117.96	3	255.96	0.7
H	Acanthurus nigrofuscus	7	KAHE1D	39	2115.85			
H	Acanthurus nigrofuscus	7	KAHE1D	81	1935.66			
H	Ctenochaetus strigosus	7	KAHE1D	63	4149.49			
H	Ctenochaetus strigosus	7	KAHE1D	79	2120.67	262	10321.67	28.6
O	Melichthys niger	7	KAHE1D	70	11433.48			
O	Cantherhines sandwichiensis	7	KAHE1D	1	82.05			
O	Canthigaster jactator	7	KAHE1D	2	7.12	73	11522.66	31.9
	TOTAL	7	KAHE1D	534	36064.9590	534	36064.959	100
C	Monotaxis grandoculis	8	KAHE5B	1	71.53			
C	Mulloides flavolineatus	8	KAHE5B	1	365.21			
C	Forcipiger flavissimus	8	KAHE5B	2	18.30			
C	Plectroglyphidodon johnstonianu	8	KAHE5B	5	15.15			
C	Paracirrhites arcatus	8	KAHE5B	1	16.35			
C	Paracirrhites arcatus	8	KAHE5B	1	3.45			
C	Cirrhitops fasciatus	8	KAHE5B	1	8.23			
C	Thalassoma duperrey	8	KAHE5B	14	769.28			
C	Thalassoma duperrey	8	KAHE5B	12	133.96			
C	Thalassoma duperrey	8	KAHE5B	10	273.90			
C	Thalassoma duperrey	8	KAHE5B	9	873.47			
C	Gomphosus varius	8	KAHE5B	1	39.39			
C	Halichoeres ornatissimus	8	KAHE5B	1	25.14			
C	Rhinecanthus rectangulus	8	KAHE5B	1	45.36	60	2658.72	41.4
CF	Chaetodon multicinctus	8	KAHE5B	2	13.31	2	13.31	0.2
H	Calotomus carolinus	8	KAHE5B	1	1288.03			
H	Acanthurus nigrofuscus	8	KAHE5B	14	759.53			
H	Acanthurus nigrofuscus	8	KAHE5B	39	931.98			
H	Acanthurus nigrofuscus	8	KAHE5B	8	60.20			
H	Acanthurus olivaceus	8	KAHE5B	1	93.77			
H	Acanthurus olivaceus	8	KAHE5B	1	163.52			
H	Naso unicornis	8	KAHE5B	1	123.12	65	3420.15	53.3
O	Stegastes fasciolatus	8	KAHE5B	2	14.78			
O	Stegastes fasciolatus	8	KAHE5B	2	51.96			
O	Cantherhines sandwichiensis	8	KAHE5B	3	246.15	7	312.90	4.9
P	Chromis vanderbilti	8	KAHE5B	55	17.37	55	17.37	0.3
	TOTAL	8	KAHE5B	189	6422.4542	189	6422.4542	100

GRP	02-Jun-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Parupeneus multifasciatus	9	KAHE7B	1	155.42			
C	Forcipiger flavissimus	9	KAHE7B	1	9.15			
C	Chaetodon auriga	9	KAHE7B	2	96.78			
C	Thalassoma duperrey	9	KAHE7B	2	194.10			
C	Thalassoma duperrey	9	KAHE7B	1	3.15			
C	Thalassoma duperrey	9	KAHE7B	1	27.39			
C	Coris venusta	9	KAHE7B	2	96.76			
C	Zanclus cornutus	9	KAHE7B	3	312.47			
C	Sufflamen bursa	9	KAHE7B	3	257.62			
C	Sufflamen fraenatus	9	KAHE7B	1	85.87	17	1238.73	64.6
H	Acanthurus nigrofuscus	9	KAHE7B	7	379.77			
H	Naso lituratus	9	KAHE7B	2	145.17			
H	Naso unicornis	9	KAHE7B	2	146.72	11	671.65	35.1
O	Canthigaster jactator	9	KAHE7B	1	3.56	1	3.56	0.2
P	Chromis vanderbilti	9	KAHE7B	7	2.21	7	2.21	0.1
	TOTAL	9	KAHE7B	36	1916.1513	36	1916.1513	100
C	Parupeneus multifasciatus	10	KAHE7C	2	108.80			
C	Parupeneus multifasciatus	10	KAHE7C	2	310.84			
C	Forcipiger flavissimus	10	KAHE7C	3	27.45			
C	Paracirrhites arcatus	10	KAHE7C	1	16.35			
C	Thalassoma duperrey	10	KAHE7C	2	54.78			
C	Gomphosus varius	10	KAHE7C	1	39.39			
C	Stethojulis balteata	10	KAHE7C	1	72.39			
C	Sufflamen bursa	10	KAHE7C	6	515.24	18	1145.25	29.8
CF	Chaetodon multicinctus	10	KAHE7C	4	52.12	4	52.12	1.4
H	Calotomus carolinus	10	KAHE7C	1	707.00			
H	Acanthurus triostegus	10	KAHE7C	1	46.32			
H	Acanthurus nigrofuscus	10	KAHE7C	5	271.26			
H	Acanthurus olivaceus	10	KAHE7C	1	393.21			
H	Acanthurus olivaceus	10	KAHE7C	1	563.17			
H	Acanthurus olivaceus	10	KAHE7C	1	93.77			
H	Acanthurus olivaceus	10	KAHE7C	1	19.74			
H	Naso lituratus	10	KAHE7C	2	255.47			
H	Naso unicornis	10	KAHE7C	1	73.36			
H	Naso unicornis	10	KAHE7C	1	190.74	15	2614.04	68.1
O	Canthigaster jactator	10	KAHE7C	1	7.59	1	7.59	0.2
P	Chaetodon miliaris	10	KAHE7C	1	21.17	1	21.17	0.6
	TOTAL	10	KAHE7C	39	3840.1692	39	3840.1692	100
C	Parupeneus multifasciatus	11	KAHE7D	1	155.42			
C	Paracirrhites arcatus	11	KAHE7D	1	3.45			
C	Sufflamen bursa	11	KAHE7D	2	171.75	4	330.61	86.0
H	Acanthurus triostegus	11	KAHE7D	1	46.32	1	46.32	12.0
O	Canthigaster jactator	11	KAHE7D	1	7.59	1	7.59	2.0
	TOTAL	11	KAHE7D	6	384.520976	6	384.52098	100

GRP	02-Jun-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Parupeneus pleurostigma	12	KAHE7E	3	12.32			
C	Parupeneus multifasciatus	12	KAHE7E	7	189.82			
C	Parupeneus multifasciatus	12	KAHE7E	27	84.21			
C	Chaetodon auriga	12	KAHE7E	2	96.78			
C	Chaetodon lunula	12	KAHE7E	2	71.99			
C	Paracirrhites forsteri	12	KAHE7E	1	39.65			
C	Cirrhitops fasciatus	12	KAHE7E	1	3.75			
C	Thalassoma duperrey	12	KAHE7E	3	9.45			
C	Thalassoma duperrey	12	KAHE7E	2	194.10			
C	Coris venusta	12	KAHE7E	3	7.66			
C	Pseudojuloides cerasinus	12	KAHE7E	6	18.90			
C	Zanclus cornutus	12	KAHE7E	1	104.16			
C	Sufflamen bursa	12	KAHE7E	1	45.36			
C	Sufflamen bursa	12	KAHE7E	3	257.62	62	1135.78	19.9
CF	Chaetodon ornatissimus	12	KAHE7E	1	69.00			
CF	Chaetodon multicinctus	12	KAHE7E	2	1.65			
CF	Chaetodon multicinctus	12	KAHE7E	2	13.31	5	83.97	1.5
H	Calotomus carolinus	12	KAHE7E	1	34.69			
H	Acanthurus triostegus	12	KAHE7E	5	231.58			
H	Acanthurus nigrofuscus	12	KAHE7E	11	11.48			
H	Acanthurus nigrofuscus	12	KAHE7E	2	15.05			
H	Acanthurus olivaceus	12	KAHE7E	1	563.17			
H	Ctenochaetus strigosus	12	KAHE7E	9	7.84			
H	Zebrasoma flavescens	12	KAHE7E	12	20.26			
H	Naso lituratus	12	KAHE7E	1	448.94	42	1333.01	23.3
O	Melichthys niger	12	KAHE7E	12	1195.86			
O	Melichthys vidua	12	KAHE7E	1	199.03	13	1394.89	24.4
P	Chromis vanderbilti	12	KAHE7E	153	48.33			
P	Naso hexacanthus	12	KAHE7E	9	1716.70	162	1765.03	30.9
	TOTAL	12	KAHE7E	284	5712.66837	284	5712.6684	100
C	Aulostomus chinensis	13	KAHE10	1	210.62			
C	Lutjanus kasmira	13	KAHE10	195	11183.74			
C	Mulloides flavolineatus	13	KAHE10	1	269.34			
C	Mulloides vanicolensis	13	KAHE10	75	17048.77			
C	Parupeneus multifasciatus	13	KAHE10	1	155.42			
C	Parupeneus multifasciatus	13	KAHE10	3	288.24			
C	Parupeneus multifasciatus	13	KAHE10	2	108.80			
C	Chaetodon auriga	13	KAHE10	2	96.78			
C	Plectroglyphidodon imparipennis	13	KAHE10	1	0.86			
C	Thalassoma duperrey	13	KAHE10	8	219.12			
C	Thalassoma duperrey	13	KAHE10	30	1648.47			
C	Thalassoma duperrey	13	KAHE10	33	3202.72			
C	Thalassoma duperrey	13	KAHE10	8	89.31			
C	Gomphosus varius	13	KAHE10	1	62.03			
C	Zanclus cornutus	13	KAHE10	1	104.16			
C	Rhinecanthus rectangulus	13	KAHE10	1	85.87			
C	Sufflamen bursa	13	KAHE10	5	429.37	368	35203.61	81.6
CF	Chaetodon multicinctus	13	KAHE10	2	26.06	2	26.06	0.1
H	Calotomus carolinus	13	KAHE10	1	218.67			
H	Scarus psittacus	13	KAHE10	1	37.87			
H	Acanthurus nigrofuscus	13	KAHE10	23	1247.81			
H	Acanthurus nigrofuscus	13	KAHE10	23	549.63			
H	Acanthurus olivaceus	13	KAHE10	1	563.17			
H	Acanthurus olivaceus	13	KAHE10	2	94.95			
H	Naso lituratus	13	KAHE10	3	217.75	54	2929.86	6.8
O	Stegastes fasciolatus	13	KAHE10	4	103.92			
O	Melichthys niger	13	KAHE10	20	3266.71			
O	Melichthys vidua	13	KAHE10	1	124.35			
O	Melichthys vidua	13	KAHE10	1	199.03			
O	Cantherhines sandwichiensis	13	KAHE10	1	82.05			
O	Canthigaster jactator	13	KAHE10	1	7.59	28	3783.65	8.8
P	Dascyllus albisella	13	KAHE10	35	108.09			
P	Abudefduf abdominalis	13	KAHE10	22	689.32			
P	Abudefduf vaigensis	13	KAHE10	12	375.99			
P	Chromis vanderbilti	13	KAHE10	33	10.42	102	1183.82	2.7
	TOTAL	13	KAHE10	554	43127.0070	554	43127.007	100

GRP	02-Jun-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Plectroglyphidodon imparipennis	14	NANA1	9	7.76			
C	Thalassoma duperrey	14	NANA1	1	97.05			
C	Thalassoma duperrey	14	NANA1	2	22.33			
C	Thalassoma duperrey	14	NANA1	3	9.45			
C	Thalassoma duperrey	14	NANA1	5	274.74			
C	Thalassoma duperrey	14	NANA1	8	219.12			
C	Rhinecanthus rectangulus	14	NANA1	1	85.87	29	716.33	63.2
H	Acanthurus nigrofuscus	14	NANA1	1	23.90			
H	Acanthurus olivaceus	14	NANA1	1	393.21	2	417.11	36.8
	TOTAL	14	NANA1	31	1133.43785	31	1133.4379	100
C	Gymnomureana zebra	15	NANA2	1	35.12			
C	Monotaxis grandoculis	15	NANA2	2	69.58			
C	Parupeneus multifasciatus	15	NANA2	3	707.24			
C	Parupeneus multifasciatus	15	NANA2	1	27.12			
C	Parupeneus multifasciatus	15	NANA2	2	192.16			
C	Parupeneus cyclostomus	15	NANA2	1	24.80			
C	Parupeneus cyclostomus	15	NANA2	1	88.57			
C	Bodianus bilunulatus	15	NANA2	1	467.86			
C	Thalassoma duperrey	15	NANA2	9	494.54			
C	Thalassoma duperrey	15	NANA2	5	485.26			
C	Thalassoma duperrey	15	NANA2	6	164.34			
C	Thalassoma duperrey	15	NANA2	13	145.12			
C	Gomphosus varius	15	NANA2	3	33.12			
C	Coris gaimard	15	NANA2	1	8.57			
C	Sufflamen bursa	15	NANA2	4	343.49	53	3286.90	23.7
CF	Chaetodon ornatissimus	15	NANA2	2	138.00	2	138.00	1.0
H	Acanthurus triostegus	15	NANA2	7	700.10			
H	Acanthurus leucopareius	15	NANA2	13	867.63			
H	Acanthurus leucopareius	15	NANA2	25	3317.51			
H	Acanthurus nigrofuscus	15	NANA2	10	238.97			
H	Acanthurus olivaceus	15	NANA2	4	3106.42			
H	Ctenochaetus strigosus	15	NANA2	3	80.53			
H	Zebrasoma flavescens	15	NANA2	5	266.40			
H	Naso lituratus	15	NANA2	3	617.96	70	9195.52	66.2
O	Stegastes fasciolatus	15	NANA2	4	29.57			
O	Melichthys niger	15	NANA2	7	1143.35			
O	Cantherhines sandwichiensis	15	NANA2	1	82.05			
O	Canthigaster rivulata	15	NANA2	1	22.05	13	1277.02	9.2
	TOTAL	15	NANA2	138	13897.4457	138	13897.446	100

GRP	02-Jun-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Tylosurus crocodilus	16	PIPE	1	15141.93			
C	Myripristis amaena	16	PIPE	5	410.41			
C	Decapterus macarellus	16	PIPE	21	2735.86			
C	Lutjanus kasmira	16	PIPE	90	5161.73			
C	Lutjanus kasmira	16	PIPE	100	2585.73			
C	Lutjanus kasmira	16	PIPE	110	12095.46			
C	Mulloides flavolineatus	16	PIPE	15	4040.11			
C	Mulloides vanicolensis	16	PIPE	490	44363.30			
C	Forcipiger flavissimus	16	PIPE	2	18.30			
C	Labroides phthirophagus	16	PIPE	3	4.46			
C	Thalassoma duperrey	16	PIPE	93	5110.25			
C	Thalassoma duperrey	16	PIPE	91	8831.73			
C	Gomphosus varius	16	PIPE	3	67.80			
C	Coris venusta	16	PIPE	3	145.14			
C	Macropharyngodon geoffroy	16	PIPE	1	18.63			
C	Zanclus cornutus	16	PIPE	4	416.63			
C	Sufflamen bursa	16	PIPE	5	429.37	1037	101576.85	72.3
CF	Chaetodon multicinctus	16	PIPE	8	104.24			
CF	Pervagor melanocephalus	16	PIPE	2	32.43	10	136.68	0.1
H	Scarus sordidus	16	PIPE	21	7707.45			
H	Scarus sordidus	16	PIPE	15	1140.20			
H	Scarus sordidus	16	PIPE	3	4282.71			
H	Scarus sordidus	16	PIPE	10	7750.68			
H	Scarus sordidus	16	PIPE	9	2111.84			
H	Acanthurus nigrofuscus	16	PIPE	35	836.40			
H	Ctenochaetus strigosus	16	PIPE	20	1317.30			
H	Ctenochaetus strigosus	16	PIPE	21	563.72			
H	Naso lituratus	16	PIPE	3	217.75	137	25928.06	18.5
O	Stegastes fasciolatus	16	PIPE	13	337.74			
O	Melichthys niger	16	PIPE	12	1960.03			
O	Melichthys vidua	16	PIPE	1	124.35			
O	Canthigaster jactator	16	PIPE	3	22.77	29	2444.89	1.7
P	Chaetodon kleini	16	PIPE	6	39.35			
P	Chaetodon miliaris	16	PIPE	7	148.18			
P	Dascyllus albisella	16	PIPE	8	24.71			
P	Abudefduf abdominalis	16	PIPE	132	4135.90			
P	Abudefduf vaigensis	16	PIPE	167	5232.54			
P	Chromis vanderbilti	16	PIPE	20	6.32			
P	Chromis ovalis	16	PIPE	70	809.18			
P	Chromis agilis	16	PIPE	12	17.46	422	10413.63	7.4
	TOTAL	16	PIPE	1635	140500.0904	1635	140500.09	100

29 AUGUST 2017 FIELD DATA

GRP	29-Aug-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Parupeneus multifasciatus	1	EAST1	1	54.40			
C	Parupeneus multifasciatus	1	EAST1	2	54.23			
C	Chaetodon ephippium	1	EAST1	2	96.78			
C	Chaetodon lunula	1	EAST1	1	35.99			
C	Plectroglyphidodon imparipennis	1	EAST1	2	1.72			
C	Paracirrhites arcatus	1	EAST1	2	32.70			
C	Paracirrhites forsteri	1	EAST1	1	39.65			
C	Labroides phthirophagus	1	EAST1	1	1.49			
C	Thalassoma duperrey	1	EAST1	7	384.64			
C	Thalassoma duperrey	1	EAST1	16	50.41			
C	Thalassoma duperrey	1	EAST1	16	178.61			
C	Thalassoma duperrey	1	EAST1	5	136.95			
C	Gomphosus varius	1	EAST1	2	22.08			
C	Stethojulis balteata	1	EAST1	2	144.78			
C	Stethojulis balteata	1	EAST1	3	107.29			
C	Halichoeres ornatissimus	1	EAST1	1	16.45			
C	Rhinecanthus rectangulus	1	EAST1	3	257.62			
C	Rhinecanthus rectangulus	1	EAST1	1	45.36			
C	Sufflamen bursa	1	EAST1	1	144.65			
C	Ostracion meleagris	1	EAST1	1	6.76	70	1812.58	4.3
CF	Chaetodon unimaculatus	1	EAST1	4	101.22	4	101.22	0.2
H	Acanthurus triostegus	1	EAST1	21	3939.64			
H	Acanthurus triostegus	1	EAST1	32	3200.46			
H	Acanthurus leucopareius	1	EAST1	14	3257.45			
H	Acanthurus leucopareius	1	EAST1	10	1327.00			
H	Acanthurus nigrofuscus	1	EAST1	12	651.03			
H	Acanthurus nigrofuscus	1	EAST1	24	573.53			
H	Acanthurus nigrofuscus	1	EAST1	15	112.87			
H	Acanthurus nigroris	1	EAST1	4	4969.07			
H	Acanthurus olivaceus	1	EAST1	10	5631.70			
H	Acanthurus olivaceus	1	EAST1	8	6212.84			
H	Acanthurus dussumieri	1	EAST1	10	5643.55			
H	Acanthurus blochii	1	EAST1	6	2721.56			
H	Naso unicornis	1	EAST1	2	1050.52	168	39291.22	94.2
O	Stegastes fasciolatus	1	EAST1	8	207.84			
O	Melichthys vidua	1	EAST1	1	199.03			
O	Canthigaster jactator	1	EAST1	1	3.56	10	410.43	1.0
P	Chaetodon miliaris	1	EAST1	5	105.84			
P	Chromis vanderbilti	1	EAST1	31	9.79	36	115.63	0.3
	TOTAL	1	EAST1	288	41731.0754	288	41731.08	100
C	Cephalopholis argus	2	EAST2	1	1077.13			
C	Gymnothorax meleagris	2	EAST2	1	233.92			
C	Fistularia commersoni	2	EAST2	1	8.09			
C	Forcipiger flavissimus	2	EAST2	1	14.92			
C	Plectroglyphidodon imparipennis	2	EAST2	3	2.59			
C	Paracirrhites arcatus	2	EAST2	1	8.12			
C	Thalassoma duperrey	2	EAST2	15	824.23			
C	Thalassoma duperrey	2	EAST2	11	122.80			
C	Thalassoma duperrey	2	EAST2	10	273.90			
C	Coris gaimard	2	EAST2	1	449.84			
C	Halichoeres ornatissimus	2	EAST2	1	4.41			
C	Halichoeres ornatissimus	2	EAST2	1	25.14			
C	Halichoeres ornatissimus	2	EAST2	1	16.45			
C	Rhinecanthus rectangulus	2	EAST2	3	257.62			
C	Sufflamen fraenatus	2	EAST2	1	461.25	52	3780.39	24.2
CF	Chaetodon ornatissimus	2	EAST2	2	273.78			
CF	Exallias brevis	2	EAST2	1	3.45	3	277.23	1.8
H	Calotomus carolinus	2	EAST2	1	34.69			
H	Acanthurus nigrofuscus	2	EAST2	24	180.59			
H	Acanthurus nigrofuscus	2	EAST2	10	238.97			
H	Acanthurus nigroris	2	EAST2	1	172.30			
H	Acanthurus nigroris	2	EAST2	1	547.19			
H	Acanthurus olivaceus	2	EAST2	3	2.08			
H	Acanthurus olivaceus	2	EAST2	15	8447.55			
H	Ctenochaetus strigosus	2	EAST2	1	0.87			
H	Naso lituratus	2	EAST2	1	127.73			
H	Naso lituratus	2	EAST2	4	1795.77	61	11547.74	73.9
O	Canthigaster jactator	2	EAST2	2	15.18	2	15.18	0.1
P	Chromis vanderbilti	2	EAST2	48	15.16	48	15.16	0.1
	TOTAL	2	EAST2	166	15635.7057	166	15635.71	100

GRP	29-Aug-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Cephalopholis argus	3	EAST3	1	1077.13			
C	Cephalopholis argus	3	EAST3	1	471.73			
C	Parupeneus multifasciatus	3	EAST3	1	96.08			
C	Parupeneus multifasciatus	3	EAST3	2	54.23			
C	Forcipiger flavissimus	3	EAST3	1	14.92			
C	Plectroglyphidodon johnstonianu	3	EAST3	5	8.61			
C	Paracirrhites arcatus	3	EAST3	6	98.09			
C	Pseudocheilinus octotaenia	3	EAST3	1	35.76			
C	Thalassoma duperrey	3	EAST3	9	100.47			
C	Thalassoma duperrey	3	EAST3	9	246.51			
C	Thalassoma duperrey	3	EAST3	8	439.59			
C	Gomphosus varius	3	EAST3	1	11.04			
C	Coris gaimard	3	EAST3	1	83.79			
C	Stethojulis balteata	3	EAST3	1	35.76			
C	Sufflamen bursa	3	EAST3	1	85.87			
C	Ostracion meleagris	3	EAST3	1	24.55	49	2884.15	17.8
CF	Chaetodon ornatissimus	3	EAST3	2	138.00			
CF	Chaetodon multicinctus	3	EAST3	8	53.25	10	191.26	1.2
H	Calotomus carolinus	3	EAST3	1	218.67			
H	Calotomus carolinus	3	EAST3	1	72.28			
H	Scarus sordidus	3	EAST3	2	2855.14			
H	Scarus rubroviolaceus	3	EAST3	1	85.39			
H	Scarus rubroviolaceus	3	EAST3	2	87.84			
H	Acanthurus nigrofuscus	3	EAST3	42	1003.68			
H	Acanthurus nigrofuscus	3	EAST3	27	203.16			
H	Acanthurus olivaceus	3	EAST3	12	6758.04			
H	Ctenochaetus strigosus	3	EAST3	14	106.06			
H	Ctenochaetus strigosus	3	EAST3	9	241.60			
H	Naso lituratus	3	EAST3	1	127.73	112	11759.60	72.7
O	Stegastes fasciolatus	3	EAST3	6	155.88			
O	Melichthys niger	3	EAST3	4	653.34			
O	Melichthys vidua	3	EAST3	1	199.03			
O	Melichthys vidua	3	EAST3	1	296.24			
O	Canthigaster jactator	3	EAST3	2	15.18	14	1319.67	8.2
P	Chromis vanderbilti	3	EAST3	90	28.43	90	28.43	0.2
	TOTAL	3	EAST3	275	16183.1059	275	16183.11	100

C	Parupeneus multifasciatus	4	EAST4	4	217.60			
C	Paracirrhites arcatus	4	EAST4	6	48.71			
C	Paracirrhites forsteri	4	EAST4	1	39.65			
C	Bodianus bilunulatus	4	EAST4	1	1141.37			
C	Thalassoma duperrey	4	EAST4	17	934.13			
C	Thalassoma duperrey	4	EAST4	16	438.25			
C	Thalassoma duperrey	4	EAST4	10	111.63			
C	Thalassoma duperrey	4	EAST4	7	679.36			
C	Halichoeres ornatissimus	4	EAST4	1	9.52			
C	Plagiotremus ewaensis	4	EAST4	1	2.43			
C	Zanclus cornutus	4	EAST4	2	208.32			
C	Rhinecanthus rectangulus	4	EAST4	1	85.87			
C	Sufflamen fraenatus	4	EAST4	1	329.34	68	4246.17	10.8
CF	Chaetodon quadrimaculatus	4	EAST4	2	50.61	2	50.61	0.1
H	Acanthurus nigrofuscus	4	EAST4	20	150.49			
H	Acanthurus nigrofuscus	4	EAST4	21	501.84			
H	Acanthurus olivaceus	4	EAST4	12	8.31			
H	Acanthurus olivaceus	4	EAST4	49	27595.34			
H	Naso lituratus	4	EAST4	7	894.14			
H	Naso lituratus	4	EAST4	7	2181.30	116	31331.42	79.9
O	Melichthys niger	4	EAST4	16	2613.37			
O	Melichthys vidua	4	EAST4	2	398.06			
O	Melichthys vidua	4	EAST4	1	296.24			
O	Canthigaster jactator	4	EAST4	4	14.25	23	3321.91	8.5
P	Chaetodon miliaris	4	EAST4	2	42.34			
P	Chromis vanderbilti	4	EAST4	691	218.28	693	260.62	0.7
	TOTAL	4	EAST4	902	39210.7308		39210.73	100

GRP	29-Aug-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Lutjanus kasmira	5	KO1	95	5448.49			
C	Lutjanus kasmira	5	KO1	92	10116.20			
C	Monotaxis grandoculis	5	KO1	1	71.53			
C	Parupeneus multifasciatus	5	KO1	1	155.42			
C	Parupeneus bifasciatus	5	KO1	1	176.01			
C	Parupeneus cyclostomus	5	KO1	1	24.80			
C	Plectroglyphidodon johnstonianu	5	KO1	3	5.17			
C	Cirrhitus pinnulatus	5	KO1	1	90.86			
C	Thalassoma duperrey	5	KO1	5	136.95			
C	Thalassoma duperrey	5	KO1	3	33.49			
C	Thalassoma duperrey	5	KO1	5	274.74			
C	Gomphosus varius	5	KO1	1	39.39			
C	Sufflamen bursa	5	KO1	2	171.75	211	16744.80	65.3
CF	Chaetodon unimaculatus	5	KO1	2	50.61			
CF	Chaetodon multicinctus	5	KO1	2	26.06	4	76.67	0.3
H	Scarus sordidus	5	KO1	1	76.01			
H	Acanthurus nigrofuscus	5	KO1	39	931.98			
H	Acanthurus nigrofuscus	5	KO1	20	150.49			
H	Ctenochaetus strigosus	5	KO1	19	2510.54			
H	Ctenochaetus strigosus	5	KO1	32	2107.68			
H	Zebrasoma flavescens	5	KO1	5	266.40	116	6043.11	23.6
O	Stegastes fasciolatus	5	KO1	4	103.92			
O	Melichthys niger	5	KO1	7	1143.35			
O	Canthigaster jactator	5	KO1	3	10.69	14	1257.96	4.9
P	Abudefduf vaigensis	5	KO1	21	657.98			
P	Chromis vanderbilti	5	KO1	15	4.74			
P	Naso hexacanthus	5	KO1	7	861.83	43	1524.55	5.9
	TOTAL	5	KO1	388	25647.0803	388	25647.08	100
C	Cephalopholis argus	6	KO2	1	1676.50			
C	Caranx melampygus	6	KO2	1	81.59			
C	Parupeneus multifasciatus	6	KO2	1	54.40			
C	Parupeneus bifasciatus	6	KO2	1	553.06			
C	Plectroglyphidodon johnstonianu	6	KO2	3	5.17			
C	Bodianus bilunulatus	6	KO2	1	467.86			
C	Labroides phthirophagus	6	KO2	3	4.46			
C	Thalassoma duperrey	6	KO2	10	549.49			
C	Thalassoma duperrey	6	KO2	9	246.51			
C	Thalassoma duperrey	6	KO2	9	100.47			
C	Thalassoma duperrey	6	KO2	2	194.10			
C	Zanclus cornutus	6	KO2	3	312.47			
C	Sufflamen bursa	6	KO2	3	257.62	47	4503.71	20.0
CF	Chaetodon unimaculatus	6	KO2	2	50.61			
CF	Chaetodon ornatissimus	6	KO2	2	273.78			
CF	Chaetodon quadrimaculatus	6	KO2	2	50.61			
CF	Chaetodon multicinctus	6	KO2	6	78.18	12	453.18	2.0
H	Acanthurus triostegus	6	KO2	4	400.06			
H	Acanthurus leucopareius	6	KO2	2	465.35			
H	Acanthurus leucopareius	6	KO2	3	398.10			
H	Acanthurus leucopareius	6	KO2	6	2244.39			
H	Acanthurus nigrofuscus	6	KO2	17	127.92			
H	Acanthurus nigrofuscus	6	KO2	38	908.09			
H	Acanthurus nigrofuscus	6	KO2	1	102.47			
H	Acanthurus nigroris	6	KO2	6	1604.09			
H	Acanthurus olivaceus	6	KO2	1	163.52			
H	Acanthurus olivaceus	6	KO2	9	5068.53			
H	Acanthurus dussumieri	6	KO2	1	564.35			
H	Acanthurus glaucopareius	6	KO2	2	123.06			
H	Acanthurus blochii	6	KO2	3	1360.78			
H	Ctenochaetus strigosus	6	KO2	8	60.61			
H	Ctenochaetus strigosus	6	KO2	11	1453.47			
H	Ctenochaetus strigosus	6	KO2	7	461.05			
H	Ctenochaetus strigosus	6	KO2	7	187.91			
H	Zebrasoma flavescens	6	KO2	7	372.96	133	16066.71	71.5
O	Melichthys niger	6	KO2	5	816.68			
O	Melichthys vidua	6	KO2	2	398.06			
O	Cantherhines sandwichiensis	6	KO2	1	82.05			
O	Canthigaster jactator	6	KO2	1	3.56	9	1300.35	5.8
P	Chaetodon miliaris	6	KO2	1	21.17			
P	Abudefduf abdominalis	6	KO2	4	125.33	5	146.50	0.7
	TOTAL	6	KO2	206	22470.4564	206	22470.46	100

GRP	29-Aug-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Myripristis amaenus	7	KAHE1D	2	164.17			
C	Myripristis amaenus	7	KAHE1D	12	1689.70			
C	Lutjanus kasmira	7	KAHE1D	3	329.88			
C	Mulloides vanicolensis	7	KAHE1D	14	707.25			
C	Parupeneus multifasciatus	7	KAHE1D	1	155.42			
C	Plectroglyphidodon johnstonianu	7	KAHE1D	1	1.72			
C	Thalassoma duperrey	7	KAHE1D	10	273.90			
C	Thalassoma duperrey	7	KAHE1D	37	2033.11			
C	Thalassoma duperrey	7	KAHE1D	53	5143.75			
C	Thalassoma ballieui	7	KAHE1D	1	167.53			
C	Gomphosus varius	7	KAHE1D	7	158.21			
C	Zanclus cornutus	7	KAHE1D	1	104.16			
C	Sufflamen bursa	7	KAHE1D	7	601.11	149	11529.92	35.0
CF	Chaetodon ornatissimus	7	KAHE1D	1	69.00	1	69.00	0.2
H	Acanthurus triostegus	7	KAHE1D	3	138.95			
H	Acanthurus nigrofuscus	7	KAHE1D	35	263.36			
H	Acanthurus nigrofuscus	7	KAHE1D	173	4134.19			
H	Ctenochaetus strigosus	7	KAHE1D	70	1879.07			
H	Ctenochaetus strigosus	7	KAHE1D	76	5005.74	357	11421.31	34.7
O	Stegastes fasciolatus	7	KAHE1D	16	415.68			
O	Melichthys niger	7	KAHE1D	58	9473.46			
O	Canthigaster jactator	7	KAHE1D	3	10.69	77	9899.83	30.1
	TOTAL	7	KAHE1D	584	32920.0520	584	32920.05	100
C	Myripristis amaenus	8	KAHE5B	1	140.81			
C	Mulloides flavolineatus	8	KAHE5B	2	383.27			
C	Forcipiger flavissimus	8	KAHE5B	2	18.30			
C	Plectroglyphidodon johnstonianu	8	KAHE5B	3	5.17			
C	Plectroglyphidodon imparipennis	8	KAHE5B	1	0.86			
C	Paracirrhites arcatus	8	KAHE5B	3	24.35			
C	Cirrhitops fasciatus	8	KAHE5B	2	31.25			
C	Pseudocheilinus octotaenia	8	KAHE5B	1	35.76			
C	Thalassoma duperrey	8	KAHE5B	9	100.47			
C	Thalassoma duperrey	8	KAHE5B	11	301.30			
C	Thalassoma duperrey	8	KAHE5B	4	388.21			
C	Thalassoma duperrey	8	KAHE5B	10	549.49			
C	Gomphosus varius	8	KAHE5B	1	62.03			
C	Stethojulis balteata	8	KAHE5B	2	71.53			
C	Macropharyngodon geoffroy	8	KAHE5B	1	18.63			
C	Macropharyngodon geoffroy	8	KAHE5B	1	42.90			
C	Halichoeres ornatissimus	8	KAHE5B	3	75.41			
C	Halichoeres ornatissimus	8	KAHE5B	4	65.80			
C	Zanclus cornutus	8	KAHE5B	3	312.47			
C	Sufflamen bursa	8	KAHE5B	3	257.62	67	2885.63	43.3
CF	Chaetodon unimaculatus	8	KAHE5B	4	101.22			
CF	Chaetodon multicinctus	8	KAHE5B	4	52.12			
CF	Pervagor spilosoma	8	KAHE5B	1	16.22	9	169.55	2.5
H	Calotomus carolinus	8	KAHE5B	1	34.69			
H	Acanthurus nigrofuscus	8	KAHE5B	17	127.92			
H	Acanthurus nigrofuscus	8	KAHE5B	46	1099.26			
H	Acanthurus olivaceus	8	KAHE5B	1	163.52			
H	Acanthurus olivaceus	8	KAHE5B	1	563.17			
H	Zebrasoma flavescens	8	KAHE5B	4	213.12			
H	Naso lituratus	8	KAHE5B	1	127.73			
H	Naso unicornis	8	KAHE5B	1	278.71	72	2608.12	39.1
O	Stegastes fasciolatus	8	KAHE5B	5	129.90			
O	Melichthys vidua	8	KAHE5B	2	398.06			
O	Cantherhines sandwichiensis	8	KAHE5B	4	328.21	11	856.17	12.8
P	Chromis vanderbilti	8	KAHE5B	82	25.90			
P	Naso hexacanthus	8	KAHE5B	1	123.12	83	149.02	2.2
	TOTAL	8	KAHE5B	242	6668.4926	242	6668.493	100

GRP	29-Aug-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Mulloides flavolineatus	9	KAHE7B	2	383.27			
C	Parupeneus pleurostigma	9	KAHE7B	5	491.24			
C	Parupeneus multifasciatus	9	KAHE7B	1	96.08			
C	Parupeneus multifasciatus	9	KAHE7B	1	235.75			
C	Parupeneus multifasciatus	9	KAHE7B	2	310.84			
C	Paracirrhites arcatus	9	KAHE7B	1	8.12			
C	Cirrhitops fasciatus	9	KAHE7B	1	3.75			
C	Thalassoma duperrey	9	KAHE7B	1	97.05			
C	Thalassoma duperrey	9	KAHE7B	1	27.39			
C	Thalassoma duperrey	9	KAHE7B	1	54.95			
C	Coris venusta	9	KAHE7B	1	48.38			
C	Anampses chrysocephalus	9	KAHE7B	1	0.27			
C	Zanclus cornutus	9	KAHE7B	1	54.90			
C	Zanclus cornutus	9	KAHE7B	1	104.16			
C	Sufflamen bursa	9	KAHE7B	2	171.75			
C	Sufflamen fraenatus	9	KAHE7B	1	144.65			
C	Ostracion meleagris	9	KAHE7B	1	6.76	24	2239.30	77.6
H	Acanthurus nigrofuscus	9	KAHE7B	11	262.87			
H	Acanthurus nigrofuscus	9	KAHE7B	5	37.62			
H	Acanthurus nigrofuscus	9	KAHE7B	5	5.22			
H	Acanthurus olivaceus	9	KAHE7B	2	327.03			
H	Naso lituratus	9	KAHE7B	1	4.24	24	636.98	22.1
P	Dascyllus albisella	9	KAHE7B	1	3.09			
P	Chromis vanderbilti	9	KAHE7B	23	7.27	24	10.35	0.4
	TOTAL	9	KAHE7B	72	2886.6376	72	2886.638	100
C	Mulloides flavolineatus	10	KAHE7C	1	269.34			
C	Parupeneus pleurostigma	10	KAHE7C	4	232.03			
C	Parupeneus multifasciatus	10	KAHE7C	2	54.23			
C	Parupeneus multifasciatus	10	KAHE7C	1	155.42			
C	Forcipiger flavissimus	10	KAHE7C	1	9.15			
C	Chaetodon auriga	10	KAHE7C	1	48.39			
C	Thalassoma duperrey	10	KAHE7C	3	291.16			
C	Thalassoma duperrey	10	KAHE7C	4	219.80			
C	Gomphosus varius	10	KAHE7C	1	39.39			
C	Gomphosus varius	10	KAHE7C	1	22.60			
C	Coris venusta	10	KAHE7C	4	193.52			
C	Coris gaimard	10	KAHE7C	1	8.57			
C	Zanclus cornutus	10	KAHE7C	1	104.16			
C	Zanclus cornutus	10	KAHE7C	2	109.80			
C	Sufflamen bursa	10	KAHE7C	7	601.11	34	2358.67	38.2
H	Calotomus carolinus	10	KAHE7C	1	13.46			
H	Acanthurus triostegus	10	KAHE7C	5	231.58			
H	Acanthurus nigrofuscus	10	KAHE7C	11	262.87			
H	Acanthurus nigrofuscus	10	KAHE7C	3	22.57			
H	Acanthurus olivaceus	10	KAHE7C	4	1046.67			
H	Acanthurus olivaceus	10	KAHE7C	1	563.17			
H	Acanthurus olivaceus	10	KAHE7C	7	1144.61			
H	Naso lituratus	10	KAHE7C	1	127.73			
H	Naso lituratus	10	KAHE7C	1	311.61	34	3724.28	60.4
O	Cantherhines sandwichiensis	10	KAHE7C	1	82.05			
O	Canthigaster jactator	10	KAHE7C	1	3.56	2	85.61	1.4
	TOTAL	10	KAHE7C	70	6168.5675	70	6168.568	100

GRP	29-Aug-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Thalassoma duperrey	11	KAHE7D	1	54.95			
C	Thalassoma duperrey	11	KAHE7D	1	97.05			
C	Sufflamen bursa	11	KAHE7D	2	171.75			
C	Sufflamen fraenatus	11	KAHE7D	1	329.34	5	653.09	71.2
H	Calotomus carolinus	11	KAHE7D	1	218.67			
H	Acanthurus nigrofuscus	11	KAHE7D	1	23.90	2	242.57	26.4
O	Canthigaster coronata	11	KAHE7D	1	22.05	1	22.05	2.4
	TOTAL	11	KAHE7D	8	917.7051	8	917.7051	100
C	Apogon kallopterus	12	KAHE7E	4	16.73			
C	Aphareus furcatus	12	KAHE7E	1	13.44			
C	Parupeneus multifasciatus	12	KAHE7E	5	272.00			
C	Parupeneus multifasciatus	12	KAHE7E	23	254.19			
C	Parupeneus multifasciatus	12	KAHE7E	21	569.45			
C	Parupeneus multifasciatus	12	KAHE7E	13	3064.73			
C	Parupeneus multifasciatus	12	KAHE7E	2	192.16			
C	Parupeneus cyclostomus	12	KAHE7E	1	24.80			
C	Parupeneus cyclostomus	12	KAHE7E	1	88.57			
C	Forcipiger flavissimus	12	KAHE7E	1	9.15			
C	Paracirrhites arcatus	12	KAHE7E	2	16.24			
C	Paracirrhites forsteri	12	KAHE7E	1	16.35			
C	Cirrhitops fasciatus	12	KAHE7E	2	0.65			
C	Cirrhitops fasciatus	12	KAHE7E	1	3.75			
C	Pseudocheilinus octotaenia	12	KAHE7E	3	1.34			
C	Thalassoma duperrey	12	KAHE7E	2	194.10			
C	Pseudojuloides cerasinus	12	KAHE7E	4	1.45			
C	Stethojulis balteata	12	KAHE7E	1	35.76			
C	Anampses chrysocephalus	12	KAHE7E	3	0.80			
C	Halichoeres ornatissimus	12	KAHE7E	3	13.22			
C	Zanclus cornutus	12	KAHE7E	1	104.16			
C	Sufflamen bursa	12	KAHE7E	4	343.49	99	5236.53	67.8
CF	Chaetodon ornatissimus	12	KAHE7E	2	1.96			
CF	Chaetodon multicinctus	12	KAHE7E	6	4.96			
CF	Chaetodon multicinctus	12	KAHE7E	8	53.25	16	60.17	0.8
H	Acanthurus triostegus	12	KAHE7E	5	231.58			
H	Acanthurus nigrofuscus	12	KAHE7E	99	103.32			
H	Acanthurus nigrofuscus	12	KAHE7E	4	30.10			
H	Acanthurus olivaceus	12	KAHE7E	1	563.17			
H	Ctenochaetus strigosus	12	KAHE7E	15	13.07			
H	Ctenochaetus strigosus	12	KAHE7E	9	68.18			
H	Zebrasoma flavescens	12	KAHE7E	13	21.95			
H	Naso lituratus	12	KAHE7E	1	72.58			
H	Naso unicornis	12	KAHE7E	1	5.44	148	1109.39	14.4
O	Melichthys niger	12	KAHE7E	5	816.68			
O	Melichthys vidua	12	KAHE7E	2	398.06			
O	Canthigaster jactator	12	KAHE7E	1	3.56	8	1218.30	15.8
P	Chaetodon kleini	12	KAHE7E	1	6.56			
P	Chaetodon kleini	12	KAHE7E	3	2.65			
P	Chromis vanderbilti	12	KAHE7E	280	88.45	284	97.66	1.3
	TOTAL	12	KAHE7E	555	7722.0483	555	7722.048	100

GRP	29-Aug-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Aulostomus chinensis	13	KAHE10	1	112.28			
C	Lutjanus kasmira	13	KAHE10	555	31830.65			
C	Mulloides vanicolensis	13	KAHE10	340	8410.36			
C	Parupeneus multifasciatus	13	KAHE10	1	235.75			
C	Parupeneus multifasciatus	13	KAHE10	4	108.47			
C	Parupeneus multifasciatus	13	KAHE10	1	54.40			
C	Parupeneus bifasciatus	13	KAHE10	2	119.53			
C	Forcipiger flavissimus	13	KAHE10	1	9.15			
C	Plectroglyphidodon imparipennis	13	KAHE10	1	0.86			
C	Paracirrhites arcatus	13	KAHE10	5	81.74			
C	Bodianus bilunulatus	13	KAHE10	1	214.67			
C	Thalassoma duperrey	13	KAHE10	10	549.49			
C	Thalassoma duperrey	13	KAHE10	11	1067.57			
C	Thalassoma duperrey	13	KAHE10	10	273.90			
C	Thalassoma duperrey	13	KAHE10	7	78.14			
C	Stethojulis balteata	13	KAHE10	4	143.05			
C	Rhinecanthus rectangulus	13	KAHE10	1	85.87			
C	Sufflamen bursa	13	KAHE10	5	429.37			
C	Sufflamen fraenatus	13	KAHE10	1	461.25			
C	Sufflamen fraenatus	13	KAHE10	1	224.79	962	44491.32	86.3
CF	Chaetodon multicinctus	13	KAHE10	2	26.06			
CF	Cantherhines dumerili	13	KAHE10	1	194.98	3	221.04	0.4
H	Calotomus carolinus	13	KAHE10	1	1288.03			
H	Scarus psittacus	13	KAHE10	1	79.27			
H	Acanthurus nigrofuscus	13	KAHE10	4	30.10			
H	Acanthurus nigrofuscus	13	KAHE10	25	597.43			
H	Acanthurus olivaceus	13	KAHE10	4	1572.84			
H	Naso lituratus	13	KAHE10	1	127.73	36	3695.40	7.2
O	Stegastes fasciolatus	13	KAHE10	2	51.96			
O	Melichthys niger	13	KAHE10	7	1143.35			
O	Melichthys vidua	13	KAHE10	1	199.03	10	1394.34	2.7
P	Dascyllus albisella	13	KAHE10	33	101.91			
P	Abudefduf abdominalis	13	KAHE10	52	1629.29			
P	Chromis vanderbilti	13	KAHE10	75	23.69	160	1754.90	3.4
	TOTAL	13	KAHE10	1171	51556.9934	1171	51556.99	100
C	Plectroglyphidodon imparipennis	14	NANA1	4	3.45			
C	Thalassoma duperrey	14	NANA1	2	54.78			
C	Thalassoma duperrey	14	NANA1	3	33.49			
C	Thalassoma duperrey	14	NANA1	5	15.75			
C	Thalassoma duperrey	14	NANA1	2	109.90			
C	Stethojulis balteata	14	NANA1	1	4.00			
C	Rhinecanthus rectangulus	14	NANA1	1	85.87	18	307.24	65.6
H	Acanthurus triostegus	14	NANA1	2	0.78			
H	Acanthurus nigrofuscus	14	NANA1	7	52.67			
H	Acanthurus nigroris	14	NANA1	1	14.21			
H	Acanthurus olivaceus	14	NANA1	4	45.29			
H	Ctenochaetus strigosus	14	NANA1	1	0.87	15	113.82	24.3
O	Canthigaster jactator	14	NANA1	1	3.56			
O	Canthigaster rivulata	14	NANA1	2	27.30	3	30.86	6.6
P	Chromis vanderbilti	14	NANA1	53	16.74	53	16.74	3.6
	TOTAL	14	NANA1	89	468.6702	89	468.6702	100

GRP	29-Aug-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Monotaxis grandoculis	15	NANA2	2	3628.74			
C	Parupeneus multifasciatus	15	NANA2	1	54.40			
C	Parupeneus multifasciatus	15	NANA2	4	108.47			
C	Parupeneus bifasciatus	15	NANA2	1	29.20			
C	Thalassoma duperrey	15	NANA2	2	194.10			
C	Thalassoma duperrey	15	NANA2	3	82.17			
C	Thalassoma duperrey	15	NANA2	3	164.85			
C	Stethojulis balteata	15	NANA2	3	107.29			
C	Macropharyngodon geoffroy	15	NANA2	1	42.90			
C	Halichoeres ornatissimus	15	NANA2	1	16.45			
C	Zanclus cornutus	15	NANA2	3	312.47			
C	Sufflamen bursa	15	NANA2	4	343.49	28	5084.54	14.2
CF	Chaetodon ornatissimus	15	NANA2	2	138.00	2	138.00	0.4
H	Calotomus carolinus	15	NANA2	1	4889.53			
H	Acanthurus triostegus	15	NANA2	3	562.81			
H	Acanthurus triostegus	15	NANA2	5	500.07			
H	Acanthurus triostegus	15	NANA2	2	92.63			
H	Acanthurus leucopareius	15	NANA2	17	3955.48			
H	Acanthurus leucopareius	15	NANA2	15	5610.96			
H	Acanthurus leucopareius	15	NANA2	32	4246.41			
H	Acanthurus nigrofuscus	15	NANA2	11	262.87			
H	Acanthurus nigrofuscus	15	NANA2	5	37.62			
H	Acanthurus nigroris	15	NANA2	1	547.19			
H	Acanthurus nigroris	15	NANA2	7	1206.08			
H	Acanthurus glaucopareius	15	NANA2	1	61.53			
H	Ctenochaetus strigosus	15	NANA2	3	197.59			
H	Ctenochaetus strigosus	15	NANA2	2	53.69			
H	Naso lituratus	15	NANA2	7	4356.49			
H	Naso lituratus	15	NANA2	9	2804.53			
H	Naso lituratus	15	NANA2	6	1235.93	127	30621.42	85.4
O	Canthigaster jactator	15	NANA2	3	22.77	3	22.77	0.1
	TOTAL	15	NANA2	160	35866.7319	160	35866.73	100
C	Myripristis amaenus	16	PIPE	83	6812.88			
C	Priacanthus meeki	16	PIPE	1	167.58			
C	Decapterus macarellus	16	PIPE	60	7816.75			
C	Caranx melampygus	16	PIPE	1	375.82			
C	Mulloides vanicolensis	16	PIPE	300	27161.20			
C	Mulloides vanicolensis	16	PIPE	255	6307.77			
C	Forcipiger flavissimus	16	PIPE	6	54.90			
C	Plectroglyphidodon johnstonianu	16	PIPE	5	8.61			
C	Paracirrhites forsteri	16	PIPE	1	39.65			
C	Cirrhitops fasciatus	16	PIPE	4	62.51			
C	Thalassoma duperrey	16	PIPE	2	22.33			
C	Thalassoma duperrey	16	PIPE	29	2814.51			
C	Thalassoma duperrey	16	PIPE	26	1428.67			
C	Thalassoma duperrey	16	PIPE	5	136.95			
C	Gomphosus varius	16	PIPE	3	67.80			
C	Gomphosus varius	16	PIPE	9	354.55			
C	Coris gaimard	16	PIPE	1	318.06			
C	Anampses chrysocephalus	16	PIPE	1	54.06			
C	Anampses chrysocephalus	16	PIPE	8	80.14			
C	Anampses chrysocephalus	16	PIPE	1	25.88			
C	Halichoeres ornatissimus	16	PIPE	1	16.45			
C	Halichoeres ornatissimus	16	PIPE	2	50.27			
C	Zanclus cornutus	16	PIPE	1	104.16			
C	Sufflamen bursa	16	PIPE	3	257.62	808	54539.12	41.9
CF	Chaetodon multicinctus	16	PIPE	4	52.12			
CF	Pervagor melanocephalus	16	PIPE	1	9.75	5	61.87	0.0
H	Calotomus carolinus	16	PIPE	1	131.69			
H	Scarus sordidus	16	PIPE	1	1866.60			
H	Scarus sordidus	16	PIPE	25	19376.71			
H	Scarus sordidus	16	PIPE	48	11263.15			
H	Scarus sordidus	16	PIPE	16	22841.11			
H	Scarus sordidus	16	PIPE	24	13069.64			
H	Acanthurus nigrofuscus	16	PIPE	57	1362.13			
H	Naso lituratus	16	PIPE	1	127.73	173	70038.76	53.8
O	Stegastes fasciolatus	16	PIPE	14	363.72			
O	Melichthys vidua	16	PIPE	1	199.03			
O	Canthigaster jactator	16	PIPE	6	45.55	21	608.30	0.5
P	Chaetodon miliaris	16	PIPE	4	84.67			
P	Dascyllus albisella	16	PIPE	22	67.94			
P	Abudefduf abdominalis	16	PIPE	60	1879.95			
P	Abudefduf vaigensis	16	PIPE	25	783.31			
P	Chromis vanderbilti	16	PIPE	40	12.64			
P	Chromis ovalis	16	PIPE	150	1733.95			
P	Chromis hanui	16	PIPE	4	2.99			
P	Naso brevirostris	16	PIPE	1	278.71	306	4844.16	3.7
	TOTAL	16	PIPE	1313	130092.2110	1313	130092.2	100

21 DECEMBER 2017 FIELD DATA

GRP	21-Dec-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Parupeneus multifasciatus	1	EAST1	3	288.24			
C	Parupeneus multifasciatus	1	EAST1	1	340.44			
C	Plectroglyphidodon johnstonianu	1	EAST1	3	2.59			
C	Plectroglyphidodon imparipennis	1	EAST1	6	5.17			
C	Paracirrhites arcatus	1	EAST1	2	32.70			
C	Paracirrhites forsteri	1	EAST1	1	39.65			
C	Labroides phthirophagus	1	EAST1	1	1.49			
C	Thalassoma duperrey	1	EAST1	7	679.36			
C	Thalassoma duperrey	1	EAST1	4	219.80			
C	Thalassoma duperrey	1	EAST1	6	164.34			
C	Rhinecanthus rectangulus	1	EAST1	5	429.37	39	2203.15	4.6
H	Acanthurus triostegus	1	EAST1	37	3700.53			
H	Acanthurus leucopareius	1	EAST1	5	1163.38			
H	Acanthurus nigrofuscus	1	EAST1	27	203.16			
H	Acanthurus nigrofuscus	1	EAST1	37	884.19			
H	Acanthurus nigrofuscus	1	EAST1	20	1085.05			
H	Acanthurus nigroris	1	EAST1	3	3726.80			
H	Acanthurus olivaceus	1	EAST1	44	24779.49			
H	Acanthurus olivaceus	1	EAST1	29	7588.35			
H	Acanthurus blochii	1	EAST1	6	2721.56	208	45852.51	95.2
O	Canthigaster jactator	1	EAST1	3	22.77	3	22.77	0.05
P	Chaetodon miliaris	1	EAST1	4	84.67			
P	Chromis vanderbilti	1	EAST1	65	20.53	69	105.20	0.2
	TOTAL	1	EAST1	319	48183.6352	319	48183.635	100
C	Cephalopholis argus	2	EAST2	1	229.32			
C	Parupeneus multifasciatus	2	EAST2	1	96.08			
C	Forcipiger flavissimus	2	EAST2	2	18.30			
C	Plectroglyphidodon johnstonianu	2	EAST2	3	5.17			
C	Plectroglyphidodon imparipennis	2	EAST2	3	2.59			
C	Paracirrhites arcatus	2	EAST2	3	49.05			
C	Thalassoma duperrey	2	EAST2	22	602.59			
C	Thalassoma duperrey	2	EAST2	13	145.12			
C	Thalassoma duperrey	2	EAST2	16	879.18			
C	Thalassoma duperrey	2	EAST2	17	1649.88			
C	Gomphosus varius	2	EAST2	4	44.17			
C	Stethojulis balteata	2	EAST2	1	35.76			
C	Halichoeres ornatissimus	2	EAST2	2	32.90			
C	Halichoeres ornatissimus	2	EAST2	3	75.41			
C	Rhinecanthus rectangulus	2	EAST2	1	85.87			
C	Rhinecanthus rectangulus	2	EAST2	1	45.36			
C	Sufflamen fraenatus	2	EAST2	1	144.65			
C	Sufflamen fraenatus	2	EAST2	1	461.25	95	4602.66	12.5
CF	Chaetodon ornatissimus	2	EAST2	2	138.00	2	138.00	0.4
H	Acanthurus triostegus	2	EAST2	2	200.03			
H	Acanthurus triostegus	2	EAST2	5	231.58			
H	Acanthurus nigrofuscus	2	EAST2	99	744.94			
H	Acanthurus nigrofuscus	2	EAST2	45	1075.37			
H	Acanthurus nigroris	2	EAST2	7	5171.86			
H	Acanthurus nigroris	2	EAST2	3	307.42			
H	Acanthurus olivaceus	2	EAST2	31	17458.28			
H	Acanthurus olivaceus	2	EAST2	15	3925.01			
H	Acanthurus blochii	2	EAST2	8	2645.36			
H	Zebrasoma flavescens	2	EAST2	2	106.56	217	31866.39	86.8
O	Canthigaster jactator	2	EAST2	2	15.18	2	15.18	0.04
P	Chromis vanderbilti	2	EAST2	220	69.50	220	69.50	0.2
	TOTAL	2	EAST2	536	36691.7333	536	36691.733	100

GRP	21-Dec-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Parupeneus multifasciatus	3	EAST3	1	96.08			
C	Parupeneus multifasciatus	3	EAST3	1	54.40			
C	Plectroglyphidodon johnstonianu	3	EAST3	4	3.45			
C	Paracirrhites arcatus	3	EAST3	1	16.35			
C	Paracirrhites forsteri	3	EAST3	1	1495.57			
C	Thalassoma duperrey	3	EAST3	10	273.90			
C	Thalassoma duperrey	3	EAST3	9	100.47			
C	Thalassoma duperrey	3	EAST3	5	274.74			
C	Gomphosus varius	3	EAST3	4	44.17			
C	Coris gaimard	3	EAST3	1	83.79			
C	Stethojulis balteata	3	EAST3	1	72.39	38	2515.31	10.2
CF	Chaetodon ornatissimus	3	EAST3	4	276.01			
CF	Chaetodon multicinctus	3	EAST3	4	52.12	8	328.13	1.3
H	Scarus sordidus	3	EAST3	2	1089.14			
H	Scarus rubroviolaceus	3	EAST3	1	673.75			
H	Scarus rubroviolaceus	3	EAST3	6	11018.28			
H	Acanthurus leucopareius	3	EAST3	3	398.10			
H	Acanthurus nigrofuscus	3	EAST3	25	597.43			
H	Acanthurus nigrofuscus	3	EAST3	45	338.61			
H	Acanthurus nigrofuscus	3	EAST3	1	54.25			
H	Acanthurus olivaceus	3	EAST3	12	6758.04			
H	Ctenochaetus strigosus	3	EAST3	13	348.97			
H	Ctenochaetus strigosus	3	EAST3	14	106.06	122	21382.63	86.4
O	Stegastes fasciolatus	3	EAST3	4	103.92			
O	Melichthys vidua	3	EAST3	2	398.06			
O	Canthigaster jactator	3	EAST3	1	7.59	7	509.57	2.1
P	Chromis vanderbilti	3	EAST3	7	2.21	7	2.21	0.01
	TOTAL	3	EAST3	182	24737.8518	182	24737.852	100
C	Parupeneus multifasciatus	4	EAST4	1	54.40			
C	Parupeneus cyclostomus	4	EAST4	1	24.80			
C	Chaetodon lunula	4	EAST4	1	35.99			
C	Plectroglyphidodon johnstonianu	4	EAST4	1	0.86			
C	Paracirrhites arcatus	4	EAST4	4	65.39			
C	Paracirrhites forsteri	4	EAST4	1	16.35			
C	Thalassoma duperrey	4	EAST4	9	246.51			
C	Thalassoma duperrey	4	EAST4	7	679.36			
C	Thalassoma duperrey	4	EAST4	11	604.44			
C	Thalassoma duperrey	4	EAST4	5	55.82			
C	Coris gaimard	4	EAST4	1	8.57			
C	Pseudojuloides cerasinus	4	EAST4	1	11.16			
C	Halichoeres ornatissimus	4	EAST4	4	65.80			
C	Rhinecanthus rectangulus	4	EAST4	2	171.75			
C	Rhinecanthus rectangulus	4	EAST4	1	45.36			
C	Sufflamen fraenatus	4	EAST4	1	144.65	51	2231.21	12.5
CF	Chaetodon quadrimaculatus	4	EAST4	2	50.61	2	50.61	0.3
H	Scarus psittacus	4	EAST4	8	116.91			
H	Acanthurus nigrofuscus	4	EAST4	35	836.40			
H	Acanthurus nigrofuscus	4	EAST4	53	398.80			
H	Acanthurus olivaceus	4	EAST4	16	9010.72			
H	Acanthurus olivaceus	4	EAST4	8	2093.34			
H	Acanthurus blochii	4	EAST4	3	1360.78			
H	Ctenochaetus strigosus	4	EAST4	2	15.15			
H	Zebrasoma flavescens	4	EAST4	1	53.28	126	13885.39	77.6
O	Melichthys niger	4	EAST4	5	1240.16			
O	Melichthys vidua	4	EAST4	2	398.06			
O	Canthigaster jactator	4	EAST4	6	45.55	13	1683.76	9.4
P	Chromis vanderbilti	4	EAST4	165	52.12	165	52.12	0.3
	TOTAL	4	EAST4	357	17903.0950	357	17903.095	100

GRP	21-Dec-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Lutjanus kasmira	5	KO1	40	2294.10			
C	Parupeneus bifasciatus	5	KO1	1	176.01			
C	Forcipiger flavissimus	5	KO1	1	9.15			
C	Plectroglyphidodon johnstonianu	5	KO1	3	5.17			
C	Thalassoma duperrey	5	KO1	13	356.08			
C	Thalassoma duperrey	5	KO1	11	122.80			
C	Thalassoma duperrey	5	KO1	6	329.69			
C	Thalassoma duperrey	5	KO1	3	291.16			
C	Gomphosus varius	5	KO1	1	39.39			
C	Pseudojuloides cerasinus	5	KO1	1	3.15			
C	Stethojulis balteata	5	KO1	1	35.76			
C	Stethojulis balteata	5	KO1	1	72.39			
C	Sufflamen bursa	5	KO1	1	85.87	83	3820.72	43.4
CF	Chaetodon ornatissimus	5	KO1	2	138.00			
CF	Chaetodon quadrimaculatus	5	KO1	2	50.61			
CF	Chaetodon multicinctus	5	KO1	10	130.30	14	318.91	3.6
H	Acanthurus leucopareius	5	KO1	1	66.74			
H	Acanthurus nigrofuscus	5	KO1	18	135.44			
H	Acanthurus nigrofuscus	5	KO1	25	597.43			
H	Acanthurus blochii	5	KO1	1	97.98			
H	Ctenochaetus strigosus	5	KO1	32	859.00			
H	Ctenochaetus strigosus	5	KO1	22	1449.03			
H	Ctenochaetus strigosus	5	KO1	9	68.18			
H	Ctenochaetus strigosus	5	KO1	6	792.80			
H	Zebrasoma flavescens	5	KO1	3	78.09	117	4144.70	47.0
O	Stegastes fasciolatus	5	KO1	1	25.98			
O	Melichthys niger	5	KO1	3	490.01			
O	Canthigaster jactator	5	KO1	3	10.69	7	526.67	6.0
	TOTAL	5	KO1	221	8810.9988	221	8810.9988	100
C	Cephalopholis argus	6	KO2	1	229.32			
C	Cephalopholis argus	6	KO2	1	471.73			
C	Parupeneus bifasciatus	6	KO2	1	553.06			
C	Parupeneus bifasciatus	6	KO2	1	1628.69			
C	Parupeneus cyclostomus	6	KO2	2	5578.07			
C	Forcipiger flavissimus	6	KO2	1	9.15			
C	Plectroglyphidodon johnstonianu	6	KO2	5	8.61			
C	Plectroglyphidodon imparipennis	6	KO2	1	0.86			
C	Paracirrhites arcatus	6	KO2	1	16.35			
C	Paracirrhites forsteri	6	KO2	1	39.65			
C	Bodianus bilunulatus	6	KO2	1	648.58			
C	Labroides phthirophagus	6	KO2	3	4.46			
C	Cirrhitus pinnulatus	6	KO2	1	406.92			
C	Cirrhitus pinnulatus	6	KO2	1	90.86			
C	Thalassoma duperrey	6	KO2	5	274.74			
C	Thalassoma duperrey	6	KO2	7	78.14			
C	Thalassoma duperrey	6	KO2	7	191.73			
C	Thalassoma duperrey	6	KO2	2	194.10			
C	Zanclus cornutus	6	KO2	2	208.32			
C	Sufflamen fraenatus	6	KO2	1	224.79	45	10858.16	23.3
CF	Chaetodon unimaculatus	6	KO2	2	50.61			
CF	Chaetodon ornatissimus	6	KO2	6	414.01			
CF	Chaetodon quadrimaculatus	6	KO2	2	50.61			
CF	Chaetodon multicinctus	6	KO2	2	26.06			
CF	Cantherhines dumerili	6	KO2	1	194.98	13	736.27	1.6
H	Scarus psittacus	6	KO2	1	1437.46			
H	Scarus rubroviolaceus	6	KO2	1	453.59			
H	Acanthurus triostegus	6	KO2	23	2300.33			
H	Acanthurus leucopareius	6	KO2	7	928.90			
H	Acanthurus leucopareius	6	KO2	3	698.03			
H	Acanthurus nigrofuscus	6	KO2	62	466.53			
H	Acanthurus nigrofuscus	6	KO2	4	409.90			
H	Acanthurus nigrofuscus	6	KO2	34	812.50			
H	Acanthurus olivaceus	6	KO2	28	15768.77			
H	Acanthurus blochii	6	KO2	9	1400.24			
H	Acanthurus blochii	6	KO2	9	2976.03			
H	Ctenochaetus strigosus	6	KO2	15	1982.01			
H	Ctenochaetus strigosus	6	KO2	7	461.05			
H	Zebrasoma flavescens	6	KO2	10	260.30			
H	Zebrasoma flavescens	6	KO2	2	106.56			
H	Naso lituratus	6	KO2	1	622.36			
H	Naso lituratus	6	KO2	1	311.61	217	31396.16	67.2
O	Stegastes fasciolatus	6	KO2	2	51.96			
O	Melichthys niger	6	KO2	11	2728.34			
O	Melichthys vidua	6	KO2	1	199.03			
O	Canthigaster jactator	6	KO2	2	7.12	16	2986.46	6.4
P	Abudefduf abdominalis	6	KO2	23	720.65	23	720.65	1.5
	TOTAL	6	KO2	314	46697.6916	314	46697.692	100

GRP	21-Dec-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Myripristis amaenus	7	KAHE1D	23	1887.91			
C	Aulostomus chinensis	7	KAHE1D	1	52.00			
C	Mulloides flavolineatus	7	KAHE1D	25	3256.98			
C	Mulloides vanicolensis	7	KAHE1D	259	38402.30			
C	Parupeneus multifasciatus	7	KAHE1D	4	384.33			
C	Forcipiger flavissimus	7	KAHE1D	2	18.30			
C	Cirrhitus pinnulatus	7	KAHE1D	1	162.54			
C	Labroides phthirophagus	7	KAHE1D	2	2.98			
C	Thalassoma duperrey	7	KAHE1D	11	301.30			
C	Thalassoma duperrey	7	KAHE1D	44	4270.29			
C	Thalassoma duperrey	7	KAHE1D	28	1538.57			
C	Thalassoma ballieui	7	KAHE1D	1	167.53			
C	Zanclus cornutus	7	KAHE1D	1	104.16			
C	Rhinecanthus rectangulus	7	KAHE1D	1	85.87			
C	Sufflamen fraenatus	7	KAHE1D	1	224.79	404	50859.82	77.0
CF	Chaetodon ornatissimus	7	KAHE1D	2	138.00	2	138.00	0.2
H	Acanthurus triostegus	7	KAHE1D	1	187.60			
H	Acanthurus nigrofuscus	7	KAHE1D	17	127.92			
H	Acanthurus nigrofuscus	7	KAHE1D	133	3178.31			
H	Ctenochaetus strigosus	7	KAHE1D	55	3622.57			
H	Ctenochaetus strigosus	7	KAHE1D	87	2335.42			
H	Zebrasoma flavescens	7	KAHE1D	4	104.12	297	9555.94	14.5
O	Stegastes fasciolatus	7	KAHE1D	12	311.76			
O	Melichthys niger	7	KAHE1D	48	4783.44			
O	Melichthys vidua	7	KAHE1D	3	373.04			
O	Canthigaster jactator	7	KAHE1D	3	22.77	66	5491.02	8.3
	TOTAL	7	KAHE1D	769	66044.7822	769	66044.782	100
C	Fistularia commersoni	8	KAHE5B	4	182.27			
C	Parupeneus multifasciatus	8	KAHE5B	1	96.08			
C	Forcipiger flavissimus	8	KAHE5B	1	9.15			
C	Plectroglyphidodon johnstonianu	8	KAHE5B	1	3.03			
C	Plectroglyphidodon imparipennis	8	KAHE5B	1	0.86			
C	Thalassoma duperrey	8	KAHE5B	5	485.26			
C	Thalassoma duperrey	8	KAHE5B	4	44.65			
C	Thalassoma duperrey	8	KAHE5B	3	82.17			
C	Thalassoma duperrey	8	KAHE5B	6	329.69			
C	Gomphosus varius	8	KAHE5B	1	39.39			
C	Coris gaimard	8	KAHE5B	1	8.57			
C	Halichoeres ornatissimus	8	KAHE5B	1	9.52			
C	Zanclus cornutus	8	KAHE5B	1	104.16			
C	Rhinecanthus rectangulus	8	KAHE5B	1	85.87			
C	Sufflamen bursa	8	KAHE5B	3	257.62	34	1738.30	39.4
CF	Chaetodon multicinctus	8	KAHE5B	2	26.06	2	26.06	0.6
H	Calotomus carolinus	8	KAHE5B	2	26.93			
H	Scarus sordidus	8	KAHE5B	4	54.92			
H	Cirripectes variolosus	8	KAHE5B	1	13.83			
H	Acanthurus nigrofuscus	8	KAHE5B	47	1123.16			
H	Zebrasoma flavescens	8	KAHE5B	6	319.68			
H	Naso lituratus	8	KAHE5B	1	72.58			
H	Naso lituratus	8	KAHE5B	1	14.90			
H	Naso lituratus	8	KAHE5B	2	411.98	64	2037.98	46.2
O	Stegastes fasciolatus	8	KAHE5B	3	77.94			
O	Melichthys vidua	8	KAHE5B	2	398.06			
O	Cantherhines sandwichiensis	8	KAHE5B	1	82.05			
O	Canthigaster jactator	8	KAHE5B	2	7.12	8	565.18	12.8
P	Chromis vanderbilti	8	KAHE5B	125	39.49	125	39.49	0.9
	TOTAL	8	KAHE5B	233	4407.00127	233	4407.0013	100

GRP	21-Dec-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Mulloides vanicolensis	9	KAHE7B	200	66275.00			
C	Parupeneus pleurostigma	9	KAHE7B	1	58.01			
C	Parupeneus multifasciatus	9	KAHE7B	2	108.80			
C	Parupeneus multifasciatus	9	KAHE7B	1	235.75			
C	Parupeneus cyclostomus	9	KAHE7B	1	24.80			
C	Thalassoma duperrey	9	KAHE7B	1	27.39			
C	Gomphosus varius	9	KAHE7B	1	22.60			
C	Zanclus cornutus	9	KAHE7B	1	104.16			
C	Sufflamen bursa	9	KAHE7B	3	257.62	211	67114.12	97.6
CF	Chaetodon multicinctus	9	KAHE7B	1	13.03	1	13.03	0.02
H	Calotomus carolinus	9	KAHE7B	1	707.00			
H	Acanthurus nigrofuscus	9	KAHE7B	12	90.30			
H	Acanthurus nigrofuscus	9	KAHE7B	12	286.76			
H	Acanthurus olivaceus	9	KAHE7B	1	261.67			
H	Naso lituratus	9	KAHE7B	1	205.99	27	1551.72	2.3
P	Chromis vanderbilti	9	KAHE7B	33	10.42			
P	Chromis ovalis	9	KAHE7B	7	80.92	40	91.34	0.1
	TOTAL	9	KAHE7B	279	68770.2144	279	68770.214	100
C	Decapterus macarellus	10	KAHE7C	19	2475.30			
C	Parupeneus multifasciatus	10	KAHE7C	3	707.24			
C	Parupeneus multifasciatus	10	KAHE7C	1	96.08			
C	Coris gaimard	10	KAHE7C	1	83.79			
C	Zanclus cornutus	10	KAHE7C	5	274.49			
C	Sufflamen bursa	10	KAHE7C	4	343.49	33	3980.40	77.4
H	Acanthurus triostegus	10	KAHE7C	3	138.95			
H	Acanthurus nigrofuscus	10	KAHE7C	1	23.90			
H	Acanthurus nigrofuscus	10	KAHE7C	1	54.25			
H	Acanthurus nigrofuscus	10	KAHE7C	1	102.47			
H	Acanthurus olivaceus	10	KAHE7C	9	427.29			
H	Acanthurus olivaceus	10	KAHE7C	1	93.77			
H	Acanthurus blochii	10	KAHE7C	1	97.98			
H	Naso lituratus	10	KAHE7C	1	205.99	18	1144.59	22.3
O	Canthigaster jactator	10	KAHE7C	2	15.18	2	15.18	0.3
P	Chromis vanderbilti	10	KAHE7C	3	0.95	3	0.95	0.02
	TOTAL	10	KAHE7C	56	5141.1255	56	5141.1255	100
C	Decapterus macarellus	11	KAHE7D	16	2084.47			
C	Parupeneus multifasciatus	11	KAHE7D	1	96.08			
C	Parupeneus multifasciatus	11	KAHE7D	1	340.44			
C	Sufflamen bursa	11	KAHE7D	1	85.87			
C	Sufflamen fraenatus	11	KAHE7D	1	144.65	20	2751.51	74.2
H	Acanthurus nigroris	11	KAHE7D	1	102.47			
H	Acanthurus olivaceus	11	KAHE7D	4	654.07	5	756.54	20.4
O	Melichthys vidua	11	KAHE7D	1	199.03	1	199.03	5.4
P	Dascyllus albisella	11	KAHE7D	1	0.80			
P	Chromis vanderbilti	11	KAHE7D	7	2.21	8	3.01	0.1
	TOTAL	11	KAHE7D	34	3710.0973	34	3710.0973	100

GRP	21-Dec-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Aulostomus chinensis	12	KAHE7E	1	27.72			
C	Decapterus macarellus	12	KAHE7E	1	191.63			
C	Aphareus furcatus	12	KAHE7E	1	148.23			
C	Aphareus furcatus	12	KAHE7E	1	44.64			
C	Parupeneus multifasciatus	12	KAHE7E	8	88.41			
C	Parupeneus multifasciatus	12	KAHE7E	2	471.50			
C	Parupeneus multifasciatus	12	KAHE7E	2	108.80			
C	Parupeneus multifasciatus	12	KAHE7E	12	37.43			
C	Forcipiger flavissimus	12	KAHE7E	2	18.30			
C	Paracirrhites arcatus	12	KAHE7E	3	49.05			
C	Pseudojuloides cerasinus	12	KAHE7E	4	44.65			
C	Pseudojuloides cerasinus	12	KAHE7E	7	22.05			
C	Zanclus cornutus	12	KAHE7E	2	109.80			
C	Sufflamen bursa	12	KAHE7E	1	19.92			
C	Sufflamen bursa	12	KAHE7E	6	515.24			
C	Sufflamen fraenatus	12	KAHE7E	1	144.65			
C	Diodon hystrix	12	KAHE7E	1	660.12	55	2702.15	61.8
CF	Chaetodon ornatissimus	12	KAHE7E	2	16.43			
CF	Chaetodon multicinctus	12	KAHE7E	4	3.31			
CF	Chaetodon multicinctus	12	KAHE7E	3	19.97			
CF	Pervagor spilosoma	12	KAHE7E	1	16.22	10	55.93	1.3
H	Centropyge potteri	12	KAHE7E	2	3.43			
H	Calotomus carolinus	12	KAHE7E	1	13.46			
H	Acanthurus triostegus	12	KAHE7E	1	46.32			
H	Acanthurus nigrofuscus	12	KAHE7E	35	263.36			
H	Acanthurus nigrofuscus	12	KAHE7E	15	15.65			
H	Acanthurus olivaceus	12	KAHE7E	3	2.08			
H	Acanthurus olivaceus	12	KAHE7E	3	17.20			
H	Acanthurus olivaceus	12	KAHE7E	1	261.67			
H	Ctenochaetus strigosus	12	KAHE7E	9	7.84			
H	Zebrasoma flavescens	12	KAHE7E	7	11.82			
H	Naso lituratus	12	KAHE7E	6	25.43			
H	Naso lituratus	12	KAHE7E	1	36.34			
H	Naso lituratus	12	KAHE7E	3	617.96	87	1322.57	30.3
O	Melichthys vidua	12	KAHE7E	1	199.03	1	199.03	4.6
P	Chromis vanderbilti	12	KAHE7E	215	67.92			
P	Chromis verater	12	KAHE7E	1	19.94			
P	Chromis hanui	12	KAHE7E	5	3.73	221	91.59	2.1
	TOTAL	12	KAHE7E	374	4371.2621	374	4371.2621	100
C	Aulostomus chinensis	13	KAHE10	1	52.00			
C	Lutjanus kasmira	13	KAHE10	225	24740.71			
C	Mulloides flavolineatus	13	KAHE10	130	10847.80			
C	Mulloides vanicolensis	13	KAHE10	350	31688.07			
C	Parupeneus multifasciatus	13	KAHE10	1	155.42			
C	Parupeneus multifasciatus	13	KAHE10	3	288.24			
C	Parupeneus bifasciatus	13	KAHE10	1	59.77			
C	Parupeneus cyclostomus	13	KAHE10	1	88.57			
C	Forcipiger flavissimus	13	KAHE10	1	9.15			
C	Chaetodon auriga	13	KAHE10	2	96.78			
C	Thalassoma duperrey	13	KAHE10	13	356.08			
C	Thalassoma duperrey	13	KAHE10	7	384.64			
C	Thalassoma duperrey	13	KAHE10	7	679.36			
C	Thalassoma lutescens	13	KAHE10	2	345.29			
C	Gomphosus varius	13	KAHE10	1	62.03			
C	Zanclus cornutus	13	KAHE10	2	208.32			
C	Rhinecanthus rectangulus	13	KAHE10	1	85.87			
C	Sufflamen bursa	13	KAHE10	3	257.62	751	70405.72	90.5
CF	Chaetodon ornatissimus	13	KAHE10	2	138.00			
CF	Chaetodon multicinctus	13	KAHE10	2	26.06			
CF	Cantherhines dumerili	13	KAHE10	1	194.98	5	359.04	0.5
H	Calotomus carolinus	13	KAHE10	2	263.37			
H	Calotomus carolinus	13	KAHE10	1	1288.03			
H	Acanthurus leucopareius	13	KAHE10	1	66.74			
H	Acanthurus nigrofuscus	13	KAHE10	38	908.09			
H	Naso lituratus	13	KAHE10	4	823.95	46	3350.19	4.3
O	Stegastes fasciolatus	13	KAHE10	2	51.96			
O	Melichthys niger	13	KAHE10	7	1143.35			
O	Melichthys vidua	13	KAHE10	1	199.03			
O	Cantherhines sandwichiensis	13	KAHE10	1	82.05			
O	Canthigaster jactator	13	KAHE10	4	30.36	15	1506.75	1.9
P	Dascyllus albisella	13	KAHE10	21	64.85			
P	Abudefduf abdominalis	13	KAHE10	59	1848.62			
P	Abudefduf vaigensis	13	KAHE10	9	281.99			
P	Chromis vanderbilti	13	KAHE10	25	7.90	114	2203.37	2.8
	TOTAL	13	KAHE10	931	77825.0696	931	77825.07	100

GRP	21-Dec-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Parupeneus multifasciatus	14	NANA1	1	54.40			
C	Plectroglyphidodon imparipennis	14	NANA1	2	1.72			
C	Chromis vanderbilti	14	NANA1	21	6.63			
C	Acanthurus nigrofuscus	14	NANA1	9	215.07			
C	Acanthurus olivaceus	14	NANA1	1	19.74			
C	Rhinecanthus rectangulus	14	NANA1	1	85.87	35	383.45	54.3
CF	Thalassoma duperrey	14	NANA1	1	27.39	1	27.39	3.9
O	Acanthurus nigrofuscus	14	NANA1	5	37.62			
O	Acanthurus nigroris	14	NANA1	3	71.69			
O	Sufflamen bursa	14	NANA1	2	171.75			
O	Canthigaster rivulata	14	NANA1	1	13.65	11	294.71	41.8
	TOTAL	14	NANA1	47	705.5500	47	705.55003	100
C	Lutjanus kasmira	15	NANA2	2	381.29			
C	Mulloides flavolineatus	15	NANA2	8	4948.40			
C	Parupeneus multifasciatus	15	NANA2	1	27.12			
C	Plectroglyphidodon johnstonianus	15	NANA2	2	3.44			
C	Paracirrhites forsteri	15	NANA2	1	39.65			
C	Thalassoma duperrey	15	NANA2	4	44.65			
C	Thalassoma duperrey	15	NANA2	3	82.17			
C	Thalassoma duperrey	15	NANA2	4	219.80			
C	Thalassoma duperrey	15	NANA2	2	194.10			
C	Stethojulis balteata	15	NANA2	1	35.76			
C	Halichoeres ornatissimus	15	NANA2	1	16.45			
C	Zanclus cornutus	15	NANA2	2	208.32			
C	Sufflamen bursa	15	NANA2	3	257.62	34	6458.78	20.5
CF	Chaetodon ornatissimus	15	NANA2	2	138.00			
CF	Chaetodon multicinctus	15	NANA2	4	52.12	6	190.12	0.6
H	Acanthurus triostegus	15	NANA2	9	900.13			
H	Acanthurus leucopareius	15	NANA2	16	9029.87			
H	Acanthurus leucopareius	15	NANA2	22	5118.86			
H	Acanthurus nigrofuscus	15	NANA2	18	430.15			
H	Acanthurus nigroris	15	NANA2	7	3830.34			
H	Acanthurus blochii	15	NANA2	5	489.88			
H	Ctenochaetus strigosus	15	NANA2	16	429.50			
H	Ctenochaetus strigosus	15	NANA2	3	22.73			
H	Ctenochaetus strigosus	15	NANA2	8	526.92			
H	Zebrasoma flavescens	15	NANA2	7	11.82			
H	Zebrasoma flavescens	15	NANA2	5	266.40			
H	Naso lituratus	15	NANA2	5	3111.78	121	24168.37	76.6
O	Stegastes fasciolatus	15	NANA2	1	25.98			
O	Melichthys niger	15	NANA2	6	597.93			
O	Cantherhines sandwichiensis	15	NANA2	1	82.05			
O	Canthigaster jactator	15	NANA2	3	22.77	11	728.73	2.3
P	Chromis vanderbilti	15	NANA2	12	3.79	12	3.79	0.01
	TOTAL	15	NANA2	184	31549.7976	184	31549.798	100

GRP	21-Dec-17 SPECIES	RB	STATION	NO.	BIOMASS	NO. IND	GROUP BIOMASS	GROUP PERCENT
C	Myripristis amaenus	16	PIPE	40	1696.13			
C	Aulostomus chinensis	16	PIPE	2	103.99			
C	Priacanthus meeki	16	PIPE	2	319.99			
C	Decapterus macarellus	16	PIPE	50	6513.95			
C	Monotaxis grandoculis	16	PIPE	1	13.74			
C	Mulloides flavolineatus	16	PIPE	400	107736.35			
C	Mulloides vanicolensis	16	PIPE	35	1768.14			
C	Mulloides vanicolensis	16	PIPE	200	66275.00			
C	Parupeneus multifasciatus	16	PIPE	3	288.24			
C	Parupeneus cyclostomus	16	PIPE	1	88.57			
C	Forcipiger flavissimus	16	PIPE	3	27.45			
C	Plectroglyphidodon johnstonianu	16	PIPE	4	6.89			
C	Cirrhitops fasciatus	16	PIPE	4	62.51			
C	Thalassoma duperrey	16	PIPE	10	549.49			
C	Thalassoma duperrey	16	PIPE	11	301.30			
C	Thalassoma duperrey	16	PIPE	17	1649.88			
C	Stethojulis balteata	16	PIPE	7	506.72			
C	Halichoeres ornatissimus	16	PIPE	5	125.68			
C	Halichoeres ornatissimus	16	PIPE	5	82.25			
C	Zanclus cornutus	16	PIPE	1	54.90			
C	Zanclus cornutus	16	PIPE	3	312.47			
C	Sufflamen bursa	16	PIPE	4	343.49	808	188827.15	90.6
CF	Chaetodon multicinctus	16	PIPE	4	52.12	4	52.12	0.03
H	Scarus sordidus	16	PIPE	2	280.01			
H	Acanthurus nigrofuscus	16	PIPE	60	1433.82			
H	Acanthurus nigrofuscus	16	PIPE	20	150.49	82	1864.33	0.9
O	Stegastes fasciolatus	16	PIPE	6	155.88			
O	Melichthys vidua	16	PIPE	3	373.04			
O	Cantherhines sandwichiensis	16	PIPE	1	82.05	10	610.97	0.3
P	Dascyllus albisella	16	PIPE	65	200.74			
P	Abudefduf abdominalis	16	PIPE	225	7049.83			
P	Abudefduf vaigensis	16	PIPE	170	7964.82			
P	Chromis ovalis	16	PIPE	70	1395.71			
P	Chromis agilis	16	PIPE	9	13.10			
P	Naso hexacanthus	16	PIPE	12	467.09	551	17091.29	8.2
	TOTAL	16	PIPE	1455	208445.8587	1455	208445.86	100