# CIP GENERATION PROJECT

# 2016 COMMUNITY BENEFITS PROGRAM

# REEF FISH MONITORING PROJECT

# YEAR 9 RESULTS

Prepared For:

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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 ninth annual report for this effort covering the period from December 2007 through December 2016 with a focus on the surveys completed in 2016. 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 2016 was hampered by inclement weather. The 2016 surveys were completed on 15 April (1st quarter), 5 July (2nd quarter) and 18 August (3rd quarter). The first and fourth quarter work could not be completed in a timely fashion due to poor weather conditions due to the protracted El Nino event that created a record number of major storms (15 in all) and generating prolonged high surf events as they passed by the Hawaiian Islands in 2015. Inclement weather events from 2015 continued into 2016. As a result the fourth quarter 2016 field work was completed on 15 March 2017. To avoid confusion with future 2017 surveys, this last (4th quarter) survey is included in the 2016 quarterly work herein.

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 thirty-six 2007-2016 survey periods, thus demonstrating stability in these communities. All species of fishes censused in the present study have been assigned to one of five feeding guilds (or trophic categories): herbivores (species feeding on algae), planktivores (species that feed on zooplankton up in the water column), omnivores (species that feed on both algae and small animals), coral feeders which are a specialized group feeding on coral tissue or mucous, and carnivores which are species feeding on smaller fishes and invertebrates living on the coral reef. Of the 151 species of fishes encountered in the thirty-six 2007-2016 surveys, twenty-six species are herbivores, fifteen are planktivores, seven are omnivores, eight are coral feeders and 95 are carnivores. Fifteen of the sixteen monitored locations are established on natural substratum where 89% 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 ninth years (2010-2016) 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 2007-2016 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 two stations (numbers 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 both 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 (2007-2016) 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 40 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 2007-2016 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 2016. 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) and the continuing operational phase data for 2016 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 ninth annual report since monitoring began for the CIP Generating Station and the seventh annual report since it began operating. This report includes a comparative assessment to baseline and during plant construction periods.

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

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

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

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

In exposed locations in Hawai'i, storm waves keep coral communities at an early point in succession (Dollar 1982, Grigg 1983, Dollar and Tribble 1993). Under such situations, coral colonies never attain any significant size and growth forms are usually prostrate, thus reducing their exposure to wave energy. Since much of the development in the associated fish community is related to the topographical complexity of the substratum (Risk 1972) and much of this complexity is directly due to the growth of corals, fish community development is usually reduced where coral communities are poorly developed and shelter space is lacking. Besides topographical complexity providing shelter habitat for fishes, the highly variable shelter created by coral communities serves a wide range of invertebrate and algal communities which may be forage for many fish species. Thus the development of coral reef fish communities is often directly linked to the degree of development of coral communities and factors that negatively affect the coral community frequently will have a similar negative impact to the fish community.

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

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

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

As part of the National Pollutant Discharge Elimination System (NPDES) permit conditions allowing the discharge of thermally-elevated cooling water into the marine environment at Kahe Point, Hawaiian Electric was required to monitor the status of the coral, algae and fish communities in the offshore waters fronting and in the vicinity of the plant. The findings from these early monitoring efforts provide an excellent overview of the environmental changes that occurred in the Kahe Point area prior to the three storm events in 1980, 1982 and 1992 and after the January 1980 and November 1982 events. Studies on coral coverage showed a significant decrease of 7% from 1973 to 1975 and an additional 13% from 1975 to 1977. These decreases were correlated with proximity to the Kahe plant discharge but the analyses did not determine whether the disturbance associated with outfall construction or plant operation were definitive factors producing the mortality. In contrast to the increased mortality, settlement and growth of coral recruits increased with proximity to the outfall after the plant began operating, which suggests that outfall construction rather than plant operation was the major factor in producing the mortality. Fish populations throughout the study area showed no changes except on the marginal reefs to the northeast of the outfall where both the numbers of species and individuals censused decreased following the commencement of outfall operations. However, the number of intertidal species on the rocky shoreline increased in the areas of thermal impingement (Coles *et al.* 1985a).

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

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). Nonparametric 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 2016 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. 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.

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 2016 data are presented below along with a comparative analysis of all data collected to date.

The complete data set from the four 2016 surveys is given in Appendix 1 and this information is summarized in Table 2 along with the earlier (2007-2015) 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 thirty-six 2007-2016 sample periods?” To address this question two nonparametric tests were used: the Kruskal-Wallis analysis of variance (ANOVA) and the Student-Newman-Kuels (SNK) Test. The Kruskal-Wallis ANOVA is able to demonstrate statistically significant differences among parameter means (by date) but cannot show where those differences are. The SNK Test is used to group related sample means and separate those means that are significantly different from one another. The results of these analyses are given in Table 3. Referring to Table 3, the Kruskal-Wallis ANOVA noted no statistically significant differences exist among the means for each of the thirty-six 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 thirty-six 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 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 thirty-six (2007-2016) 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 seven years covering the operation phase of the facility, there were 109 species of fishes recorded at the sixteen sites in 2010, in 2011, 106 species, in 2012, 100 species, in 2013, 107 species, in 2014, 110 species, in 2015, 109 species and in the four surveys covering 2016 there were 110 species observed at the sixteen sites. In total among the thirty-six surveys, 151 species of fishes have been recorded among the sixteen survey sites. Forty-eight percent or 72 species encountered were in common among the thirty-six surveys carried out over the nine-year period. These data suggest a reasonable level of stability in these fish communities.

Of the 151 species of fishes recorded over the thirty-six surveys, 63% (95 species) are carnivores, 17% (26 species) are herbivores, 10% (or 15 species) are planktivores, 5% (7 species) are omnivores and 5% (8 species) are coral feeders. The assignment of fish species to the five trophic categories are given in Appendix 1 of this report as well as in Brock (2009, 2010, 2011, 2012, 2013, 2014, 2015 and 2016) for species encountered on each transect and earlier survey dates. Table 4 summarizes the feeding guild information by survey date providing the mean percent contribution by weight of each trophic category for stations in two groups; the first group includes Stations 1 through 15 (natural substratum) and the second group considers only Station 16 (the Kahe outfall station). Although the data in Table 4 are in summary form, two facts emerge: (1) that the majority (here 89%) 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 28%) but carnivores remain important at Station 16 (53%) 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% and in 2016 back up to 28% 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 2007-16 period?" can be answered again using the Kruskal-Wallis ANOVA and the SNK Test. The results of these statistical procedures are given in Table 5. As noted previously, the Kruskal-Wallis ANOVA can discern whether means differ significantly but cannot separate those that are thus the SNK Test is used to demonstrate which means differ significantly from the others. In all cases the ANOVA noted significant differences exist among the four areas (i.e., CIP, Ko'Olina, Kahe and Nanakuli) for all three parameters (i.e., mean number of fish species per transect, mean number of individual fish per transect and mean standing crop of fishes per transect). The SNK Test demonstrated that the mean number of fish species, individuals and standing crops are significantly greater and statistically separable at the Ko'Olina group of stations over the three other station groups, all of which were related (Table 5). Coral community development (coverage) appears to be greater at the three Ko'Olina stations than found at any of the other transect sites and may be responsible for the greater diversity of species, numbers of individuals and standing crops present there.

Summarizing the results presented in Table 5, several non-significant trends are apparent. First, there is no statistical separation among the Nanakuli, Kahe and CIP station groups for the three parameters measured here (i.e., mean number of fish species, individuals or standing crop per transect); secondly the Nanakuli group of stations ranked second to the Ko'Olina group of stations for two of the three measures (i.e., mean number of fish species per transect and mean number of individual fish per transect) and lastly, the CIP and Kahe station groups have similar means especially for the mean number of fish species and individuals. These results are not unexpected because the development of benthic communities, including corals, is greater at Ko'Olina than it is offshore of most Kahe and Nanakuli stations and at all Campbell Industrial Park stations where the topographical complexity which often serves as shelter for fishes is probably the least among the four station groups. Benthic community development, which includes the development of corals and topographical complexity, are probably less at the North group of stations (Station nos. 13-15) relative to Ko'Olina but greater than found offshore of Kahe or Campbell Industrial Park. The probable reason for the greater estimated standing crops at the CIP and Nanakuli stations over those found at Kahe stations is the presence of cover serving as shelter for fishes. At CIP Station 1 there is a natural circular depression (about ten meters in diameter and 1.5 meters deep) having undercut ledges located about 6 meters shoreward of station 1 and at Stations 13 and 15 there is considerable cover created by the spur and groove formations. Because these geologic features serve as shelter for these diurnally-active fishes (i.e., surgeonfishes, goatfishes, wrasses, etc.) which if present and foraging out across the substratum away from the cover will occasionally pass through the transect during censusing resulting in higher biomass estimates.

The final statistical analysis of the 2007-2016 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 2007-2016?" 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 11 and 14 where the mean number of fish species is significantly less than at all other stations (all of which are related). Station 11 also has the least mean number of individual fish (non-significant) and the second lowest mean standing crop (not statistically separable). These low numbers are probably related to the poorly developed coral community at 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) provides lists of all fish species observed over the thirty-six 2007-2016 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 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 both 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 are many mamo (two species recognized, the Hawaiian mamo - *Abudefduf abdominalis* and the recently recognized species *Abudefduf vaigiensis*). Under the cover of the rocks are seen menpachi (*Myripristes amaneus*), aweoweo (*Priacanthus cruentatus*) and 'upapalu (*Apogon kallopterus*). In the December 2007 survey an estimated 200 grey mullet or ama'ama (*Mugil cephalus*) were encountered at Station 13. These fish had an average estimated length of 33 cm (~13 inches) contributing an estimated weight of 97.7 kilograms (215 lbs) to the standing crop at this station.

Many coral reef species other than fish are caught and consumed by people; among these are specific algae and a number of invertebrates. Some individuals are interested in the collection of shells and when these usually cryptic species are seen at a station, they are so noted. Two species of molluscs have been observed on several occasions in the 2007-2016 surveys; these are the tiger cowry (*Cypraea tigris*) and the triton shell (*Charonia tritonis*). A species important in the making of fishing lures is the pearl oyster or pa (*Pinctado margaritifera*) which is protected by law and is commonly seen at many of the survey sites. The octopus or he'e (*Octopus cyanea*) was occasionally encountered at some of the stations. Individual he'e ranged from less than a pound in weight up to an estimated four pounds. The sought-after alga, limu kohu (*Asparagopsis taxiformis*) is seasonally common at many of the stations sampled in this study.

**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.

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 Early Hawaiian Electric Biological Data to the 2007-2016 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 2007-2016 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 2007-2016 periods?" Again, to address this question two non-parametric tests were used: the Kruskal-Wallis analysis of variance (ANOVA) and the Student-Newman-Kuels (SNK) Test where the Kruskal-Wallis ANOVA is used to demonstrate statistically significant differences among parameter means (by date) but cannot show where those differences are and the SNK Test is used to group related sample means and separate those means that are significantly different from one another.

The results of these analyses are given in Table 7 and referring to this table, it is shown that there are no significant differences among either of the annual means for the number of fish species seen per transect or the number of individual fish censused per transect despite the imposition of three major storm events. With respect to the annual mean number of species per transect, we find the greatest annual means occurring prior to the January 1980 storm event and the lowest mean (1983) occurring following Hurricane Iwa in 1982. With the annual mean number of individual fish seen per transect, the highest means occur with the recent (2007-2016) 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 2007-2016 dataset. Despite the mean estimated standing crop (here 61 $g/m^2$) being greater in 2007-2016 than in 1984 (26 $g/m^2$), the Wilcoxon Two-Sample Test failed to find any statistically significant differences ($p>0.18$, 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 40-year period (1976-2016) 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-three of the thirty-six 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.

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 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 40 years of well-documented environmental history for the Barbers Point - Kahe Point area (completed largely by the Hawaiian Electric environmental program), provides much of the explanation to the degree of development of resident fish communities we encounter in the area today.

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

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

**TABLE 2.** Summary of the fish censuses carried out at sixteen locations on thirty-six surveys over the 2007 - 2016 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

| | | | | | % Total Biomass (g) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sample Date | Transect No. | No. Species | No. Individuals | Biomass g/m2 | 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

| | | | | | | | % Total Biomass (g) | | |
|---|---|---|---|---|---|---|---|---|---|
| Sample Date | Transect No. | No. Species | No. Individuals | Biomass g/m2 | 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

| | | | | | % Total Biomass (g) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sample Date | Transect No. | No. Species | No. Individuals | Biomass g/m2 | 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

| | | | | | % Total Biomass (g) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sample Date | Transect No. | No. Species | No. Individuals | Biomass g/m2 | 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 | 230.94 | 89 | | 0 | 11 | |
| | 2 | 20 | 278 | 159.72 | 89 | 0 | 2 | 8 | 1 |
| | 3 | 24 | 283 | 92.94 | 44 | 0 | 9 | 46 | 1 |
| | 4 | 37 | 310 | 141.95 | 80 | 0 | 10 | 8 | 1 |
| | 5 | 31 | 275 | 59.14 | 52 | 1 | 20 | 22 | 4 |
| | 6 | 29 | 381 | 95.85 | 58 | 4 | 16 | 17 | 6 |
| | 7 | 20 | 677 | 229.11 | 17 | | 62 | 21 | 0 |
| | 8 | 27 | 146 | 30.83 | 18 | 0 | 10 | 66 | 6 |
| | 9 | 17 | 81 | 10.81 | 58 | 1 | | 40 | 1 |
| | 10 | 19 | 47 | 15.88 | 67 | 2 | | 31 | 1 |
| | 11 | 3 | 5 | 4.56 | | | 2 | 98 | |
| | 12 | 22 | 137 | 16.27 | 38 | 13 | 18 | 30 | 1 |
| | 13 | 26 | 612 | 313.06 | 5 | 1 | 1 | 93 | 0 |
| | 14 | 15 | 85 | 14.69 | 52 | | | 43 | 5 |
| | 15 | 23 | 174 | 52.67 | 73 | 0 | 11 | 15 | 1 |
| | 16 | 43 | 1246 | 253.63 | 24 | 19 | 2 | 55 | 0 |
| 18-Jun-15 | 1 | 19 | 277 | 129.33 | 83 | 0 | 1 | 16 | |
| | 2 | 16 | 249 | 92.08 | 84 | 0 | 2 | 14 | 0 |
| | 3 | 20 | 160 | 18.41 | 36 | 0 | 34 | 28 | 2 |
| | 4 | 19 | 386 | 248.08 | 90 | 0 | 3 | 7 | 0 |
| | 5 | 29 | 284 | 68.11 | 28 | 2 | 12 | 56 | 2 |
| | 6 | 28 | 190 | 72.43 | 63 | 1 | 13 | 19 | 4 |
| | 7 | 28 | 587 | 122.54 | 22 | 5 | 49 | 23 | 0 |
| | 8 | 25 | 183 | 38.91 | 66 | 7 | 5 | 21 | 2 |
| | 9 | 21 | 121 | 34.32 | 66 | 1 | 4 | 29 | 0 |
| | 10 | 11 | 43 | 21.04 | 62 | 21 | | 16 | 1 |
| | 11 | 7 | 15 | 20.37 | 55 | 2 | 23 | 20 | |
| | 12 | 25 | 179 | 67.62 | 17 | 1 | 8 | 74 | 0 |
| | 13 | 25 | 901 | 600.04 | 1 | 3 | 0 | 96 | 0 |
| | 14 | 13 | 73 | 8.67 | 81 | 0 | | 19 | |
| | 15 | 21 | 235 | 94.93 | 16 | 5 | 5 | 73 | 1 |
| | 16 | 29 | 1435 | 505.80 | 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 | 1196.47 | 29 | 0 | 1 | 69 | 0 |
| | 6 | 30 | 379 | 111.53 | 77 | | 5 | 17 | 1 |
| | 7 | 24 | 348 | 159.35 | 49 | | 30 | 20 | 1 |
| | 8 | 27 | 348 | 73.62 | 72 | 2 | 4 | 20 | 2 |
| | 9 | 19 | 106 | 26.26 | 60 | 1 | 7 | 32 | 1 |
| | 10 | 17 | 45 | 26.46 | 45 | 0 | 4 | 52 | |
| | 11 | 8 | 22 | 15.61 | | 0 | 20 | 76 | 4 |
| | 12 | 29 | 546 | 58.41 | 20 | 10 | 14 | 57 | 0 |
| | 13 | 26 | 457 | 161.41 | 6 | 4 | 15 | 75 | 0 |
| | 14 | 14 | 197 | 59.91 | 87 | 0 | 0 | 11 | 1 |
| | 15 | 31 | 316 | 280.07 | 68 | 1 | 0 | 30 | 0 |
| | 16 | 35 | 978 | 558.85 | 7 | 8 | 3 | 81 | 0 |
| 08-Apr-16 | 1 | 21 | 245 | 107.07 | 83 | | 1 | 15 | 1 |
| | 2 | 25 | 262 | 290.73 | 93 | 0 | 1 | 5 | 1 |
| | 3 | 20 | 236 | 156.84 | 88 | 0 | 1 | 11 | 0 |
| | 4 | 24 | 370 | 145.15 | 74 | 6 | 4 | 15 | 0 |
| | 5 | 22 | 678 | 517.35 | 12 | 1 | 1 | 85 | 0 |
| | 6 | 22 | 158 | 44.51 | 54 | | 13 | 29 | 4 |
| | 7 | 21 | 398 | 87.26 | 45 | | 30 | 21 | 3 |
| | 8 | 20 | 410 | 96.88 | 86 | 2 | 1 | 11 | 0 |
| | 9 | 18 | 127 | 132.39 | 7 | 0 | 0 | 93 | 0 |
| | 10 | 14 | 43 | 22.47 | 64 | 2 | 7 | 27 | |
| | 11 | 6 | 10 | 6.09 | | 0 | 3 | 97 | |
| | 12 | 23 | 651 | 29.03 | 15 | 3 | 48 | 32 | 1 |
| | 13 | 27 | 406 | 146.28 | 10 | 5 | 3 | 82 | 0 |
| | 14 | 15 | 95 | 43.37 | 94 | 0 | | 6 | |
| | 15 | 21 | 185 | 151.05 | 93 | | 0 | 6 | 0 |
| | 16 | 25 | 1039 | 280.58 | 36 | 21 | 13 | 31 | 0 |
| 15-Apr-16 | 1 | 21 | 155 | 171.41 | 94 | 0 | 0 | 5 | 1 |
| | 2 | 27 | 369 | 395.15 | 91 | 0 | 1 | 7 | 0 |
| | 3 | 26 | 209 | 256.30 | 89 | | 3 | 7 | 0 |
| | 4 | 29 | 253 | 180.30 | 85 | 2 | 2 | 10 | 0 |
| | 5 | 25 | 1162 | 969.45 | 8 | | 1 | 91 | 0 |
| | 6 | 20 | 188 | 47.69 | 35 | | 42 | 20 | 3 |
| | 7 | 30 | 365 | 69.99 | 29 | 0 | 20 | 50 | 1 |
| | 8 | 26 | 344 | 61.51 | 75 | 0 | 3 | 19 | 2 |
| | 9 | 12 | 53 | 9.62 | 57 | 0 | 7 | 35 | 1 |
| | 10 | 17 | 57 | 84.42 | 16 | | 1 | 83 | 0 |
| | 11 | 4 | 6 | 16.16 | 66 | | | 34 | |
| | 12 | 29 | 225 | 43.14 | 14 | 15 | 35 | 36 | 0 |
| | 13 | 34 | 661 | 399.62 | 11 | 2 | 2 | 85 | 0 |
| | 14 | 8 | 34 | 2.35 | 23 | 0 | | 73 | 3 |
| | 15 | 21 | 123 | 80.24 | 87 | | 5 | 6 | 2 |
| | 16 | 31 | 1722 | 718.70 | 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 | 379.19 | 87 | 0 | 0 | 13 | 0 |
| | 2 | 14 | 171 | 166.58 | 88 | | 0 | 11 | 1 |
| | 3 | 16 | 123 | 32.34 | 42 | | 2 | 52 | 4 |
| | 4 | 20 | 269 | 190.02 | 62 | 9 | 17 | 11 | 1 |
| | 5 | 24 | 921 | 385.31 | 6 | | 3 | 90 | 1 |
| | 6 | 22 | 251 | 172.88 | 92 | | 4 | 3 | 1 |
| | 7 | 19 | 334 | 70.99 | 37 | 0 | 33 | 28 | 2 |
| | 8 | 27 | 273 | 34.29 | 51 | 4 | 5 | 38 | 2 |
| | 9 | 18 | 120 | 10.93 | 40 | 2 | | 56 | 1 |
| | 10 | 7 | 35 | 6.05 | 14 | 1 | | 86 | |
| | 11 | 2 | 3 | 6.57 | | | | 100 | |
| | 12 | 24 | 584 | 19.31 | 21 | 4 | 38 | 36 | 1 |
| | 13 | 29 | 354 | 90.00 | 23 | 3 | 8 | 65 | 1 |
| | 14 | 11 | 65 | 50.57 | 94 | | | 6 | 0 |
| | 15 | 29 | 292 | 318.92 | 54 | 0 | 4 | 41 | 0 |
| | 16 | 38 | 1543 | 802.30 | 5 | 13 | 2 | 79 | 1 |
| 18-Aug-16 | 1 | 23 | 302 | 333.87 | 93 | 0 | 0 | 7 | 0 |
| | 2 | 19 | 219 | 36.84 | 46 | 0 | 0 | 48 | 5 |
| | 3 | 21 | 178 | 101.78 | 60 | 0 | 3 | 36 | 1 |
| | 4 | 20 | 139 | 26.30 | 48 | | 6 | 42 | 4 |
| | 5 | 22 | 486 | 210.36 | 15 | | 5 | 79 | 1 |
| | 6 | 22 | 337 | 245.20 | 90 | 1 | 4 | 4 | 1 |
| | 7 | 26 | 289 | 81.22 | 29 | | 40 | 28 | 2 |
| | 8 | 27 | 352 | 62.35 | 72 | 0 | 2 | 25 | 0 |
| | 9 | 18 | 233 | 79.36 | 11 | 0 | 1 | 88 | 0 |
| | 10 | 14 | 50 | 8.80 | 47 | 1 | 7 | 44 | 1 |
| | 11 | 2 | 3 | 4.16 | | | | 100 | |
| | 12 | 26 | 815 | 40.79 | 12 | 3 | 26 | 59 | 0 |
| | 13 | 26 | 363 | 138.26 | 11 | 3 | 2 | 84 | 0 |
| | 14 | 10 | 86 | 8.32 | 13 | 1 | | 78 | 8 |
| | 15 | 23 | 164 | 159.96 | 83 | 0 | 2 | 15 | 0 |
| | 16 | 39 | 1552 | 797.47 | 5 | 6 | 2 | 87 | 0 |
| 15-Mar-17 | 1 | 23 | 215 | 133.85 | 89 | 0 | 1 | 10 | 0 |
| | 2 | 24 | 461 | 243.40 | 96 | 0 | 0 | 2 | 1 |
| | 3 | 26 | 225 | 118.37 | 75 | 0 | 7 | 17 | 1 |
| | 4 | 20 | 309 | 197.29 | 88 | 0 | 8 | 4 | 0 |
| | 5 | 19 | 424 | 136.65 | 11 | 0 | 1 | 88 | 0 |
| | 6 | 23 | 168 | 140.73 | 66 | 0 | 2 | 31 | 0 |
| | 7 | 21 | 525 | 159.09 | 30 | 1 | 22 | 46 | 0 |
| | 8 | 28 | 206 | 27.34 | 65 | 2 | 9 | 22 | 2 |
| | 9 | 21 | 97 | 12.12 | 14 | 4 | | 81 | 1 |
| | 10 | 11 | 43 | 19.17 | 65 | 0 | | 35 | |
| | 11 | 4 | 6 | 4.43 | | | 6 | 94 | |
| | 12 | 28 | 235 | 23.85 | 43 | 3 | 13 | 40 | 1 |
| | 13 | 25 | 306 | 121.93 | 11 | 4 | 11 | 74 | 1 |
| | 14 | 13 | 86 | 5.67 | 27 | 1 | 0 | 72 | |
| | 15 | 29 | 235 | 212.97 | 52 | 0 | 1 | 47 | 0 |
| | 16 | 29 | 1204 | 809.75 | 2 | 6 | 0 | 92 | 0 |

**TABLE 3.** Results of the Kruskal-Wallis ANOVA and the Student-Neuman-Keuls (SNK) Test addressing the question , "Are there any statistically significant differences among the mean number of fish species seen per transect,the mean number of individual fish censused per transect or the mean estimated total standing crop (in g/m2) per transect for the 15 stations among the thirty-six 2007-2016 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 2016 quarterly survey periods.

**1. Mean Number of Fish Species Per Transect (p>0.27, 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 |
| Jun-14 | 15 | 21.3 | A |
| **Mar-17** | **15** | **21.0** | **A** |
| Mar-09 | 15 | 20.9 | A |
| May-09 | 15 | 20.9 | 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 |
| 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 thirty-six sample periods.

**TABLE 3. Continued.**

**2. Mean Number of Individual Fish Per Transect (p>0.64, n.s.)**

| YEAR | [n] | Mean | SNK Grouping |
|---|---|---|---|
| Oct-15 | 11 | 409 | A |
| Jul-09 | 15 | 355 | A |
| Sep-14 | 15 | 334 | A |
| Nov-11 | 15 | 313 | 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 |
| **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 thirty-six sample periods.

**3. Mean Standing Crop of Fish in g/m2  Per Transect (p>0.71, n.s.)**

| YEAR | [n] | Mean | SNK Grouping |
|---|---|---|---|
| Sep-13 | 15 | 190 | A |
| **bApr-16** | **15** | **186** | **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 |
| Jun-15 | 15 | 109 | A |
| Oct-15 | 11 | 106 | A |
| **Mar-17** | **15** | **104** | **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 thirty-six 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 thirty-six 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=34). In the body of the table are given the percent contribution by weight to each trophic category. Note that the December 2007 survey did not sample three of the fifteen stations and October 2015 did not sample four of fifteen stations. Data summarized from Table 2.

**PART A. Stations 1 - 15:**

| | | Mean Percent by Weight | | | | |
|---|---|---|---|---|---|---|
| **Date** | **[n]** | **Herbivore** | **Planktivore** | **Omnivore** | **Coral Feeder** | **Carnivore** |
| 27-Dec-07 | 12 | 35 | 2 | 8 | 5 | 50 |
| 04-Apr-08 | 15 | 35 | 2 | 8 | 4 | 51 |
| 30-May-08 | 15 | 37 | 7 | 14 | 3 | 39 |
| 19-Aug-08 | 15 | 36 | 2 | 10 | 3 | 49 |
| 25-Nov-08 | 15 | 43 | 5 | 6 | 4 | 42 |
| 19-Mar-09 | 15 | 35 | 1 | 7 | 2 | 55 |
| 11-May-09 | 15 | 44 | 1 | 8 | 1 | 46 |
| 21-Jul-09 | 15 | 33 | 6 | 10 | 2 | 49 |
| 29-Mar-10 | 15 | 44 | 5 | 9 | 2 | 40 |
| 19-May-10 | 15 | 51 | 6 | 9 | 1 | 33 |
| 12-Aug-10 | 15 | 49 | 7 | 10 | 1 | 33 |
| 29-Oct-10 | 15 | 41 | 1 | 9 | 1 | 48 |
| 25-Feb-11 | 15 | 30 | 6 | 15 | 1 | 54 |
| 16-Jun-11 | 15 | 46 | 6 | 7 | 1 | 41 |
| 29-Jul-11 | 15 | 36 | 4 | 11 | 1 | 50 |
| 23-Nov-11 | 15 | 55 | 2 | 9 | 1 | 33 |
| 02-May-12 | 15 | 42 | 2 | 8 | 1 | 48 |
| 23-May-12 | 15 | 48 | 1 | 8 | 1 | 42 |
| 23-Jul-12 | 15 | 36 | 2 | 12 | 1 | 50 |
| 02-Nov-12 | 15 | 46 | 3 | 8 | 1 | 47 |
| 03-May-13 | 15 | 52 | 1 | 10 | 1 | 37 |
| 14-Jun-13 | 15 | 50 | 1 | 12 | >1 | 43 |
| 20-Sep-13 | 15 | 41 | 2 | 13 | 2 | 44 |
| 18-Dec-13 | 15 | 50 | 4 | 10 | 1 | 36 |
| 08-May-14 | 15 | 52 | 1 | 10 | 1 | 36 |
| 06-Jun-14 | 15 | 55 | 3 | 9 | 2 | 41 |
| 26-Sep-14 | 15 | 49 | 1 | 12 | 1 | 38 |
| 27-Feb-15 | 15 | 58 | 4 | 5 | 1 | 41 |
| 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 |
| | Grand Means | 45.6 | 2.9 | 9.5 | 1.6 | 42.7 |

**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 |
| | Grand Means | 15.5 | 28.4 | 2.8 | 0.1 | 53.2 |

**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 2007-2016 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 | 105 | 27.8 | A |
| Nanakuli | 108 | 21.6 | B |
| CIP | 140 | 20.7 | B |
| Kahe | 180 | 19.7 | B |

**Interpretation:** Both the Kruskal-Wallis ANOVA and the SNK Test found significant differences among station groups, where the mean number of fish species per transect at Ko'Olina stations is significantly greater than at any of the other station groups which are all related over the thirty-six 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 | 105 | 369 | A |
| Nanakuli | 108 | 249 | B |
| CIP | 140 | 225 | B |
| Kahe | 180 | 197 | B |

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

**TABLE 5. Continued.**

**3. Mean Standing Crop of Fishes (in g/m²) Per Transect by Station Group ($p<0.0001$, Significant)**

| Station Group | (n) | Mean | SNK Grouping |
|---|---|---|---|
| Ko'Olina | 105 | 144 | A |
| CIP | 140 | 102 | B |
| Nanakuli | 108 | 100 | B |
| Kahe | 180 | 54 | B |

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

**TABLE 6.** Results of the Kruskal-Wallis ANOVA and the Student-Neuman-Keuls (SNK) Test addressing the question, "Are there any statistically significant differences among the mean number of fish species per transect, the mean number of individual fish per transect or the mean estimated standing crop (in g/m2) per transect seen among the sixteen stations established and sampled over the thirty-six periods in 2007-2016?" 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 2007-16 (p < 0.0001, Significant)**

| Station Group | [n] | Mean | SNK Grouping | | | |
|---|---|---|---|---|---|---|
| 16 (Pipe) | 34 | 34 | A | | | |
| 6 (Ko'Olina 2) | 35 | 30 | | B | | |
| 13 (HECO 10C) | 36 | 30 | | B | | |
| 5 (Ko'Olina 1) | 35 | 28 | | B | C | |
| 12 (HECO 7E) | 36 | 27 | | B | C | D |
| 8 (HECO 5B) | 36 | 26 | E | | C | D |
| 7 (HECO 1D) | 35 | 25 | E | F | | D |
| 4 (East 4) | 35 | 24 | E | F | G | |
| 3 (East 3) | 35 | 23 | | F | G | |
| 15 (Nana-2) | 36 | 22 | | | G | H |
| 9 (HECO 7B) | 36 | 20 | I | | | H |
| 2 (East 2) | 35 | 19 | I | | | H |
| 1 (East 1) | 35 | 17 | I | | | |
| 10 (HECO 7C) | 36 | 17 | I | | | |
| 14 (Nana-1) | 36 | 13 | | J | | |
| 11 (HECO 7D) | 36 | 9 | | | K | |

**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 noted that station 11 and 14 have significantly fewer species present due to the poor development of topographical relief that provides shelter space at both 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 2007-16 (p < 0.0001, Significant)**

| Station Group | [n] | Mean | Grouping | | | |
|---|---|---|---|---|---|---|
| 16 (Pipe) | 34 | 1220 | A | | | |
| 13 (HECO 10C) | 36 | 471 | | B | | |
| 5 (Ko'Olina 1) | 35 | 416 | | B | C | |
| 7 (HECO 1D) | 35 | 415 | | B | C | |
| 12 (HECO 7E) | 36 | 391 | | B | C | |
| 8 (HECO 5B) | 36 | 327 | | | C | D |
| 4 (East 4) | 35 | 301 | E | | | D |
| 6 (Ko'Olina 2) | 35 | 274 | E | F | | D |
| 2 (East 2) | 35 | 229 | E | F | G | |
| 15 (Nana-2) | 36 | 187 | | F | G | H |
| 3 (East 3) | 35 | 187 | | F | G | H |
| 1 (East 1) | 35 | 182 | | F | G | H |
| 9 (HECO 7B) | 36 | 144 | | | G | H |
| 10 (HECO 7C) | 36 | 92 | I | | | H |
| 14 (Nana-1) | 36 | 89 | I | | | H |
| 11 (HECO 7D) | 36 | 30 | I | | | |

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

| Station Group | [n] | Mean | Grouping | | | |
|---|---|---|---|---|---|---|
| 16 (Pipe) | 34 | 427 | A | | | |
| 13 (HECO 10C) | 36 | 170 | | B | | |
| 5 (Ko'Olina 1) | 35 | 168 | | B | | |
| 6 (Ko'Olina 2) | 35 | 149 | | B | | |
| 9 (HECO 7B) | 36 | 121 | | B | C | |
| 15 (Nana-2) | 36 | 118 | | B | C | |
| 7 (HECO 1D) | 35 | 115 | | B | C | |
| 2 (East 2) | 35 | 113 | | B | C | |
| 4 (East 4) | 35 | 105 | | B | C | D |
| 1 (East 1) | 35 | 102 | | B | C | D |
| 3 (East 3) | 35 | 88 | E | B | C | D |
| 8 (HECO 5B) | 36 | 59 | E | | C | D |
| 12 (HECO 7E) | 36 | 43 | E | | C | D |
| 10 (HECO 7C) | 36 | 26 | E | | | D |
| 11 (HECO 7D) | 36 | 23 | E | | | D |
| 14 (Nana-1) | 36 | 12 | E | | | |

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

**TABLE 7.** Results of the Kruskal-Wallis ANOVA and the Student-Neuman-Keuls (SNK) Test addressing the question , "Are there any statistically significant differences among the annual mean number of fish species per transect or the annual mean number of individual fish censused per transect among seven stations sampled in common over nineteen years encompassing a 41-year period (i.e., 1976-1984 and 2007-2016 sample periods)?" The Kruskal-Wallis result is given as a "p" value at the top of the entry where ($p<0.05$ or less for significance). The SNK Test is used to separate means that are significantly different from one another. In the body of the table are given the sample date and mean for a given parameter on that date. Letters are used to show differences with the SNK Test; letters with the same designation show means and sample dates that are related and changes in letter designation show where significant differences exist. Overlaps in the letters indicate a lack of significant differences and in such cases, only the extremes may be significantly different.

**1. Mean Number of Fish Species Per Transect ($p>0.76$, n.s.)**

| YEAR | [n] | Mean | SNK Grouping |
|---|---|---|---|
| 1976 | 3 | 29.0 | A |
| 1977 | 3 | 26.0 | A |
| 1979 | 6 | 24.3 | A |
| 1978 | 3 | 24.0 | A |
| 2007 | 7 | 23.7 | A |
| 2008 | 7 | 23.6 | A |
| 1984 | 7 | 23.4 | A |
| 1980 | 6 | 23.2 | A |
| 2010 | 7 | 22.3 | A |
| 2014 | 7 | 21.6 | A |
| 2011 | 7 | 21.1 | A |
| 2012 | 7 | 21.1 | A |
| 2009 | 7 | 21.0 | A |
| 2013 | 7 | 20.6 | A |
| 1981 | 6 | 19.2 | A |
| 2015 | 7 | 19.1 | A |
| 2016 | 7 | 19.0 | A |
| 1982 | 6 | 17.7 | A |
| 1983 | 6 | 15.8 | A |

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

**TABLE 7.Continued.**

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

| YEAR | [n] | Mean | SNK Grouping |
|---|---|---|---|
| 2008 | 7 | 303.1 | A |
| 2007 | 7 | 302.3 | A |
| 2011 | 7 | 276.7 | A |
| 2015 | 7 | 274.0 | A |
| 2009 | 7 | 271.7 | A |
| 2014 | 7 | 270.4 | A |
| 1980 | 6 | 250.3 | A |
| 2016 | 7 | 239.6 | A |
| 2010 | 7 | 232.3 | A |
| 2013 | 7 | 224.7 | A |
| 2012 | 7 | 215.4 | A |
| 1976 | 3 | 201.7 | A |
| 1979 | 6 | 195.0 | A |
| 1981 | 6 | 173.2 | A |
| 1978 | 3 | 169.0 | A |
| 1977 | 3 | 163.0 | A |
| 1984 | 7 | 150.0 | A |
| 1982 | 6 | 141.0 | A |
| 1983 | 6 | 85.8 | A |

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

**FIGURE 1.** Map showing the southwest coastline of Oahu from the Barbers Point Harbor on the southeast to Nanakuli Beach Park 7.9 km to the northwest. The approximate locations of each of the sixteen permanently marked stations monitored in this study are numbered. All stations except station 16 have an orientation that parallels the coastline and all are 50 m in length except for station 11 (or 7-D) which is 10.5 m in length. Station 16 is established on the terminus of the 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
Kahe Point
Milo Cove
Barbers Point Harbor
CORAL PIT
MAKAKILO CITY
H O N O U L I U
KALAELOA AIRPOR
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 2016 surveys conducted on 15 April (representing the first quarter), 5 July (for the second quarter), 18 August (third quarter) and 15 March 2017 (representing fourth quarter 2016). 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) and the eighth annual report (Brock 2016). 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).

# 15 APRIL 2016 FIELD DATA

| GRP | 15-Apr-16<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Parupeneus multifasciatus | 1 | EAST1 | 2 | 471.50 | | | |
| C | Parupeneus multifasciatus | 1 | EAST1 | 3 | 288.24 | | | |
| C | Parupeneus multifasciatus | 1 | EAST1 | 2 | 310.84 | | | |
| C | Paracirrhites arcatus | 1 | EAST1 | 2 | 16.24 | | | |
| C | Thalassoma duperrey | 1 | EAST1 | 5 | 55.82 | | | |
| C | Thalassoma duperrey | 1 | EAST1 | 2 | 54.78 | | | |
| C | Thalassoma duperrey | 1 | EAST1 | 2 | 109.90 | | | |
| C | Stethojulis balteata | 1 | EAST1 | 1 | 35.76 | | | |
| C | Halichoeres ornatissimus | 1 | EAST1 | 1 | 16.45 | | | |
| C | Rhinecanthus rectangulus | 1 | EAST1 | 2 | 171.75 | | | |
| C | Sufflamen bursa | 1 | EAST1 | 1 | 85.87 | 23 | 1617.15 | 4.7 |
| CF | Chaetodon unimaculatus | 1 | EAST1 | 2 | 50.61 | | | |
| CF | Chaetodon ornatissimus | 1 | EAST1 | 2 | 138.00 | | | |
| CF | Chaetodon quadrimaculatus | 1 | EAST1 | 2 | 50.61 | 6 | 239.22 | 0.7 |
| H | Acanthurus triostegus | 1 | EAST1 | 12 | 1200.17 | | | |
| H | Acanthurus nigrofuscus | 1 | EAST1 | 9 | 67.72 | | | |
| H | Acanthurus nigrofuscus | 1 | EAST1 | 30 | 716.91 | | | |
| H | Acanthurus nigroris | 1 | EAST1 | 3 | 802.05 | | | |
| H | Acanthurus nigroris | 1 | EAST1 | 2 | 344.60 | | | |
| H | Acanthurus olivaceus | 1 | EAST1 | 28 | 15768.77 | | | |
| H | Acanthurus olivaceus | 1 | EAST1 | 15 | 3925.01 | | | |
| H | Acanthurus dussumieri | 1 | EAST1 | 2 | 1128.71 | | | |
| H | Acanthurus blochii | 1 | EAST1 | 3 | 1360.78 | | | |
| H | Acanthurus blochii | 1 | EAST1 | 5 | 3919.05 | | | |
| H | Zebrasoma flavescens | 1 | EAST1 | 2 | 106.56 | | | |
| H | Naso lituratus | 1 | EAST1 | 6 | 1235.93 | | | |
| H | Naso lituratus | 1 | EAST1 | 4 | 1795.77 | 121 | 32372.02 | 94.4 |
| O | Canthigaster jactator | 1 | EAST1 | 3 | 10.69 | 3 | 10.69 | 0.03 |
| P | Chaetodon miliaris | 1 | EAST1 | 2 | 42.34 | 2 | 42.34 | 0.1 |
| | TOTAL | 1 | EAST1 | 155 | 34281.41 | 155 | 34281.41 | 100 |
| | | | | | | | | |
| C | Cephalopholis argus | 2 | EAST2 | 1 | 638.29 | | | |
| C | Parupeneus multifasciatus | 2 | EAST2 | 1 | 340.44 | | | |
| C | Parupeneus cyclostomus | 2 | EAST2 | 1 | 1003.88 | | | |
| C | Parupeneus cyclostomus | 2 | EAST2 | 1 | 1573.35 | | | |
| C | Forcipiger flavissimus | 2 | EAST2 | 2 | 18.30 | | | |
| C | Chaetodon lunula | 2 | EAST2 | 1 | 35.99 | | | |
| C | Paracirrhites forsteri | 2 | EAST2 | 1 | 16.35 | | | |
| C | Thalassoma duperrey | 2 | EAST2 | 12 | 659.39 | | | |
| C | Thalassoma duperrey | 2 | EAST2 | 14 | 156.29 | | | |
| C | Thalassoma duperrey | 2 | EAST2 | 21 | 575.20 | | | |
| C | Stethojulis balteata | 2 | EAST2 | 3 | 107.29 | | | |
| C | Halichoeres ornatissimus | 2 | EAST2 | 1 | 16.45 | | | |
| C | Rhinecanthus rectangulus | 2 | EAST2 | 7 | 601.11 | 66 | 5742.32 | 7.3 |
| CF | Chaetodon unimaculatus | 2 | EAST2 | 4 | 101.22 | | | |
| CF | Chaetodon ornatissimus | 2 | EAST2 | 2 | 138.00 | | | |
| CF | Chaetodon quadrimaculatus | 2 | EAST2 | 3 | 75.91 | 9 | 315.13 | 0.4 |
| H | Calotomus carolinus | 2 | EAST2 | 1 | 1288.03 | | | |
| H | Acanthurus triostegus | 2 | EAST2 | 91 | 9101.30 | | | |
| H | Acanthurus leucopareius | 2 | EAST2 | 5 | 1163.38 | | | |
| H | Acanthurus nigrofuscus | 2 | EAST2 | 21 | 501.84 | | | |
| H | Acanthurus nigrofuscus | 2 | EAST2 | 18 | 135.44 | | | |
| H | Acanthurus nigroris | 2 | EAST2 | 2 | 534.70 | | | |
| H | Acanthurus nigroris | 2 | EAST2 | 1 | 547.19 | | | |
| H | Acanthurus olivaceus | 2 | EAST2 | 10 | 2616.67 | | | |
| H | Acanthurus olivaceus | 2 | EAST2 | 94 | 52938.00 | | | |
| H | Acanthurus blochii | 2 | EAST2 | 2 | 907.19 | | | |
| H | Ctenochaetus strigosus | 2 | EAST2 | 5 | 134.22 | | | |
| H | Zebrasoma flavescens | 2 | EAST2 | 8 | 426.24 | | | |
| H | Naso lituratus | 2 | EAST2 | 9 | 1149.61 | | | |
| H | Naso lituratus | 2 | EAST2 | 2 | 623.23 | | | |
| H | Naso lituratus | 2 | EAST2 | 3 | 217.75 | 272 | 72284.79 | 91.5 |
| O | Melichthys vidua | 2 | EAST2 | 2 | 592.48 | | | |
| O | Cantherhines sandwichiensis | 2 | EAST2 | 1 | 82.05 | | | |
| O | Canthigaster jactator | 2 | EAST2 | 2 | 7.12 | 5 | 681.65 | 0.9 |
| P | Chromis vanderbilti | 2 | EAST2 | 17 | 5.37 | 17 | 5.37 | 0.01 |
| | TOTAL | 2 | EAST2 | 369 | 79029.27 | 369 | 79029.27 | 100 |

| GRP | 15-Apr-16 SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP BIOMASS | GROUP PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Cephalopholis argus | 3 | EAST3 | 2 | 943.46 | | | |
| C | Parupeneus multifasciatus | 3 | EAST3 | 1 | 54.40 | | | |
| C | Parupeneus bifasciatus | 3 | EAST3 | 1 | 29.20 | | | |
| C | Plectroglyphidodon johnstonianu | 3 | EAST3 | 1 | 1.72 | | | |
| C | Paracirrhites arcatus | 3 | EAST3 | 1 | 16.35 | | | |
| C | Bodianus bilunulatus | 3 | EAST3 | 1 | 1141.37 | | | |
| C | Labroides phthirophagus | 3 | EAST3 | 1 | 1.49 | | | |
| C | Thalassoma duperrey | 3 | EAST3 | 6 | 164.34 | | | |
| C | Thalassoma duperrey | 3 | EAST3 | 8 | 439.59 | | | |
| C | Thalassoma duperrey | 3 | EAST3 | 3 | 33.49 | | | |
| C | Gomphosus varius | 3 | EAST3 | 2 | 22.08 | | | |
| C | Gomphosus varius | 3 | EAST3 | 2 | 78.79 | | | |
| C | Pseudojuloides cerasinus | 3 | EAST3 | 1 | 11.16 | | | |
| C | Stethojulis balteata | 3 | EAST3 | 2 | 71.53 | | | |
| C | Halichoeres ornatissimus | 3 | EAST3 | 2 | 32.90 | | | |
| C | Sufflamen bursa | 3 | EAST3 | 1 | 85.87 | | | |
| C | Sufflamen fraenatus | 3 | EAST3 | 1 | 623.45 | 36 | 3751.20 | 7.3 |
| CF | Chaetodon multicinctus | 3 | EAST3 | 8 | 104.24 | 8 | 104.24 | 0.2 |
| H | Scarus sordidus | 3 | EAST3 | 1 | 1427.57 | | | |
| H | Acanthurus leucopareius | 3 | EAST3 | 2 | 465.35 | | | |
| H | Acanthurus leucopareius | 3 | EAST3 | 2 | 265.40 | | | |
| H | Acanthurus nigrofuscus | 3 | EAST3 | 19 | 142.97 | | | |
| H | Acanthurus nigrofuscus | 3 | EAST3 | 40 | 955.88 | | | |
| H | Acanthurus olivaceus | 3 | EAST3 | 7 | 40.13 | | | |
| H | Acanthurus olivaceus | 3 | EAST3 | 56 | 31537.53 | | | |
| H | Acanthurus dussumieri | 3 | EAST3 | 4 | 2257.42 | | | |
| H | Acanthurus blochii | 3 | EAST3 | 9 | 7054.29 | | | |
| H | Acanthurus blochii | 3 | EAST3 | 2 | 907.19 | | | |
| H | Zebrasoma flavescens | 3 | EAST3 | 4 | 213.12 | | | |
| H | Naso lituratus | 3 | EAST3 | 2 | 411.98 | 148 | 45678.83 | 89.1 |
| O | Stegastes fasciolatus | 3 | EAST3 | 9 | 233.82 | | | |
| O | Melichthys niger | 3 | EAST3 | 5 | 816.68 | | | |
| O | Melichthys vidua | 3 | EAST3 | 2 | 592.48 | | | |
| O | Cantherhines sandwichiensis | 3 | EAST3 | 1 | 82.05 | 17 | 1725.03 | 3.4 |
| | TOTAL | 3 | EAST3 | 209 | 51259.30 | 209 | 51259.3 | 100 |
| | | | | | | | | |
| C | Parupeneus multifasciatus | 4 | EAST4 | 1 | 96.08 | | | |
| C | Forcipiger flavissimus | 4 | EAST4 | 2 | 18.30 | | | |
| C | Chaetodon auriga | 4 | EAST4 | 2 | 194.15 | | | |
| C | Paracirrhites arcatus | 4 | EAST4 | 2 | 16.24 | | | |
| C | Paracirrhites forsteri | 4 | EAST4 | 2 | 32.69 | | | |
| C | Bodianus bilunulatus | 4 | EAST4 | 1 | 1141.37 | | | |
| C | Pseudocheilinus tetrataenia | 4 | EAST4 | 1 | 8.10 | | | |
| C | Thalassoma duperrey | 4 | EAST4 | 15 | 824.23 | | | |
| C | Thalassoma duperrey | 4 | EAST4 | 16 | 438.25 | | | |
| C | Thalassoma duperrey | 4 | EAST4 | 14 | 156.29 | | | |
| C | Stethojulis balteata | 4 | EAST4 | 3 | 107.29 | | | |
| C | Zanclus cornutus | 4 | EAST4 | 2 | 208.32 | | | |
| C | Rhinecanthus rectangulus | 4 | EAST4 | 2 | 289.30 | | | |
| C | Sufflamen fraenatus | 4 | EAST4 | 1 | 144.65 | 64 | 3675.25 | 10.2 |
| CF | Chaetodon ornatissimus | 4 | EAST4 | 1 | 69.00 | | | |
| CF | Chaetodon quadrimaculatus | 4 | EAST4 | 2 | 50.61 | 3 | 119.61 | 0.3 |
| H | Acanthurus triostegus | 4 | EAST4 | 34 | 3400.48 | | | |
| H | Acanthurus triostegus | 4 | EAST4 | 5 | 938.01 | | | |
| H | Acanthurus leucopareius | 4 | EAST4 | 2 | 465.35 | | | |
| H | Acanthurus nigrofuscus | 4 | EAST4 | 7 | 52.67 | | | |
| H | Acanthurus nigrofuscus | 4 | EAST4 | 24 | 573.53 | | | |
| H | Acanthurus nigroris | 4 | EAST4 | 6 | 1604.09 | | | |
| H | Acanthurus olivaceus | 4 | EAST4 | 3 | 785.00 | | | |
| H | Acanthurus olivaceus | 4 | EAST4 | 37 | 20837.30 | | | |
| H | Acanthurus blochii | 4 | EAST4 | 2 | 907.19 | | | |
| H | Ctenochaetus strigosus | 4 | EAST4 | 2 | 53.69 | | | |
| H | Naso lituratus | 4 | EAST4 | 2 | 897.88 | | | |
| H | Naso lituratus | 4 | EAST4 | 1 | 205.99 | 125 | 30721.19 | 85.2 |
| O | Melichthys niger | 4 | EAST4 | 2 | 326.67 | | | |
| O | Melichthys vidua | 4 | EAST4 | 2 | 398.06 | | | |
| O | Cantherhines sandwichiensis | 4 | EAST4 | 1 | 131.57 | | | |
| O | Canthigaster jactator | 4 | EAST4 | 2 | 15.18 | 7 | 871.49 | 2.4 |
| P | Chaetodon miliaris | 4 | EAST4 | 4 | 84.67 | | | |
| P | Chromis vanderbilti | 4 | EAST4 | 47 | 14.85 | | | |
| P | Naso brevirostris | 4 | EAST4 | 3 | 572.23 | 54 | 671.75 | 1.9 |
| | TOTAL | 4 | EAST4 | 253 | 36059.29 | 253 | 36059.29 | 100 |

| GRP | 15-Apr-16 SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP BIOMASS | GROUP PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Lutjanus kasmira | 5 | KO1 | 880 | 167769.23 | | | |
| C | Monotaxis grandoculis | 5 | KO1 | 5 | 1632.11 | | | |
| C | Monotaxis grandoculis | 5 | KO1 | 10 | 715.27 | | | |
| C | Monotaxis grandoculis | 5 | KO1 | 3 | 2013.35 | | | |
| C | Mulloides flavolineatus | 5 | KO1 | 7 | 1885.39 | | | |
| C | Parupeneus bifasciatus | 5 | KO1 | 1 | 270.20 | | | |
| C | Plectroglyphidodon imparipennis | 5 | KO1 | 3 | 2.59 | | | |
| C | Paracirrhites arcatus | 5 | KO1 | 3 | 24.35 | | | |
| C | Labroides phthirophagus | 5 | KO1 | 1 | 1.49 | | | |
| C | Thalassoma duperrey | 5 | KO1 | 7 | 384.64 | | | |
| C | Thalassoma duperrey | 5 | KO1 | 4 | 388.21 | | | |
| C | Thalassoma duperrey | 5 | KO1 | 16 | 438.25 | | | |
| C | Thalassoma ballieui | 5 | KO1 | 1 | 167.53 | | | |
| C | Gomphosus varius | 5 | KO1 | 1 | 22.60 | | | |
| C | Sufflamen bursa | 5 | KO1 | 3 | 433.95 | | | |
| C | Sufflamen bursa | 5 | KO1 | 2 | 171.75 | | | |
| C | Sufflamen fraenatus | 5 | KO1 | 1 | 461.25 | 948 | 176782.14 | 91.2 |
| CF | Chaetodon unimaculatus | 5 | KO1 | 6 | 151.82 | | | |
| CF | Chaetodon ornatissimus | 5 | KO1 | 2 | 138.00 | | | |
| CF | Chaetodon multicinctus | 5 | KO1 | 6 | 78.18 | 14 | 368.01 | 0.2 |
| H | Acanthurus leucopareius | 5 | KO1 | 3 | 698.03 | | | |
| H | Acanthurus leucopareius | 5 | KO1 | 6 | 400.44 | | | |
| H | Acanthurus leucopareius | 5 | KO1 | 11 | 1459.70 | | | |
| H | Acanthurus nigrofuscus | 5 | KO1 | 15 | 112.87 | | | |
| H | Acanthurus nigrofuscus | 5 | KO1 | 53 | 1266.54 | | | |
| H | Acanthurus nigroris | 5 | KO1 | 19 | 5079.62 | | | |
| H | Acanthurus olivaceus | 5 | KO1 | 5 | 1308.34 | | | |
| H | Ctenochaetus strigosus | 5 | KO1 | 17 | 2246.27 | | | |
| H | Ctenochaetus strigosus | 5 | KO1 | 22 | 590.57 | | | |
| H | Ctenochaetus strigosus | 5 | KO1 | 26 | 1712.49 | | | |
| H | Zebrasoma flavescens | 5 | KO1 | 6 | 319.68 | | | |
| H | Zebrasoma flavescens | 5 | KO1 | 2 | 18.97 | 185 | 15213.52 | 7.8 |
| O | Stegastes fasciolatus | 5 | KO1 | 9 | 233.82 | | | |
| O | Melichthys niger | 5 | KO1 | 4 | 992.12 | | | |
| O | Melichthys vidua | 5 | KO1 | 1 | 296.24 | | | |
| O | Canthigaster jactator | 5 | KO1 | 1 | 3.56 | 15 | 1525.75 | 0.8 |
| | TOTAL | 5 | KO1 | 1162 | 193889.42 | 1162 | 193889.4 | 100 |
| | | | | | | | | |
| C | Parupeneus multifasciatus | 6 | KO2 | 1 | 235.75 | | | |
| C | Parupeneus cyclostomus | 6 | KO2 | 1 | 143.72 | | | |
| C | Plectroglyphidodon johnstonianus | 6 | KO2 | 3 | 5.17 | | | |
| C | Plectroglyphidodon imparipennis | 6 | KO2 | 1 | 0.86 | | | |
| C | Labroides phthirophagus | 6 | KO2 | 1 | 1.49 | | | |
| C | Thalassoma duperrey | 6 | KO2 | 11 | 604.44 | | | |
| C | Thalassoma duperrey | 6 | KO2 | 2 | 194.10 | | | |
| C | Thalassoma duperrey | 6 | KO2 | 15 | 410.86 | | | |
| C | Thalassoma duperrey | 6 | KO2 | 19 | 212.10 | | | |
| C | Gomphosus varius | 6 | KO2 | 1 | 39.39 | | | |
| C | Halichoeres ornatissimus | 6 | KO2 | 1 | 16.45 | | | |
| C | Sufflamen bursa | 6 | KO2 | 1 | 85.87 | 57 | 1950.20 | 20.4 |
| CF | Chaetodon unimaculatus | 6 | KO2 | 2 | 50.61 | | | |
| CF | Chaetodon ornatissimus | 6 | KO2 | 2 | 138.00 | | | |
| CF | Chaetodon multicinctus | 6 | KO2 | 6 | 78.18 | 10 | 266.79 | 2.8 |
| H | Acanthurus nigrofuscus | 6 | KO2 | 20 | 150.49 | | | |
| H | Acanthurus nigrofuscus | 6 | KO2 | 45 | 1075.37 | | | |
| H | Acanthurus olivaceus | 6 | KO2 | 1 | 261.67 | | | |
| H | Ctenochaetus strigosus | 6 | KO2 | 7 | 461.05 | | | |
| H | Ctenochaetus strigosus | 6 | KO2 | 14 | 375.81 | | | |
| H | Ctenochaetus strigosus | 6 | KO2 | 7 | 924.94 | | | |
| H | Zebrasoma flavescens | 6 | KO2 | 1 | 53.28 | 95 | 3302.61 | 34.6 |
| O | Stegastes fasciolatus | 6 | KO2 | 8 | 207.84 | | | |
| O | Melichthys niger | 6 | KO2 | 15 | 3720.47 | | | |
| O | Cantherhines sandwichiensis | 6 | KO2 | 1 | 82.05 | | | |
| O | Canthigaster jactator | 6 | KO2 | 2 | 7.12 | 26 | 4017.49 | 42.1 |
| | TOTAL | 6 | KO2 | 188 | 9537.09 | 188 | 9537.09 | 100 |

| GRP | 15-Apr-16<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Myripristis amaenus | 7 | KAHE1D | 7 | 296.82 | | | |
| C | Myripristis amaenus | 7 | KAHE1D | 4 | 328.33 | | | |
| C | Aulostomus chinensis | 7 | KAHE1D | 7 | 363.98 | | | |
| C | Aulostomus chinensis | 7 | KAHE1D | 1 | 27.72 | | | |
| C | Fistularia commersoni | 7 | KAHE1D | 1 | 14.94 | | | |
| C | Monotaxis grandoculis | 7 | KAHE1D | 2 | 69.58 | | | |
| C | Parupeneus multifasciatus | 7 | KAHE1D | 1 | 11.05 | | | |
| C | Plectroglyphidodon johnstonianu | 7 | KAHE1D | 4 | 6.89 | | | |
| C | Plectroglyphidodon imparipennis | 7 | KAHE1D | 3 | 2.59 | | | |
| C | Paracirrhites arcatus | 7 | KAHE1D | 4 | 32.47 | | | |
| C | Cirrhitus pinnulatus | 7 | KAHE1D | 1 | 90.86 | | | |
| C | Labroides phthirophagus | 7 | KAHE1D | 1 | 0.63 | | | |
| C | Thalassoma duperrey | 7 | KAHE1D | 18 | 989.08 | | | |
| C | Thalassoma duperrey | 7 | KAHE1D | 31 | 3008.61 | | | |
| C | Thalassoma duperrey | 7 | KAHE1D | 10 | 273.90 | | | |
| C | Thalassoma ballieui | 7 | KAHE1D | 1 | 102.61 | | | |
| C | Gomphosus varius | 7 | KAHE1D | 5 | 55.21 | | | |
| C | Gomphosus varius | 7 | KAHE1D | 1 | 39.39 | | | |
| C | Stethojulis balteata | 7 | KAHE1D | 4 | 143.05 | | | |
| C | Halichoeres ornatissimus | 7 | KAHE1D | 1 | 16.45 | | | |
| C | Halichoeres ornatissimus | 7 | KAHE1D | 2 | 50.27 | | | |
| C | Zanclus cornutus | 7 | KAHE1D | 4 | 416.63 | | | |
| C | Sufflamen bursa | 7 | KAHE1D | 7 | 601.11 | 120 | 6942.19 | 49.6 |
| CF | Chaetodon ornatissimus | 7 | KAHE1D | 2 | 138.00 | | | |
| CF | Chaetodon quadrimaculatus | 7 | KAHE1D | 1 | 25.30 | | | |
| CF | Chaetodon multicinctus | 7 | KAHE1D | 2 | 26.06 | 5 | 189.37 | 1.4 |
| H | Acanthurus triostegus | 7 | KAHE1D | 8 | 137.33 | | | |
| H | Acanthurus triostegus | 7 | KAHE1D | 6 | 25.43 | | | |
| H | Acanthurus nigrofuscus | 7 | KAHE1D | 21 | 158.02 | | | |
| H | Acanthurus nigrofuscus | 7 | KAHE1D | 64 | 1529.41 | | | |
| H | Acanthurus nigrofuscus | 7 | KAHE1D | 5 | 271.26 | | | |
| H | Ctenochaetus strigosus | 7 | KAHE1D | 19 | 143.94 | | | |
| H | Ctenochaetus strigosus | 7 | KAHE1D | 44 | 1181.13 | | | |
| H | Ctenochaetus strigosus | 7 | KAHE1D | 9 | 592.78 | | | |
| H | Zebrasoma flavescens | 7 | KAHE1D | 1 | 9.48 | | | |
| H | Naso lituratus | 7 | KAHE1D | 2 | 72.69 | 179 | 4121.48 | 29.4 |
| O | Stegastes fasciolatus | 7 | KAHE1D | 9 | 132.87 | | | |
| O | Melichthys niger | 7 | KAHE1D | 15 | 2450.03 | | | |
| O | Melichthys vidua | 7 | KAHE1D | 1 | 124.35 | | | |
| O | Canthigaster jactator | 7 | KAHE1D | 8 | 28.50 | 33 | 2735.74 | 19.5 |
| P | Chromis vanderbilti | 7 | KAHE1D | 28 | 8.84 | 28 | 8.84 | 0.1 |
| | TOTAL | 7 | KAHE1D | 365 | 13997.63 | 365 | 13997.63 | 100 |
| | | | | | | | | |
| C | Parupeneus multifasciatus | 8 | KAHE5B | 1 | 54.40 | | | |
| C | Forcipiger flavissimus | 8 | KAHE5B | 1 | 9.15 | | | |
| C | Plectroglyphidodon johnstonianu | 8 | KAHE5B | 7 | 12.05 | | | |
| C | Paracirrhites arcatus | 8 | KAHE5B | 7 | 56.82 | | | |
| C | Thalassoma duperrey | 8 | KAHE5B | 5 | 485.26 | | | |
| C | Thalassoma duperrey | 8 | KAHE5B | 9 | 246.51 | | | |
| C | Thalassoma duperrey | 8 | KAHE5B | 8 | 439.59 | | | |
| C | Gomphosus varius | 8 | KAHE5B | 1 | 62.03 | | | |
| C | Macropharyngodon geoffroy | 8 | KAHE5B | 1 | 18.63 | | | |
| C | Halichoeres ornatissimus | 8 | KAHE5B | 1 | 25.14 | | | |
| C | Halichoeres ornatissimus | 8 | KAHE5B | 4 | 38.09 | | | |
| C | Zanclus cornutus | 8 | KAHE5B | 2 | 208.32 | | | |
| C | Rhinecanthus rectangulus | 8 | KAHE5B | 2 | 171.75 | | | |
| C | Sufflamen bursa | 8 | KAHE5B | 6 | 515.24 | | | |
| C | Ostracion meleagris | 8 | KAHE5B | 1 | 6.76 | 56 | 2349.75 | 19.1 |
| CF | Chaetodon unimaculatus | 8 | KAHE5B | 5 | 126.52 | | | |
| CF | Chaetodon multicinctus | 8 | KAHE5B | 2 | 26.06 | | | |
| CF | Pervagor spilosoma | 8 | KAHE5B | 2 | 32.43 | | | |
| CF | Cantherhines dumerili | 8 | KAHE5B | 1 | 117.96 | 10 | 302.98 | 2.5 |
| H | Scarus sordidus | 8 | KAHE5B | 1 | 544.57 | | | |
| H | Scarus psittacus | 8 | KAHE5B | 2 | 158.54 | | | |
| H | Acanthurus nigrofuscus | 8 | KAHE5B | 71 | 1696.69 | | | |
| H | Acanthurus nigrofuscus | 8 | KAHE5B | 12 | 90.30 | | | |
| H | Acanthurus olivaceus | 8 | KAHE5B | 15 | 3925.01 | | | |
| H | Acanthurus olivaceus | 8 | KAHE5B | 4 | 2252.68 | | | |
| H | Zebrasoma flavescens | 8 | KAHE5B | 1 | 53.28 | | | |
| H | Naso lituratus | 8 | KAHE5B | 2 | 411.98 | | | |
| H | Naso lituratus | 8 | KAHE5B | 2 | 145.17 | 110 | 9278.20 | 75.4 |
| O | Stegastes fasciolatus | 8 | KAHE5B | 10 | 147.63 | | | |
| O | Cantherhines sandwichiensis | 8 | KAHE5B | 2 | 164.10 | | | |
| O | Canthigaster jactator | 8 | KAHE5B | 3 | 10.69 | 15 | 322.42 | 2.6 |
| P | Chromis vanderbilti | 8 | KAHE5B | 153 | 48.33 | 153 | 48.33 | 0.4 |
| | TOTAL | 8 | KAHE5B | 344 | 12301.68 | 344 | 12301.68 | 100 |

| GRP | 15-Apr-16 SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP BIOMASS | GROUP PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Parupeneus multifasciatus | 9 | KAHE7B | 2 | 108.80 | | | |
| C | Parupeneus cyclostomus | 9 | KAHE7B | 1 | 143.72 | | | |
| C | Forcipiger flavissimus | 9 | KAHE7B | 6 | 54.90 | | | |
| C | Paracirrhites arcatus | 9 | KAHE7B | 2 | 32.70 | | | |
| C | Sufflamen bursa | 9 | KAHE7B | 2 | 171.75 | 14 | 667.28 | 34.7 |
| CF | Chaetodon ornatissimus | 9 | KAHE7B | 1 | 28.53 | 1 | 28.53 | 1.5 |
| H | Acanthurus nigrofuscus | 9 | KAHE7B | 3 | 162.76 | | | |
| H | Acanthurus nigrofuscus | 9 | KAHE7B | 3 | 71.69 | | | |
| H | Acanthurus olivaceus | 9 | KAHE7B | 4 | 654.07 | | | |
| H | Naso lituratus | 9 | KAHE7B | 2 | 72.69 | | | |
| H | Naso lituratus | 9 | KAHE7B | 1 | 127.73 | 13 | 1088.93 | 56.6 |
| O | Melichthys vidua | 9 | KAHE7B | 1 | 124.35 | | | |
| O | Canthigaster coronata | 9 | KAHE7B | 1 | 7.59 | 2 | 131.94 | 6.9 |
| P | Chromis vanderbilti | 9 | KAHE7B | 23 | 7.27 | 23 | 7.27 | 0.4 |
| | TOTAL | 9 | KAHE7B | 53 | 1923.95 | 53 | 1923.95 | 100 |
| | | | | | | | | |
| C | Monotaxis grandoculis | 10 | KAHE7C | 1 | 128.89 | | | |
| C | Mulloides flavolineatus | 10 | KAHE7C | 16 | 5843.34 | | | |
| C | Mulloides flavolineatus | 10 | KAHE7C | 7 | 4329.85 | | | |
| C | Parupeneus pleurostigma | 10 | KAHE7C | 1 | 225.63 | | | |
| C | Parupeneus multifasciatus | 10 | KAHE7C | 1 | 235.75 | | | |
| C | Forcipiger flavissimus | 10 | KAHE7C | 3 | 27.45 | | | |
| C | Thalassoma duperrey | 10 | KAHE7C | 1 | 54.95 | | | |
| C | Thalassoma duperrey | 10 | KAHE7C | 1 | 97.05 | | | |
| C | Zanclus cornutus | 10 | KAHE7C | 1 | 54.90 | | | |
| C | Sufflamen bursa | 10 | KAHE7C | 3 | 433.95 | | | |
| C | Sufflamen bursa | 10 | KAHE7C | 2 | 171.75 | | | |
| C | Alutera scripta | 10 | KAHE7C | 1 | 2404.50 | 38 | 14008.01 | 83.0 |
| CF | Chaetodon multicinctus | 10 | KAHE7C | 2 | 26.06 | 2 | 26.06 | 0.2 |
| H | Calotomus carolinus | 10 | KAHE7C | 1 | 34.69 | | | |
| H | Acanthurus triostegus | 10 | KAHE7C | 1 | 46.32 | | | |
| H | Acanthurus nigrofuscus | 10 | KAHE7C | 1 | 23.90 | | | |
| H | Acanthurus nigrofuscus | 10 | KAHE7C | 2 | 108.50 | | | |
| H | Acanthurus olivaceus | 10 | KAHE7C | 4 | 1046.67 | | | |
| H | Acanthurus olivaceus | 10 | KAHE7C | 2 | 1126.34 | | | |
| H | Naso lituratus | 10 | KAHE7C | 1 | 72.58 | | | |
| H | Naso unicornis | 10 | KAHE7C | 1 | 190.74 | | | |
| H | Naso unicornis | 10 | KAHE7C | 1 | 73.36 | 14 | 2723.10 | 16.1 |
| O | Cantherhines sandwichiensis | 10 | KAHE7C | 1 | 82.05 | | | |
| O | Canthigaster coronata | 10 | KAHE7C | 2 | 44.10 | 3 | 126.15 | 0.7 |
| | TOTAL | 10 | KAHE7C | 57 | 16883.32 | 57 | 16883.32 | 100 |
| | | | | | | | | |
| C | Sufflamen bursa | 11 | KAHE7D | 1 | 85.87 | | | |
| C | Sufflamen bursa | 11 | KAHE7D | 1 | 144.65 | 2 | 230.52 | 34.0 |
| H | Acanthurus triostegus | 11 | KAHE7D | 1 | 17.17 | | | |
| H | Acanthurus triostegus | 11 | KAHE7D | 1 | 46.32 | | | |
| H | Acanthurus olivaceus | 11 | KAHE7D | 1 | 261.67 | | | |
| H | Naso unicornis | 11 | KAHE7D | 1 | 123.12 | 4 | 448.27 | 66.0 |
| | TOTAL | 11 | KAHE7D | 6 | 678.79 | 6 | 678.7898 | 100 |

| GRP | 15-Apr-16<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Gymnothorax eurostus | 12 | KAHE7E | 1 | 110.10 | | | |
| C | Fistularia commersoni | 12 | KAHE7E | 1 | 147.62 | | | |
| C | Mulloides flavolineatus | 12 | KAHE7E | 2 | 730.42 | | | |
| C | Parupeneus multifasciatus | 12 | KAHE7E | 4 | 44.21 | | | |
| C | Parupeneus multifasciatus | 12 | KAHE7E | 1 | 96.08 | | | |
| C | Parupeneus multifasciatus | 12 | KAHE7E | 2 | 54.23 | | | |
| C | Forcipiger flavissimus | 12 | KAHE7E | 3 | 27.45 | | | |
| C | Plectroglyphidodon johnstonianu | 12 | KAHE7E | 3 | 2.59 | | | |
| C | Paracirrhites arcatus | 12 | KAHE7E | 1 | 8.12 | | | |
| C | Cirrhitops fasciatus | 12 | KAHE7E | 1 | 3.75 | | | |
| C | Cheilinus bimaculatus | 12 | KAHE7E | 1 | 9.63 | | | |
| C | Pseudocheilinus tetrataenia | 12 | KAHE7E | 1 | 4.00 | | | |
| C | Novaculichthys taeniourus | 12 | KAHE7E | 1 | 288.32 | | | |
| C | Thalassoma duperrey | 12 | KAHE7E | 1 | 97.05 | | | |
| C | Thalassoma duperrey | 12 | KAHE7E | 2 | 109.90 | | | |
| C | Thalassoma duperrey | 12 | KAHE7E | 4 | 44.65 | | | |
| C | Thalassoma duperrey | 12 | KAHE7E | 2 | 54.78 | | | |
| C | Coris gaimard | 12 | KAHE7E | 2 | 431.77 | | | |
| C | Pseudojuloides cerasinus | 12 | KAHE7E | 2 | 22.33 | | | |
| C | Macropharyngodon geoffroy | 12 | KAHE7E | 1 | 5.75 | | | |
| C | Halichoeres ornatissimus | 12 | KAHE7E | 1 | 4.41 | | | |
| C | Sufflamen bursa | 12 | KAHE7E | 6 | 515.24 | | | |
| C | Sufflamen fraenatus | 12 | KAHE7E | 2 | 289.30 | 45 | 3101.70 | 35.9 |
| CF | Pervagor spilosoma | 12 | KAHE7E | 1 | 16.22 | 1 | 16.22 | 0.2 |
| H | Acanthurus triostegus | 12 | KAHE7E | 9 | 416.84 | | | |
| H | Acanthurus olivaceus | 12 | KAHE7E | 3 | 490.55 | | | |
| H | Acanthurus olivaceus | 12 | KAHE7E | 1 | 261.67 | | | |
| H | Naso lituratus | 12 | KAHE7E | 1 | 14.90 | 14 | 1183.95 | 13.7 |
| O | Melichthys niger | 12 | KAHE7E | 17 | 2776.70 | | | |
| O | Melichthys vidua | 12 | KAHE7E | 1 | 199.03 | | | |
| O | Canthigaster coronata | 12 | KAHE7E | 1 | 7.59 | | | |
| O | Canthigaster jactator | 12 | KAHE7E | 2 | 7.12 | 21 | 2990.45 | 34.7 |
| P | Chaetodon kleini | 12 | KAHE7E | 10 | 65.58 | | | |
| P | Chromis vanderbilti | 12 | KAHE7E | 124 | 39.17 | | | |
| P | Naso brevirostris | 12 | KAHE7E | 10 | 1231.18 | 144 | 1335.93 | 15.5 |
| | TOTAL | 12 | KAHE7E | 225 | 8628.24 | 225 | 8628.243 | 100 |
| | | | | | | | | |
| C | Fistularia commersoni | 13 | KAHE10 | 1 | 253.56 | | | |
| C | Lutjanus kasmira | 13 | KAHE10 | 225 | 42895.54 | | | |
| C | Lutjanus kasmira | 13 | KAHE10 | 70 | 7697.11 | | | |
| C | Mulloides flavolineatus | 13 | KAHE10 | 45 | 12120.34 | | | |
| C | Mulloides vanicolensis | 13 | KAHE10 | 14 | 1267.52 | | | |
| C | Parupeneus multifasciatus | 13 | KAHE10 | 2 | 108.80 | | | |
| C | Parupeneus multifasciatus | 13 | KAHE10 | 1 | 155.42 | | | |
| C | Parupeneus multifasciatus | 13 | KAHE10 | 1 | 235.75 | | | |
| C | Chaetodon fremblii | 13 | KAHE10 | 1 | 20.91 | | | |
| C | Chaetodon lunula | 13 | KAHE10 | 1 | 35.99 | | | |
| C | Plectroglyphidodon johnstonianu | 13 | KAHE10 | 4 | 3.45 | | | |
| C | Paracirrhites arcatus | 13 | KAHE10 | 2 | 16.24 | | | |
| C | Thalassoma duperrey | 13 | KAHE10 | 3 | 82.17 | | | |
| C | Thalassoma duperrey | 13 | KAHE10 | 4 | 219.80 | | | |
| C | Thalassoma duperrey | 13 | KAHE10 | 7 | 679.36 | | | |
| C | Coris gaimard | 13 | KAHE10 | 1 | 139.13 | | | |
| C | Stethojulis balteata | 13 | KAHE10 | 1 | 35.76 | | | |
| C | Rhinecanthus rectangulus | 13 | KAHE10 | 2 | 171.75 | | | |
| C | Sufflamen bursa | 13 | KAHE10 | 10 | 858.73 | | | |
| C | Sufflamen fraenatus | 13 | KAHE10 | 3 | 433.95 | | | |
| C | Sufflamen fraenatus | 13 | KAHE10 | 1 | 623.45 | 399 | 68054.74 | 85.1 |
| CF | Chaetodon ornatissimus | 13 | KAHE10 | 2 | 138.00 | | | |
| CF | Chaetodon multicinctus | 13 | KAHE10 | 2 | 45.11 | | | |
| CF | Exallias brevis | 13 | KAHE10 | 1 | 16.35 | 5 | 199.47 | 0.2 |
| H | Calotomus carolinus | 13 | KAHE10 | 1 | 1288.03 | | | |
| H | Scarus psittacus | 13 | KAHE10 | 1 | 375.61 | | | |
| H | Acanthurus leucopareius | 13 | KAHE10 | 3 | 200.22 | | | |
| H | Acanthurus nigrofuscus | 13 | KAHE10 | 80 | 1911.76 | | | |
| H | Acanthurus nigrofuscus | 13 | KAHE10 | 12 | 90.30 | | | |
| H | Acanthurus nigroris | 13 | KAHE10 | 1 | 172.30 | | | |
| H | Acanthurus olivaceus | 13 | KAHE10 | 2 | 1126.34 | | | |
| H | Acanthurus olivaceus | 13 | KAHE10 | 11 | 2878.34 | | | |
| H | Naso lituratus | 13 | KAHE10 | 1 | 72.58 | | | |
| H | Naso lituratus | 13 | KAHE10 | 1 | 127.73 | | | |
| H | Naso lituratus | 13 | KAHE10 | 2 | 72.69 | | | |
| H | Naso unicornis | 13 | KAHE10 | 1 | 190.74 | 116 | 8506.65 | 10.6 |
| O | Stegastes fasciolatus | 13 | KAHE10 | 14 | 206.69 | | | |
| O | Melichthys niger | 13 | KAHE10 | 5 | 816.68 | | | |
| O | Melichthys vidua | 13 | KAHE10 | 2 | 248.69 | 21 | 1272.05 | 1.6 |
| P | Dascyllus albisella | 13 | KAHE10 | 20 | 61.77 | | | |
| P | Abudefduf abdominalis | 13 | KAHE10 | 43 | 1347.30 | | | |
| P | Abudefduf vaigensis | 13 | KAHE10 | 9 | 421.67 | | | |
| P | Chromis vanderbilti | 13 | KAHE10 | 44 | 13.90 | | | |
| P | Chromis ovalis | 13 | KAHE10 | 4 | 46.24 | 120 | 1890.87 | 2.4 |
| | TOTAL | 13 | KAHE10 | 661 | 79923.78 | 661 | 79923.78 | 100 |

| GRP | 15-Apr-16<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Plectroglyphidodon imparipennis | 14 | NANA1 | 5 | 4.31 | | | |
| C | Paracirrhites arcatus | 14 | NANA1 | 1 | 8.12 | | | |
| C | Thalassoma duperrey | 14 | NANA1 | 8 | 89.31 | | | |
| C | Thalassoma duperrey | 14 | NANA1 | 7 | 22.05 | | | |
| C | Plagiotremus ewaensis | 14 | NANA1 | 1 | 2.43 | | | |
| C | Rhinecanthus rectangulus | 14 | NANA1 | 1 | 45.36 | | | |
| C | Rhinecanthus rectangulus | 14 | NANA1 | 2 | 171.75 | 25 | 343.32 | 73.0 |
| CF | Pervagor spilosoma | 14 | NANA1 | 1 | 16.22 | 1 | 16.22 | 3.4 |
| H | Naso lituratus | 14 | NANA1 | 1 | 72.58 | | | |
| H | Naso lituratus | 14 | NANA1 | 1 | 36.34 | 2 | 108.93 | 23.2 |
| P | Chromis vanderbilti | 14 | NANA1 | 6 | 1.90 | 6 | 1.90 | 0.4 |
| | TOTAL | 14 | NANA1 | 34 | 470.36 | 34 | 470.3634 | 100 |
| | | | | | | | | |
| C | Parupeneus multifasciatus | 15 | NANA2 | 2 | 108.80 | | | |
| C | Parupeneus multifasciatus | 15 | NANA2 | 2 | 192.16 | | | |
| C | Parupeneus multifasciatus | 15 | NANA2 | 2 | 22.10 | | | |
| C | Thalassoma duperrey | 15 | NANA2 | 2 | 54.78 | | | |
| C | Thalassoma duperrey | 15 | NANA2 | 4 | 44.65 | | | |
| C | Thalassoma duperrey | 15 | NANA2 | 2 | 194.10 | | | |
| C | Gomphosus varius | 15 | NANA2 | 2 | 22.08 | | | |
| C | Stethojulis balteata | 15 | NANA2 | 1 | 35.76 | | | |
| C | Halichoeres ornatissimus | 15 | NANA2 | 1 | 9.52 | | | |
| C | Halichoeres ornatissimus | 15 | NANA2 | 1 | 25.14 | | | |
| C | Sufflamen bursa | 15 | NANA2 | 3 | 257.62 | 22 | 966.73 | 6.0 |
| CF | Chaetodon ornatissimus | 15 | NANA2 | 3 | 207.01 | | | |
| CF | Chaetodon ornatissimus | 15 | NANA2 | 2 | 57.06 | | | |
| CF | Chaetodon multicinctus | 15 | NANA2 | 2 | 13.31 | 7 | 277.38 | 1.7 |
| H | Acanthurus triostegus | 15 | NANA2 | 3 | 138.95 | | | |
| H | Acanthurus triostegus | 15 | NANA2 | 2 | 200.03 | | | |
| H | Acanthurus leucopareius | 15 | NANA2 | 3 | 398.10 | | | |
| H | Acanthurus leucopareius | 15 | NANA2 | 7 | 467.18 | | | |
| H | Acanthurus nigrofuscus | 15 | NANA2 | 16 | 382.35 | | | |
| H | Acanthurus nigrofuscus | 15 | NANA2 | 9 | 67.72 | | | |
| H | Acanthurus olivaceus | 15 | NANA2 | 18 | 10137.06 | | | |
| H | Acanthurus olivaceus | 15 | NANA2 | 2 | 523.33 | | | |
| H | Acanthurus glaucopareius | 15 | NANA2 | 2 | 123.06 | | | |
| H | Acanthurus blochii | 15 | NANA2 | 1 | 453.59 | | | |
| H | Ctenochaetus strigosus | 15 | NANA2 | 2 | 15.15 | | | |
| H | Ctenochaetus strigosus | 15 | NANA2 | 9 | 241.60 | | | |
| H | Zebrasoma flavescens | 15 | NANA2 | 8 | 426.24 | | | |
| H | Naso lituratus | 15 | NANA2 | 3 | 383.20 | | | |
| H | Naso lituratus | 15 | NANA2 | 2 | 72.69 | 87 | 14030.26 | 87.4 |
| O | Stegastes fasciolatus | 15 | NANA2 | 1 | 14.76 | | | |
| O | Melichthys niger | 15 | NANA2 | 3 | 744.09 | | | |
| O | Canthigaster jactator | 15 | NANA2 | 2 | 7.12 | | | |
| O | Canthigaster rivulata | 15 | NANA2 | 1 | 7.59 | 7 | 773.57 | 4.8 |
| | TOTAL | 15 | NANA2 | 123 | 16047.94 | 123 | 16047.94 | 100 |

| GRP | 15-Apr-16<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Aulostomus chinensis | 16 | PIPE | 1 | 27.72 | | | |
| C | Lutjanus kasmira | 16 | PIPE | 208 | 39654.55 | | | |
| C | Lutjanus kasmira | 16 | PIPE | 170 | 9749.93 | | | |
| C | Mulloides flavolineatus | 16 | PIPE | 3 | 808.02 | | | |
| C | Mulloides vanicolensis | 16 | PIPE | 150 | 49706.25 | | | |
| C | Mulloides vanicolensis | 16 | PIPE | 62 | 5613.32 | | | |
| C | Parupeneus multifasciatus | 16 | PIPE | 2 | 310.84 | | | |
| C | Forcipiger flavissimus | 16 | PIPE | 4 | 36.60 | | | |
| C | Plectroglyphidodon johnstonianu | 16 | PIPE | 6 | 10.33 | | | |
| C | Paracirrhites arcatus | 16 | PIPE | 5 | 81.74 | | | |
| C | Thalassoma duperrey | 16 | PIPE | 22 | 602.59 | | | |
| C | Thalassoma duperrey | 16 | PIPE | 87 | 4780.55 | | | |
| C | Thalassoma duperrey | 16 | PIPE | 63 | 6114.27 | | | |
| C | Gomphosus varius | 16 | PIPE | 7 | 77.29 | | | |
| C | Coris venusta | 16 | PIPE | 3 | 145.14 | | | |
| C | Coris venusta | 16 | PIPE | 2 | 173.73 | | | |
| C | Stethojulis balteata | 16 | PIPE | 4 | 289.56 | | | |
| C | Macropharyngodon geoffroy | 16 | PIPE | 3 | 55.89 | | | |
| C | Zanclus cornutus | 16 | PIPE | 3 | 312.47 | | | |
| C | Sufflamen bursa | 16 | PIPE | 4 | 79.70 | | | |
| C | Sufflamen bursa | 16 | PIPE | 3 | 257.62 | 812 | 118888.12 | 82.7 |
| CF | Chaetodon multicinctus | 16 | PIPE | 4 | 52.12 | | | |
| CF | Cantherhines dumerili | 16 | PIPE | 1 | 442.38 | 5 | 494.50 | 0.3 |
| H | Calotomus carolinus | 16 | PIPE | 1 | 339.30 | | | |
| H | Scarus sordidus | 16 | PIPE | 1 | 367.02 | | | |
| H | Scarus sordidus | 16 | PIPE | 25 | 1900.33 | | | |
| H | Acanthurus nigrofuscus | 16 | PIPE | 13 | 310.66 | | | |
| H | Acanthurus nigrofuscus | 16 | PIPE | 14 | 759.53 | | | |
| H | Acanthurus nigroris | 16 | PIPE | 3 | 307.42 | 57 | 3984.27 | 2.8 |
| O | Stegastes fasciolatus | 16 | PIPE | 18 | 467.64 | | | |
| O | Melichthys vidua | 16 | PIPE | 2 | 248.69 | | | |
| O | Cantherhines sandwichiensis | 16 | PIPE | 1 | 82.05 | 21 | 798.39 | 0.6 |
| P | Chaetodon miliaris | 16 | PIPE | 9 | 190.51 | | | |
| P | Dascyllus albisella | 16 | PIPE | 15 | 46.32 | | | |
| P | Abudefduf abdominalis | 16 | PIPE | 38 | 1190.64 | | | |
| P | Abudefduf vaigensis | 16 | PIPE | 355 | 11123.07 | | | |
| P | Chromis vanderbilti | 16 | PIPE | 35 | 11.06 | | | |
| P | Chromis ovalis | 16 | PIPE | 60 | 693.58 | | | |
| P | Chromis ovalis | 16 | PIPE | 305 | 6081.31 | | | |
| P | Acanthurus thompsoni | 16 | PIPE | 10 | 238.97 | 827 | 19575.46 | 13.6 |
| | TOTAL | 16 | PIPE | 1722 | 143740.73 | 1722 | 143740.7 | 100 |

# 5 JULY 2016 FIELD DATA

| GRP | 05-Jul-16<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Caranx melampygus | 1 | EAST1 | 1 | 375.82 | | | |
| C | Lutjanus fulvus | 1 | EAST1 | 12 | 1250.93 | | | |
| C | Lutjanus fulvus | 1 | EAST1 | 4 | 1215.68 | | | |
| C | Parupeneus multifasciatus | 1 | EAST1 | 4 | 1361.77 | | | |
| C | Parupeneus multifasciatus | 1 | EAST1 | 6 | 576.49 | | | |
| C | Parupeneus multifasciatus | 1 | EAST1 | 2 | 1670.64 | | | |
| C | Chaetodon fremblii | 1 | EAST1 | 1 | 20.91 | | | |
| C | Chaetodon auriga | 1 | EAST1 | 2 | 194.15 | | | |
| C | Plectroglyphidodon imparipennis | 1 | EAST1 | 1 | 0.86 | | | |
| C | Paracirrhites forsteri | 1 | EAST1 | 2 | 79.29 | | | |
| C | Bodianus bilunulatus | 1 | EAST1 | 1 | 0.52 | | | |
| C | Bodianus bilunulatus | 1 | EAST1 | 1 | 324.75 | | | |
| C | Labroides phthirophagus | 1 | EAST1 | 3 | 1.88 | | | |
| C | Thalassoma duperrey | 1 | EAST1 | 17 | 53.56 | | | |
| C | Thalassoma duperrey | 1 | EAST1 | 9 | 873.47 | | | |
| C | Thalassoma duperrey | 1 | EAST1 | 8 | 219.12 | | | |
| C | Thalassoma duperrey | 1 | EAST1 | 12 | 133.96 | | | |
| C | Thalassoma duperrey | 1 | EAST1 | 10 | 549.49 | | | |
| C | Halichoeres ornatissimus | 1 | EAST1 | 2 | 32.90 | | | |
| C | Rhinecanthus rectangulus | 1 | EAST1 | 4 | 343.49 | | | |
| C | Sufflamen fraenatus | 1 | EAST1 | 1 | 144.65 | | | |
| C | Sufflamen fraenatus | 1 | EAST1 | 1 | 329.34 | 104 | 9753.68 | 12.9 |
| CF | Chaetodon unimaculatus | 1 | EAST1 | 2 | 50.61 | | | |
| CF | Chaetodon ornatissimus | 1 | EAST1 | 2 | 138.00 | | | |
| CF | Chaetodon quadrimaculatus | 1 | EAST1 | 1 | 25.30 | 5 | 213.92 | 0.3 |
| H | Calotomus carolinus | 1 | EAST1 | 1 | 707.00 | | | |
| H | Acanthurus triostegus | 1 | EAST1 | 13 | 2438.82 | | | |
| H | Acanthurus triostegus | 1 | EAST1 | 33 | 3300.47 | | | |
| H | Acanthurus triostegus | 1 | EAST1 | 18 | 833.67 | | | |
| H | Acanthurus leucopareius | 1 | EAST1 | 3 | 398.10 | | | |
| H | Acanthurus leucopareius | 1 | EAST1 | 4 | 930.70 | | | |
| H | Acanthurus nigrofuscus | 1 | EAST1 | 16 | 868.04 | | | |
| H | Acanthurus nigrofuscus | 1 | EAST1 | 62 | 1481.62 | | | |
| H | Acanthurus nigroris | 1 | EAST1 | 5 | 3694.18 | | | |
| H | Acanthurus olivaceus | 1 | EAST1 | 25 | 6541.68 | | | |
| H | Acanthurus olivaceus | 1 | EAST1 | 44 | 24779.49 | | | |
| H | Acanthurus dussumieri | 1 | EAST1 | 8 | 4514.84 | | | |
| H | Acanthurus dussumieri | 1 | EAST1 | 7 | 2286.16 | | | |
| H | Acanthurus blochii | 1 | EAST1 | 5 | 6223.31 | | | |
| H | Acanthurus blochii | 1 | EAST1 | 7 | 5486.67 | | | |
| H | Naso lituratus | 1 | EAST1 | 3 | 934.84 | | | |
| H | Naso lituratus | 1 | EAST1 | 3 | 383.20 | 257 | 65802.80 | 86.8 |
| O | Canthigaster jactator | 1 | EAST1 | 1 | 3.56 | 1 | 3.56 | 0.005 |
| P | Chaetodon miliaris | 1 | EAST1 | 3 | 63.50 | 3 | 63.50 | 0.1 |
| | TOTAL | 1 | EAST1 | 370 | 75837.46 | 370 | 75837.46 | 100 |
| | | | | | | | | |
| C | Paracirrhites arcatus | 2 | EAST2 | 1 | 16.35 | | | |
| C | Lutjanus fulvus | 2 | EAST2 | 5 | 1107.79 | | | |
| C | Thalassoma duperrey | 2 | EAST2 | 16 | 879.18 | | | |
| C | Thalassoma duperrey | 2 | EAST2 | 25 | 279.08 | | | |
| C | Thalassoma duperrey | 2 | EAST2 | 3 | 291.16 | | | |
| C | Thalassoma duperrey | 2 | EAST2 | 21 | 575.20 | | | |
| C | Halichoeres ornatissimus | 2 | EAST2 | 4 | 65.80 | | | |
| C | Zanclus cornutus | 2 | EAST2 | 2 | 208.32 | | | |
| C | Rhinecanthus rectangulus | 2 | EAST2 | 2 | 171.75 | | | |
| C | Sufflamen fraenatus | 2 | EAST2 | 1 | 144.65 | 80 | 3739.27 | 11.2 |
| CF | Chaetodon unimaculatus | 2 | EAST2 | 4 | 101.22 | | | |
| CF | Cantherhines dumerili | 2 | EAST2 | 1 | 194.98 | 5 | 296.19 | 0.9 |
| H | Acanthurus triostegus | 2 | EAST2 | 11 | 1100.16 | | | |
| H | Acanthurus triostegus | 2 | EAST2 | 3 | 562.81 | | | |
| H | Acanthurus nigrofuscus | 2 | EAST2 | 9 | 215.07 | | | |
| H | Acanthurus nigrofuscus | 2 | EAST2 | 10 | 75.25 | | | |
| H | Acanthurus olivaceus | 2 | EAST2 | 4 | 1046.67 | | | |
| H | Acanthurus olivaceus | 2 | EAST2 | 45 | 25342.66 | | | |
| H | Naso lituratus | 2 | EAST2 | 3 | 934.84 | 85 | 29277.45 | 87.9 |
| O | Canthigaster jactator | 2 | EAST2 | 1 | 3.56 | 1 | 3.56 | 0.01 |
| | TOTAL | 2 | EAST2 | 171 | 33316.48 | 171 | 33316.48 | 100 |

| GRP | 05-Jul-16<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Cephalopholis argus | 3 | EAST3 | 1 | 638.29 | | | |
| C | Parupeneus multifasciatus | 3 | EAST3 | 1 | 54.40 | | | |
| C | Parupeneus multifasciatus | 3 | EAST3 | 1 | 27.12 | | | |
| C | Forcipiger flavissimus | 3 | EAST3 | 2 | 18.30 | | | |
| C | Paracirrhites arcatus | 3 | EAST3 | 3 | 49.05 | | | |
| C | Paracirrhites forsteri | 3 | EAST3 | 1 | 39.65 | | | |
| C | Thalassoma duperrey | 3 | EAST3 | 18 | 989.08 | | | |
| C | Thalassoma duperrey | 3 | EAST3 | 6 | 582.31 | | | |
| C | Thalassoma duperrey | 3 | EAST3 | 4 | 44.65 | | | |
| C | Thalassoma duperrey | 3 | EAST3 | 23 | 629.98 | | | |
| C | Gomphosus varius | 3 | EAST3 | 3 | 33.12 | | | |
| C | Gomphosus varius | 3 | EAST3 | 2 | 78.79 | | | |
| C | Sufflamen bursa | 3 | EAST3 | 2 | 171.75 | | | |
| C | Ostracion meleagris | 3 | EAST3 | 1 | 6.76 | 68 | 3363.25 | 52.0 |
| CF | Chaetodon ornatissimus | 3 | EAST3 | 3 | 207.01 | | | |
| CF | Chaetodon multicinctus | 3 | EAST3 | 4 | 52.12 | 7 | 259.13 | 4.0 |
| H | Acanthurus nigrofuscus | 3 | EAST3 | 14 | 334.56 | | | |
| H | Acanthurus nigrofuscus | 3 | EAST3 | 20 | 150.49 | | | |
| H | Acanthurus olivaceus | 3 | EAST3 | 2 | 1126.34 | | | |
| H | Acanthurus olivaceus | 3 | EAST3 | 4 | 1046.67 | | | |
| H | Ctenochaetus strigosus | 3 | EAST3 | 1 | 65.86 | | | |
| H | Ctenochaetus strigosus | 3 | EAST3 | 2 | 15.15 | 43 | 2739.08 | 42.3 |
| O | Stegastes fasciolatus | 3 | EAST3 | 4 | 103.92 | | | |
| O | Canthigaster jactator | 3 | EAST3 | 1 | 3.56 | 5 | 107.48 | 1.7 |
| | TOTAL | 3 | EAST3 | 123 | 6468.93 | 123 | 6468.93 | 100 |
| | | | | | | | | |
| C | Cephalopholis argus | 4 | EAST4 | 1 | 471.73 | | | |
| C | Lutjanus fulvus | 4 | EAST4 | 1 | 221.56 | | | |
| C | Chaetodon lunula | 4 | EAST4 | 9 | 323.94 | | | |
| C | Plectroglyphidodon imparipennis | 4 | EAST4 | 1 | 0.86 | | | |
| C | Paracirrhites arcatus | 4 | EAST4 | 4 | 65.39 | | | |
| C | Bodianus bilunulatus | 4 | EAST4 | 1 | 1840.61 | | | |
| C | Thalassoma duperrey | 4 | EAST4 | 11 | 122.80 | | | |
| C | Thalassoma duperrey | 4 | EAST4 | 7 | 191.73 | | | |
| C | Thalassoma duperrey | 4 | EAST4 | 5 | 274.74 | | | |
| C | Coris venusta | 4 | EAST4 | 1 | 48.38 | | | |
| C | Coris gaimard | 4 | EAST4 | 1 | 449.84 | | | |
| C | Halichoeres ornatissimus | 4 | EAST4 | 3 | 13.22 | | | |
| C | Halichoeres ornatissimus | 4 | EAST4 | 2 | 32.90 | | | |
| C | Rhinecanthus rectangulus | 4 | EAST4 | 3 | 257.62 | 50 | 4315.34 | 11.4 |
| CF | Chaetodon ornatissimus | 4 | EAST4 | 4 | 276.01 | 4 | 276.01 | 0.7 |
| H | Acanthurus triostegus | 4 | EAST4 | 15 | 2814.03 | | | |
| H | Acanthurus triostegus | 4 | EAST4 | 28 | 2800.40 | | | |
| H | Acanthurus olivaceus | 4 | EAST4 | 6 | 1570.00 | | | |
| H | Acanthurus olivaceus | 4 | EAST4 | 26 | 14642.43 | | | |
| H | Naso lituratus | 4 | EAST4 | 5 | 1029.94 | | | |
| H | Naso lituratus | 4 | EAST4 | 2 | 623.23 | 82 | 23480.03 | 61.8 |
| O | Melichthys niger | 4 | EAST4 | 39 | 6370.08 | | | |
| O | Canthigaster jactator | 4 | EAST4 | 3 | 10.69 | 42 | 6380.77 | 16.8 |
| P | Chaetodon miliaris | 4 | EAST4 | 2 | 42.34 | | | |
| P | Chromis vanderbilti | 4 | EAST4 | 57 | 18.01 | | | |
| P | Naso brevirostris | 4 | EAST4 | 9 | 660.22 | | | |
| P | Naso brevirostris | 4 | EAST4 | 23 | 2831.72 | 91 | 3552.28 | 9.3 |
| | 05-Jul-16 | 4 | EAST4 | 269 | 38004.42 | 269 | 38004.42 | 100 |

| GRP | 05-Jul-16<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Gymnothorax flavimarginatus | 5 | KO1 | 1 | 2267.96 | | | |
| C | Scomberoides laysan | 5 | KO1 | 1 | 149.61 | | | |
| C | Lutjanus fulvus | 5 | KO1 | 1 | 70.45 | | | |
| C | Lutjanus kasmira | 5 | KO1 | 310 | 34087.20 | | | |
| C | Lutjanus kasmira | 5 | KO1 | 395 | 22654.25 | | | |
| C | Monotaxis grandoculis | 5 | KO1 | 5 | 1060.31 | | | |
| C | Monotaxis grandoculis | 5 | KO1 | 15 | 7162.95 | | | |
| C | Forcipiger flavissimus | 5 | KO1 | 1 | 9.15 | | | |
| C | Paracirrhites arcatus | 5 | KO1 | 3 | 49.05 | | | |
| C | Thalassoma duperrey | 5 | KO1 | 13 | 714.34 | | | |
| C | Thalassoma duperrey | 5 | KO1 | 11 | 301.30 | | | |
| C | Thalassoma duperrey | 5 | KO1 | 7 | 78.14 | | | |
| C | Thalassoma duperrey | 5 | KO1 | 4 | 388.21 | | | |
| C | Thalassoma ballieui | 5 | KO1 | 1 | 167.53 | | | |
| C | Gomphosus varius | 5 | KO1 | 1 | 39.39 | | | |
| C | Gomphosus varius | 5 | KO1 | 4 | 44.17 | | | |
| C | Stethojulis balteata | 5 | KO1 | 1 | 72.39 | | | |
| C | Zanclus cornutus | 5 | KO1 | 1 | 104.16 | | | |
| C | Sufflamen bursa | 5 | KO1 | 3 | 257.62 | 778 | 69678.17 | 90.4 |
| CF | Chaetodon unimaculatus | 5 | KO1 | 9 | 227.74 | | | |
| CF | Chaetodon ornatissimus | 5 | KO1 | 2 | 138.00 | | | |
| CF | Chaetodon multicinctus | 5 | KO1 | 7 | 157.90 | 18 | 523.64 | 0.7 |
| H | Scarus psittacus | 5 | KO1 | 1 | 241.42 | | | |
| H | Acanthurus achilles | 5 | KO1 | 1 | 26.95 | | | |
| H | Acanthurus nigrofuscus | 5 | KO1 | 35 | 263.36 | | | |
| H | Acanthurus nigrofuscus | 5 | KO1 | 15 | 358.46 | | | |
| H | Acanthurus nigroris | 5 | KO1 | 1 | 102.47 | | | |
| H | Ctenochaetus strigosus | 5 | KO1 | 10 | 1321.34 | | | |
| H | Ctenochaetus strigosus | 5 | KO1 | 13 | 348.97 | | | |
| H | Ctenochaetus strigosus | 5 | KO1 | 31 | 2041.81 | 107 | 4704.78 | 6.1 |
| O | Stegastes fasciolatus | 5 | KO1 | 4 | 29.57 | | | |
| O | Melichthys niger | 5 | KO1 | 13 | 2123.36 | | | |
| O | Canthigaster jactator | 5 | KO1 | 1 | 2.21 | 18 | 2155.13 | 2.8 |
| | TOTAL | 5 | KO1 | 921 | 77061.73 | 921 | 77061.73 | 100 |
| | | | | | | | | |
| C | Parupeneus multifasciatus | 6 | KO2 | 1 | 54.40 | | | |
| C | Parupeneus bifasciatus | 6 | KO2 | 1 | 553.06 | | | |
| C | Forcipiger flavissimus | 6 | KO2 | 4 | 36.60 | | | |
| C | Plectroglyphidodon johnstonianu | 6 | KO2 | 1 | 1.72 | | | |
| C | Thalassoma duperrey | 6 | KO2 | 5 | 136.95 | | | |
| C | Thalassoma duperrey | 6 | KO2 | 2 | 109.90 | | | |
| C | Thalassoma duperrey | 6 | KO2 | 2 | 22.33 | | | |
| C | Gomphosus varius | 6 | KO2 | 1 | 39.39 | | | |
| C | Gomphosus varius | 6 | KO2 | 1 | 22.60 | | | |
| C | Zanclus cornutus | 6 | KO2 | 1 | 104.16 | 19 | 1081.11 | 3.1 |
| CF | Chaetodon unimaculatus | 6 | KO2 | 2 | 50.61 | | | |
| CF | Chaetodon quadrimaculatus | 6 | KO2 | 6 | 151.82 | | | |
| CF | Chaetodon multicinctus | 6 | KO2 | 8 | 180.46 | 16 | 382.89 | 1.1 |
| H | Calotomus carolinus | 6 | KO2 | 1 | 339.30 | | | |
| H | Scarus psittacus | 6 | KO2 | 2 | 482.85 | | | |
| H | Acanthurus triostegus | 6 | KO2 | 16 | 1600.23 | | | |
| H | Acanthurus triostegus | 6 | KO2 | 12 | 555.78 | | | |
| H | Acanthurus leucopareius | 6 | KO2 | 17 | 2255.91 | | | |
| H | Acanthurus leucopareius | 6 | KO2 | 3 | 1122.19 | | | |
| H | Acanthurus leucopareius | 6 | KO2 | 17 | 3955.48 | | | |
| H | Acanthurus nigrofuscus | 6 | KO2 | 21 | 158.02 | | | |
| H | Acanthurus nigrofuscus | 6 | KO2 | 15 | 358.46 | | | |
| H | Acanthurus nigroris | 6 | KO2 | 10 | 1722.98 | | | |
| H | Acanthurus nigroris | 6 | KO2 | 18 | 1844.53 | | | |
| H | Acanthurus nigroris | 6 | KO2 | 17 | 9302.26 | | | |
| H | Acanthurus olivaceus | 6 | KO2 | 7 | 3942.19 | | | |
| H | Acanthurus olivaceus | 6 | KO2 | 4 | 1046.67 | | | |
| H | Acanthurus glaucopareius | 6 | KO2 | 1 | 61.53 | | | |
| H | Ctenochaetus strigosus | 6 | KO2 | 6 | 395.19 | | | |
| H | Ctenochaetus strigosus | 6 | KO2 | 2 | 53.69 | | | |
| H | Ctenochaetus strigosus | 6 | KO2 | 8 | 1057.07 | | | |
| H | Zebrasoma flavescens | 6 | KO2 | 24 | 1278.72 | | | |
| H | Zebrasoma flavescens | 6 | KO2 | 4 | 104.12 | | | |
| H | Zebrasoma flavescens | 6 | KO2 | 1 | 1.69 | 206 | 31638.85 | 91.5 |
| O | Melichthys niger | 6 | KO2 | 9 | 1470.02 | | | |
| O | Canthigaster jactator | 6 | KO2 | 1 | 3.56 | 10 | 1473.58 | 4.3 |
| | TOTAL | 6 | KO2 | 251 | 34576.43 | 251 | 34576.43 | 100 |

| GRP | 05-Jul-16<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Myripristis amaenus | 7 | KAHE1D | 12 | 508.84 | | | |
| C | Mulloides flavolineatus | 7 | KAHE1D | 7 | 584.11 | | | |
| C | Plectroglyphidodon johnstonianu | 7 | KAHE1D | 1 | 1.72 | | | |
| C | Labroides phthirophagus | 7 | KAHE1D | 5 | 3.14 | | | |
| C | Thalassoma duperrey | 7 | KAHE1D | 17 | 1649.88 | | | |
| C | Thalassoma duperrey | 7 | KAHE1D | 15 | 824.23 | | | |
| C | Thalassoma ballieui | 7 | KAHE1D | 1 | 102.61 | | | |
| C | Gomphosus varius | 7 | KAHE1D | 3 | 33.12 | | | |
| C | Gomphosus varius | 7 | KAHE1D | 3 | 67.80 | | | |
| C | Rhinecanthus rectangulus | 7 | KAHE1D | 1 | 45.36 | | | |
| C | Sufflamen bursa | 7 | KAHE1D | 1 | 85.87 | 66 | 3906.70 | 27.5 |
| CF | Chaetodon unimaculatus | 7 | KAHE1D | 1 | 25.30 | | | |
| CF | Chaetodon ornatissimus | 7 | KAHE1D | 2 | 138.00 | | | |
| CF | Chaetodon quadrimaculatus | 7 | KAHE1D | 2 | 50.61 | 5 | 213.92 | 1.5 |
| H | Acanthurus triostegus | 7 | KAHE1D | 3 | 51.50 | | | |
| H | Acanthurus nigrofuscus | 7 | KAHE1D | 47 | 353.66 | | | |
| H | Acanthurus nigrofuscus | 7 | KAHE1D | 102 | 2437.50 | | | |
| H | Ctenochaetus strigosus | 7 | KAHE1D | 17 | 1119.70 | | | |
| H | Ctenochaetus strigosus | 7 | KAHE1D | 34 | 912.69 | | | |
| H | Ctenochaetus strigosus | 7 | KAHE1D | 3 | 396.40 | | | |
| H | Zebrasoma flavescens | 7 | KAHE1D | 2 | 52.06 | 208 | 5323.51 | 37.5 |
| O | Melichthys niger | 7 | KAHE1D | 29 | 4736.73 | | | |
| O | Canthigaster jactator | 7 | KAHE1D | 3 | 10.69 | 32 | 4747.42 | 33.4 |
| P | Chromis vanderbilti | 7 | KAHE1D | 23 | 7.27 | 23 | 7.27 | 0.1 |
| | TOTAL | 7 | KAHE1D | 334 | 14198.81 | 334 | 14198.81 | 100 |
| | | | | | | | | |
| C | Mulloides flavolineatus | 8 | KAHE5B | 1 | 269.34 | | | |
| C | Parupeneus multifasciatus | 8 | KAHE5B | 1 | 54.40 | | | |
| C | Chaetodon auriga | 8 | KAHE5B | 2 | 194.15 | | | |
| C | Plectroglyphidodon johnstonianu | 8 | KAHE5B | 3 | 5.17 | | | |
| C | Plectroglyphidodon imparipennis | 8 | KAHE5B | 5 | 4.31 | | | |
| C | Paracirrhites arcatus | 8 | KAHE5B | 4 | 65.39 | | | |
| C | Paracirrhites forsteri | 8 | KAHE5B | 1 | 39.65 | | | |
| C | Cirrhitops fasciatus | 8 | KAHE5B | 1 | 15.63 | | | |
| C | Thalassoma duperrey | 8 | KAHE5B | 3 | 82.17 | | | |
| C | Thalassoma duperrey | 8 | KAHE5B | 5 | 274.74 | | | |
| C | Thalassoma duperrey | 8 | KAHE5B | 3 | 291.16 | | | |
| C | Thalassoma duperrey | 8 | KAHE5B | 2 | 22.33 | | | |
| C | Gomphosus varius | 8 | KAHE5B | 1 | 22.60 | | | |
| C | Coris venusta | 8 | KAHE5B | 1 | 48.38 | | | |
| C | Halichoeres ornatissimus | 8 | KAHE5B | 2 | 32.90 | | | |
| C | Halichoeres ornatissimus | 8 | KAHE5B | 1 | 25.14 | | | |
| C | Zanclus cornutus | 8 | KAHE5B | 4 | 416.63 | | | |
| C | Rhinecanthus rectangulus | 8 | KAHE5B | 1 | 45.36 | | | |
| C | Rhinecanthus rectangulus | 8 | KAHE5B | 2 | 171.75 | | | |
| C | Sufflamen bursa | 8 | KAHE5B | 6 | 515.24 | 49 | 2596.44 | 37.9 |
| CF | Chaetodon unimaculatus | 8 | KAHE5B | 2 | 50.61 | | | |
| CF | Chaetodon multicinctus | 8 | KAHE5B | 6 | 78.18 | | | |
| CF | Pervagor spilosoma | 8 | KAHE5B | 1 | 16.22 | 9 | 145.01 | 2.1 |
| H | Calotomus carolinus | 8 | KAHE5B | 1 | 72.28 | | | |
| H | Acanthurus triostegus | 8 | KAHE5B | 2 | 92.63 | | | |
| H | Acanthurus nigrofuscus | 8 | KAHE5B | 7 | 52.67 | | | |
| H | Acanthurus nigrofuscus | 8 | KAHE5B | 59 | 1409.93 | | | |
| H | Acanthurus olivaceus | 8 | KAHE5B | 2 | 187.54 | | | |
| H | Acanthurus olivaceus | 8 | KAHE5B | 1 | 563.17 | | | |
| H | Acanthurus olivaceus | 8 | KAHE5B | 4 | 1046.67 | | | |
| H | Naso lituratus | 8 | KAHE5B | 1 | 72.58 | 77 | 3497.47 | 51.0 |
| O | Cantherhines sandwichiensis | 8 | KAHE5B | 4 | 328.21 | | | |
| O | Canthigaster jactator | 8 | KAHE5B | 1 | 3.56 | 5 | 331.77 | 4.8 |
| P | Chromis vanderbilti | 8 | KAHE5B | 131 | 41.38 | | | |
| P | Naso brevirostris | 8 | KAHE5B | 2 | 246.24 | 133 | 287.62 | 4.2 |
| | TOTAL | 8 | KAHE5B | 273 | 6858.30 | 273 | 6858.30 | 100 |

| GRP | 05-Jul-16<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Parupeneus multifasciatus | 9 | KAHE7B | 1 | 155.42 | | | |
| C | Parupeneus multifasciatus | 9 | KAHE7B | 1 | 27.12 | | | |
| C | Parupeneus cyclostomus | 9 | KAHE7B | 1 | 88.57 | | | |
| C | Forcipiger flavissimus | 9 | KAHE7B | 1 | 5.13 | | | |
| C | Paracirrhites arcatus | 9 | KAHE7B | 1 | 8.12 | | | |
| C | Labroides phthirophagus | 9 | KAHE7B | 1 | 0.63 | | | |
| C | Thalassoma duperrey | 9 | KAHE7B | 1 | 97.05 | | | |
| C | Thalassoma duperrey | 9 | KAHE7B | 1 | 54.95 | | | |
| C | Thalassoma duperrey | 9 | KAHE7B | 5 | 136.95 | | | |
| C | Coris venusta | 9 | KAHE7B | 1 | 23.64 | | | |
| C | Stethojulis balteata | 9 | KAHE7B | 1 | 35.76 | | | |
| C | Sufflamen bursa | 9 | KAHE7B | 7 | 601.11 | 22 | 1234.46 | 56.5 |
| CF | Chaetodon multicinctus | 9 | KAHE7B | 2 | 13.31 | | | |
| CF | Pervagor spilosoma | 9 | KAHE7B | 1 | 16.22 | 3 | 29.53 | 1.4 |
| H | Acanthurus nigrofuscus | 9 | KAHE7B | 5 | 119.49 | | | |
| H | Acanthurus olivaceus | 9 | KAHE7B | 3 | 490.55 | | | |
| H | Naso lituratus | 9 | KAHE7B | 1 | 72.58 | | | |
| H | Naso unicornis | 9 | KAHE7B | 1 | 190.74 | 10 | 873.36 | 40.0 |
| P | Chaetodon kleini | 9 | KAHE7B | 2 | 13.12 | | | |
| P | Dascyllus albisella | 9 | KAHE7B | 3 | 9.26 | | | |
| P | Chromis vanderbilti | 9 | KAHE7B | 80 | 25.27 | 85 | 47.65 | 2.2 |
| | TOTAL | 9 | KAHE7B | 120 | 2185.00 | 120 | 2185.00 | 100 |
| C | Malacanthus brevirostris | 10 | KAHE7C | 2 | 4.49 | | | |
| C | Parupeneus multifasciatus | 10 | KAHE7C | 1 | 96.08 | | | |
| C | Parupeneus multifasciatus | 10 | KAHE7C | 1 | 235.75 | | | |
| C | Coris venusta | 10 | KAHE7C | 1 | 9.39 | | | |
| C | Coris venusta | 10 | KAHE7C | 1 | 86.86 | | | |
| C | Sufflamen bursa | 10 | KAHE7C | 1 | 85.87 | | | |
| C | Sufflamen bursa | 10 | KAHE7C | 3 | 433.95 | | | |
| C | Sufflamen fraenatus | 10 | KAHE7C | 1 | 85.87 | 11 | 1038.27 | 85.9 |
| H | Acanthurus olivaceus | 10 | KAHE7C | 1 | 163.52 | 1 | 163.52 | 13.5 |
| P | Chromis vanderbilti | 10 | KAHE7C | 23 | 7.27 | 23 | 7.27 | 0.6 |
| | TOTAL | 10 | KAHE7C | 35 | 1209.05 | 35 | 1209.05 | 100 |
| C | Zanclus cornutus | 11 | KAHE7D | 1 | 104.16 | | | |
| C | Sufflamen bursa | 11 | KAHE7D | 2 | 171.75 | 3 | 275.90 | 100.0 |
| | TOTAL | 11 | KAHE7D | 3 | 275.90 | 3 | 275.90 | 100 |
| C | Parupeneus pleurostigma | 12 | KAHE7E | 1 | 13.25 | | | |
| C | Parupeneus multifasciatus | 12 | KAHE7E | 1 | 27.12 | | | |
| C | Parupeneus multifasciatus | 12 | KAHE7E | 22 | 243.14 | | | |
| C | Parupeneus multifasciatus | 12 | KAHE7E | 5 | 15.60 | | | |
| C | Labroides phthirophagus | 12 | KAHE7E | 1 | 0.19 | | | |
| C | Pseudocheilinus octotaenia | 12 | KAHE7E | 2 | 8.00 | | | |
| C | Pseudocheilinus tetrataenia | 12 | KAHE7E | 1 | 4.00 | | | |
| C | Thalassoma duperrey | 12 | KAHE7E | 2 | 109.90 | | | |
| C | Thalassoma duperrey | 12 | KAHE7E | 2 | 194.10 | | | |
| C | Thalassoma duperrey | 12 | KAHE7E | 4 | 44.65 | | | |
| C | Thalassoma duperrey | 12 | KAHE7E | 7 | 191.73 | | | |
| C | Pseudojuloides cerasinus | 12 | KAHE7E | 5 | 15.75 | | | |
| C | Anampses chrysocephalus | 12 | KAHE7E | 4 | 10.51 | | | |
| C | Sufflamen bursa | 12 | KAHE7E | 3 | 433.95 | | | |
| C | Sufflamen bursa | 12 | KAHE7E | 2 | 90.72 | | | |
| C | Ostracion meleagris | 12 | KAHE7E | 1 | 2.71 | 63 | 1405.33 | 36.4 |
| CF | Pervagor spilosoma | 12 | KAHE7E | 3 | 48.65 | 3 | 48.65 | 1.3 |
| H | Acanthurus nigrofuscus | 12 | KAHE7E | 1 | 23.90 | | | |
| H | Acanthurus nigrofuscus | 12 | KAHE7E | 12 | 12.52 | | | |
| H | Acanthurus nigrofuscus | 12 | KAHE7E | 11 | 82.77 | | | |
| H | Acanthurus nigroris | 12 | KAHE7E | 3 | 9.94 | | | |
| H | Acanthurus olivaceus | 12 | KAHE7E | 2 | 327.03 | | | |
| H | Acanthurus olivaceus | 12 | KAHE7E | 1 | 261.67 | | | |
| H | Ctenochaetus strigosus | 12 | KAHE7E | 4 | 3.49 | | | |
| H | Zebrasoma flavescens | 12 | KAHE7E | 4 | 6.75 | | | |
| H | Naso lituratus | 12 | KAHE7E | 1 | 72.58 | 39 | 800.66 | 20.7 |
| O | Melichthys niger | 12 | KAHE7E | 4 | 653.34 | | | |
| O | Melichthys vidua | 12 | KAHE7E | 4 | 796.12 | | | |
| O | Canthigaster jactator | 12 | KAHE7E | 2 | 7.12 | 10 | 1456.59 | 37.7 |
| P | Dascyllus albisella | 12 | KAHE7E | 7 | 0.56 | | | |
| P | Chromis vanderbilti | 12 | KAHE7E | 451 | 142.47 | | | |
| P | Chromis ovalis | 12 | KAHE7E | 5 | 7.28 | | | |
| P | Chromis hanui | 12 | KAHE7E | 6 | 0.56 | 469 | 150.87 | 3.9 |
| | TOTAL | 12 | KAHE7E | 584 | 3862.09 | 584 | 3862.09 | 100 |

| GRP | 05-Jul-16<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Lutjanus kasmira | 13 | KAHE10 | 70 | 7697.11 | | | |
| C | Parupeneus multifasciatus | 13 | KAHE10 | 4 | 621.69 | | | |
| C | Parupeneus multifasciatus | 13 | KAHE10 | 3 | 288.24 | | | |
| C | Parupeneus multifasciatus | 13 | KAHE10 | 1 | 27.12 | | | |
| C | Forcipiger flavissimus | 13 | KAHE10 | 2 | 18.30 | | | |
| C | Chaetodon lunula | 13 | KAHE10 | 1 | 35.99 | | | |
| C | Plectroglyphidodon johnstonianu | 13 | KAHE10 | 2 | 3.44 | | | |
| C | Paracirrhites arcatus | 13 | KAHE10 | 5 | 81.74 | | | |
| C | Thalassoma duperrey | 13 | KAHE10 | 3 | 164.85 | | | |
| C | Thalassoma duperrey | 13 | KAHE10 | 5 | 136.95 | | | |
| C | Thalassoma duperrey | 13 | KAHE10 | 6 | 66.98 | | | |
| C | Thalassoma duperrey | 13 | KAHE10 | 18 | 1746.94 | | | |
| C | Zanclus cornutus | 13 | KAHE10 | 1 | 104.16 | | | |
| C | Rhinecanthus rectangulus | 13 | KAHE10 | 1 | 85.87 | | | |
| C | Sufflamen bursa | 13 | KAHE10 | 6 | 515.24 | | | |
| C | Sufflamen fraenatus | 13 | KAHE10 | 1 | 85.87 | 129 | 11680.50 | 64.9 |
| CF | Chaetodon ornatissimus | 13 | KAHE10 | 2 | 138.00 | | | |
| CF | Chaetodon multicinctus | 13 | KAHE10 | 2 | 26.06 | 4 | 164.06 | 0.9 |
| H | Acanthurus triostegus | 13 | KAHE10 | 3 | 138.95 | | | |
| H | Acanthurus nigrofuscus | 13 | KAHE10 | 23 | 549.63 | | | |
| H | Acanthurus nigrofuscus | 13 | KAHE10 | 7 | 379.77 | | | |
| H | Acanthurus olivaceus | 13 | KAHE10 | 2 | 1126.34 | | | |
| H | Acanthurus olivaceus | 13 | KAHE10 | 2 | 523.33 | | | |
| H | Ctenochaetus strigosus | 13 | KAHE10 | 1 | 26.84 | | | |
| H | Naso lituratus | 13 | KAHE10 | 1 | 622.36 | | | |
| H | Naso lituratus | 13 | KAHE10 | 3 | 217.75 | | | |
| H | Naso unicornis | 13 | KAHE10 | 1 | 525.26 | 43 | 4110.23 | 22.8 |
| O | Stegastes fasciolatus | 13 | KAHE10 | 5 | 129.90 | | | |
| O | Melichthys niger | 13 | KAHE10 | 7 | 1143.35 | | | |
| O | Melichthys vidua | 13 | KAHE10 | 1 | 199.03 | | | |
| O | Canthigaster jactator | 13 | KAHE10 | 1 | 3.56 | 14 | 1475.84 | 8.2 |
| P | Chaetodon kleini | 13 | KAHE10 | 2 | 13.12 | | | |
| P | Dascyllus albisella | 13 | KAHE10 | 27 | 83.38 | | | |
| P | Abudefduf abdominalis | 13 | KAHE10 | 6 | 188.00 | | | |
| P | Abudefduf vaigensis | 13 | KAHE10 | 6 | 188.00 | | | |
| P | Chromis vanderbilti | 13 | KAHE10 | 120 | 37.91 | | | |
| P | Chromis ovalis | 13 | KAHE10 | 3 | 59.82 | 164 | 570.21 | 3.2 |
| | TOTAL | 13 | KAHE10 | 354 | 18000.85 | 354 | 18000.85 | 100 |
| | | | | | | | | |
| C | Plectroglyphidodon imparipennis | 14 | NANA1 | 4 | 3.45 | | | |
| C | Thalassoma duperrey | 14 | NANA1 | 3 | 33.49 | | | |
| C | Thalassoma duperrey | 14 | NANA1 | 1 | 54.95 | | | |
| C | Thalassoma duperrey | 14 | NANA1 | 5 | 15.75 | | | |
| C | Thalassoma duperrey | 14 | NANA1 | 3 | 82.17 | | | |
| C | Coris gaimard | 14 | NANA1 | 1 | 215.88 | | | |
| C | Rhinecanthus rectangulus | 14 | NANA1 | 1 | 85.87 | | | |
| C | Sufflamen bursa | 14 | NANA1 | 1 | 85.87 | 19 | 577.44 | 5.7 |
| CF | Chaetodon multicinctus | 14 | NANA1 | 1 | 22.56 | 1 | 22.56 | 0.2 |
| H | Acanthurus triostegus | 14 | NANA1 | 7 | 700.10 | | | |
| H | Acanthurus triostegus | 14 | NANA1 | 13 | 602.10 | | | |
| H | Acanthurus leucopareius | 14 | NANA1 | 3 | 698.03 | | | |
| H | Acanthurus leucopareius | 14 | NANA1 | 6 | 796.20 | | | |
| H | Acanthurus nigroris | 14 | NANA1 | 1 | 267.35 | | | |
| H | Acanthurus olivaceus | 14 | NANA1 | 5 | 1308.34 | | | |
| H | Acanthurus olivaceus | 14 | NANA1 | 9 | 5068.53 | | | |
| H | Naso lituratus | 14 | NANA1 | 1 | 72.58 | 45 | 9513.22 | 94.1 |
| | TOTAL | 14 | NANA1 | 65 | 10113.22 | 65 | 10113.22 | 100 |

| GRP | 05-Jul-16<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Lutjanus fulvus | 15 | NANA2 | 2 | 443.11 | | | |
| C | Lutjanus kasmira | 15 | NANA2 | 56 | 10676.22 | | | |
| C | Monotaxis grandoculis | 15 | NANA2 | 12 | 10886.22 | | | |
| C | Monotaxis grandoculis | 15 | NANA2 | 1 | 1360.78 | | | |
| C | Monotaxis grandoculis | 15 | NANA2 | 6 | 1958.53 | | | |
| C | Parupeneus multifasciatus | 15 | NANA2 | 1 | 96.08 | | | |
| C | Plectroglyphidodon johnstonianu | 15 | NANA2 | 1 | 0.86 | | | |
| C | Plectroglyphidodon imparipennis | 15 | NANA2 | 2 | 1.72 | | | |
| C | Paracirrhites arcatus | 15 | NANA2 | 3 | 49.05 | | | |
| C | Thalassoma duperrey | 15 | NANA2 | 3 | 82.17 | | | |
| C | Thalassoma duperrey | 15 | NANA2 | 1 | 54.95 | | | |
| C | Thalassoma lutescens | 15 | NANA2 | 1 | 364.17 | | | |
| C | Stethojulis balteata | 15 | NANA2 | 1 | 35.76 | | | |
| C | Halichoeres ornatissimus | 15 | NANA2 | 2 | 50.27 | | | |
| C | Halichoeres ornatissimus | 15 | NANA2 | 1 | 16.45 | | | |
| C | Sufflamen bursa | 15 | NANA2 | 2 | 171.75 | 95 | 26248.10 | 41.2 |
| CF | Chaetodon ornatissimus | 15 | NANA2 | 3 | 207.01 | 3 | 207.01 | 0.3 |
| H | Calotomus carolinus | 15 | NANA2 | 1 | 1288.03 | | | |
| H | Scarus perspicillatus | 15 | NANA2 | 1 | 1360.78 | | | |
| H | Acanthurus triostegus | 15 | NANA2 | 3 | 562.81 | | | |
| H | Acanthurus triostegus | 15 | NANA2 | 10 | 1000.14 | | | |
| H | Acanthurus leucopareius | 15 | NANA2 | 21 | 2786.71 | | | |
| H | Acanthurus leucopareius | 15 | NANA2 | 24 | 5584.21 | | | |
| H | Acanthurus nigrofuscus | 15 | NANA2 | 11 | 262.87 | | | |
| H | Acanthurus nigrofuscus | 15 | NANA2 | 21 | 158.02 | | | |
| H | Acanthurus nigroris | 15 | NANA2 | 23 | 6149.02 | | | |
| H | Acanthurus nigroris | 15 | NANA2 | 18 | 9849.46 | | | |
| H | Acanthurus olivaceus | 15 | NANA2 | 6 | 3379.02 | | | |
| H | Acanthurus dussumieri | 15 | NANA2 | 5 | 1632.97 | | | |
| H | Ctenochaetus strigosus | 15 | NANA2 | 2 | 53.69 | | | |
| H | Zebrasoma flavescens | 15 | NANA2 | 5 | 266.40 | | | |
| H | Naso unicornis | 15 | NANA2 | 1 | 190.74 | 152 | 34524.85 | 54.1 |
| O | Stegastes fasciolatus | 15 | NANA2 | 2 | 14.78 | | | |
| O | Melichthys niger | 15 | NANA2 | 17 | 2776.70 | | | |
| O | Canthigaster jactator | 15 | NANA2 | 1 | 3.56 | 20 | 2795.05 | 4.4 |
| P | Chromis vanderbilti | 15 | NANA2 | 21 | 6.63 | | | |
| P | Chromis ovalis | 15 | NANA2 | 1 | 2.51 | 22 | 9.14 | 0.01 |
| | TOTAL | 15 | NANA2 | 292 | 63784.15 | 292 | 63784.15 | 100 |
| | | | | | | | | |
| C | Myripristis amaenus | 16 | PIPE | 15 | 1231.24 | | | |
| C | Myripristis amaenus | 16 | PIPE | 50 | 2120.16 | | | |
| C | Aulostomus chinensis | 16 | PIPE | 2 | 55.44 | | | |
| C | Lutjanus kasmira | 16 | PIPE | 110 | 6308.78 | | | |
| C | Lutjanus kasmira | 16 | PIPE | 180 | 4654.32 | | | |
| C | Lutjanus kasmira | 16 | PIPE | 40 | 4398.35 | | | |
| C | Mulloides flavolineatus | 16 | PIPE | 160 | 58433.43 | | | |
| C | Mulloides vanicolensis | 16 | PIPE | 120 | 39765.00 | | | |
| C | Parupeneus multifasciatus | 16 | PIPE | 1 | 155.42 | | | |
| C | Forcipiger flavissimus | 16 | PIPE | 1 | 9.15 | | | |
| C | Chaetodon auriga | 16 | PIPE | 1 | 97.08 | | | |
| C | Plectroglyphidodon johnstonianu | 16 | PIPE | 5 | 8.61 | | | |
| C | Paracirrhites forsteri | 16 | PIPE | 3 | 118.94 | | | |
| C | Thalassoma duperrey | 16 | PIPE | 48 | 4658.49 | | | |
| C | Thalassoma duperrey | 16 | PIPE | 22 | 602.59 | | | |
| C | Thalassoma duperrey | 16 | PIPE | 55 | 3022.19 | | | |
| C | Gomphosus varius | 16 | PIPE | 5 | 113.00 | | | |
| C | Coris venusta | 16 | PIPE | 1 | 142.48 | | | |
| C | Stethojulis balteata | 16 | PIPE | 6 | 214.58 | | | |
| C | Halichoeres ornatissimus | 16 | PIPE | 6 | 150.82 | | | |
| C | Halichoeres ornatissimus | 16 | PIPE | 3 | 49.35 | | | |
| C | Zanclus cornutus | 16 | PIPE | 1 | 54.90 | | | |
| C | Zanclus cornutus | 16 | PIPE | 3 | 312.47 | | | |
| C | Sufflamen bursa | 16 | PIPE | 2 | 171.75 | 840 | 126848.55 | 79.1 |
| CF | Chaetodon ornatissimus | 16 | PIPE | 2 | 138.00 | | | |
| CF | Cantherhines dumerili | 16 | PIPE | 6 | 707.76 | | | |
| CF | Cantherhines dumerili | 16 | PIPE | 1 | 623.68 | 9 | 1469.45 | 0.9 |
| H | Calotomus carolinus | 16 | PIPE | 2 | 999.79 | | | |
| H | Scarus sordidus | 16 | PIPE | 1 | 775.07 | | | |
| H | Scarus sordidus | 16 | PIPE | 5 | 380.07 | | | |
| H | Scarus sordidus | 16 | PIPE | 1 | 1427.57 | | | |
| H | Scarus psittacus | 16 | PIPE | 1 | 375.61 | | | |
| H | Scarus psittacus | 16 | PIPE | 1 | 1437.46 | | | |
| H | Acanthurus leucopareius | 16 | PIPE | 7 | 928.90 | | | |
| H | Acanthurus nigrofuscus | 16 | PIPE | 22 | 165.54 | | | |
| H | Acanthurus nigrofuscus | 16 | PIPE | 50 | 1194.85 | | | |
| H | Ctenochaetus strigosus | 16 | PIPE | 15 | 987.97 | 105 | 8672.84 | 5.4 |
| O | Stegastes fasciolatus | 16 | PIPE | 27 | 701.47 | | | |
| O | Melichthys niger | 16 | PIPE | 12 | 1960.03 | | | |
| O | Melichthys vidua | 16 | PIPE | 1 | 124.35 | 40 | 2785.84 | 1.7 |
| P | Hemitaurichthys thompsoni | 16 | PIPE | 1 | 48.61 | | | |
| P | Chaetodon kleini | 16 | PIPE | 9 | 59.02 | | | |
| P | Chaetodon miliaris | 16 | PIPE | 20 | 423.36 | | | |
| P | Dascyllus albisella | 16 | PIPE | 22 | 67.94 | | | |
| P | Abudefduf abdominalis | 16 | PIPE | 173 | 5420.54 | | | |
| P | Abudefduf vaigensis | 16 | PIPE | 108 | 3383.92 | | | |
| P | Chromis vanderbilti | 16 | PIPE | 32 | 10.11 | | | |
| P | Chromis ovalis | 16 | PIPE | 60 | 1196.32 | | | |
| P | Acanthurus thompsoni | 16 | PIPE | 15 | 358.46 | | | |
| P | Naso brevirostris | 16 | PIPE | 44 | 1712.68 | | | |
| P | Naso brevirostris | 16 | PIPE | 65 | 8002.68 | 549 | 20683.63 | 12.9 |
| | TOTAL | 16 | PIPE | 1543 | 160460.31 | 1543 | 160460.31 | 100 |

**18 AUGUST 2016 FIELD DATA**

| GRP | 18-Aug-16<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Parupeneus multifasciatus | 1 | EAST1 | 5 | 777.11 | | | |
| C | Parupeneus multifasciatus | 1 | EAST1 | 4 | 1361.77 | | | |
| C | Plectroglyphidodon imparipennis | 1 | EAST1 | 3 | 2.59 | | | |
| C | Paracirrhites arcatus | 1 | EAST1 | 2 | 16.24 | | | |
| C | Paracirrhites forsteri | 1 | EAST1 | 1 | 39.65 | | | |
| C | Labroides phthirophagus | 1 | EAST1 | 5 | 3.14 | | | |
| C | Thalassoma duperrey | 1 | EAST1 | 7 | 78.14 | | | |
| C | Thalassoma duperrey | 1 | EAST1 | 9 | 28.35 | | | |
| C | Thalassoma duperrey | 1 | EAST1 | 12 | 659.39 | | | |
| C | Thalassoma duperrey | 1 | EAST1 | 14 | 1358.73 | | | |
| C | Stethojulis balteata | 1 | EAST1 | 1 | 14.41 | | | |
| C | Rhinecanthus rectangulus | 1 | EAST1 | 2 | 171.75 | | | |
| C | Sufflamen bursa | 1 | EAST1 | 1 | 85.87 | | | |
| C | Ostracion meleagris | 1 | EAST1 | 1 | 24.55 | 67 | 4621.69 | 6.9 |
| CF | Chaetodon unimaculatus | 1 | EAST1 | 3 | 75.91 | | | |
| CF | Chaetodon quadrimaculatus | 1 | EAST1 | 4 | 101.22 | 7 | 177.13 | 0.3 |
| H | Calotomus carolinus | 1 | EAST1 | 1 | 1288.03 | | | |
| H | Acanthurus triostegus | 1 | EAST1 | 6 | 1915.82 | | | |
| H | Acanthurus triostegus | 1 | EAST1 | 73 | 7301.04 | | | |
| H | Acanthurus leucopareius | 1 | EAST1 | 4 | 930.70 | | | |
| H | Acanthurus nigrofuscus | 1 | EAST1 | 23 | 1247.81 | | | |
| H | Acanthurus nigrofuscus | 1 | EAST1 | 47 | 1123.16 | | | |
| H | Acanthurus nigroris | 1 | EAST1 | 3 | 2216.51 | | | |
| H | Acanthurus olivaceus | 1 | EAST1 | 55 | 42713.26 | | | |
| H | Acanthurus dussumieri | 1 | EAST1 | 3 | 2688.52 | | | |
| H | Naso lituratus | 1 | EAST1 | 1 | 448.94 | 216 | 61873.80 | 92.7 |
| O | Canthigaster jactator | 1 | EAST1 | 2 | 15.18 | 2 | 15.18 | 0.02 |
| P | Chaetodon miliaris | 1 | EAST1 | 4 | 84.67 | | | |
| P | Chromis vanderbilti | 1 | EAST1 | 6 | 1.90 | 10 | 86.57 | 0.1 |
| | TOTAL | 1 | EAST1 | 302 | 66774.37 | 302 | 66774.37 | 100 |
| | | | | | | | | |
| C | Lutjanus fulvus | 2 | EAST2 | 1 | 155.61 | | | |
| C | Lutjanus fulvus | 2 | EAST2 | 1 | 221.56 | | | |
| C | Parupeneus multifasciatus | 2 | EAST2 | 1 | 54.40 | | | |
| C | Parupeneus multifasciatus | 2 | EAST2 | 2 | 310.84 | | | |
| C | Parupeneus multifasciatus | 2 | EAST2 | 1 | 96.08 | | | |
| C | Plectroglyphidodon johnstonianu | 2 | EAST2 | 2 | 1.72 | | | |
| C | Paracirrhites arcatus | 2 | EAST2 | 3 | 49.05 | | | |
| C | Paracirrhites forsteri | 2 | EAST2 | 1 | 39.65 | | | |
| C | Labroides phthirophagus | 2 | EAST2 | 1 | 0.63 | | | |
| C | Pseudocheilinus octotaenia | 2 | EAST2 | 1 | 35.76 | | | |
| C | Thalassoma duperrey | 2 | EAST2 | 28 | 766.93 | | | |
| C | Thalassoma duperrey | 2 | EAST2 | 14 | 769.28 | | | |
| C | Thalassoma duperrey | 2 | EAST2 | 8 | 776.42 | | | |
| C | Thalassoma duperrey | 2 | EAST2 | 4 | 44.65 | | | |
| C | Gomphosus varius | 2 | EAST2 | 1 | 11.04 | | | |
| C | Gomphosus varius | 2 | EAST2 | 1 | 22.60 | | | |
| C | Halichoeres ornatissimus | 2 | EAST2 | 2 | 32.90 | | | |
| C | Rhinecanthus rectangulus | 2 | EAST2 | 2 | 171.75 | 74 | 3560.87 | 48.3 |
| CF | Chaetodon unimaculatus | 2 | EAST2 | 3 | 75.91 | | | |
| CF | Chaetodon ornatissimus | 2 | EAST2 | 4 | 276.01 | 7 | 351.92 | 4.8 |
| H | Acanthurus triostegus | 2 | EAST2 | 20 | 2000.29 | | | |
| H | Acanthurus nigrofuscus | 2 | EAST2 | 27 | 383.74 | | | |
| H | Acanthurus nigrofuscus | 2 | EAST2 | 8 | 191.18 | | | |
| H | Acanthurus olivaceus | 2 | EAST2 | 1 | 563.17 | | | |
| H | Acanthurus olivaceus | 2 | EAST2 | 1 | 261.67 | 57 | 3400.04 | 46.1 |
| O | Stegastes fasciolatus | 2 | EAST2 | 1 | 14.76 | | | |
| O | Canthigaster jactator | 2 | EAST2 | 2 | 15.18 | 3 | 29.95 | 0.4 |
| P | Chromis vanderbilti | 2 | EAST2 | 78 | 24.64 | 78 | 24.64 | 0.3 |
| | TOTAL | 2 | EAST2 | 219 | 7367.42 | 219 | 7367.42 | 100 |

| GRP | 18-Aug-16<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Cephalopholis argus | 3 | EAST3 | 1 | 1355.30 | | | |
| C | Lutjanus fulvus | 3 | EAST3 | 2 | 208.49 | | | |
| C | Parupeneus multifasciatus | 3 | EAST3 | 2 | 54.23 | | | |
| C | Parupeneus cyclostomus | 3 | EAST3 | 1 | 440.45 | | | |
| C | Chaetodon lunula | 3 | EAST3 | 1 | 35.99 | | | |
| C | Paracirrhites arcatus | 3 | EAST3 | 3 | 24.35 | | | |
| C | Bodianus bilunulatus | 3 | EAST3 | 1 | 1141.37 | | | |
| C | Bodianus bilunulatus | 3 | EAST3 | 1 | 648.58 | | | |
| C | Thalassoma duperrey | 3 | EAST3 | 24 | 1318.77 | | | |
| C | Thalassoma duperrey | 3 | EAST3 | 7 | 679.36 | | | |
| C | Thalassoma duperrey | 3 | EAST3 | 21 | 234.43 | | | |
| C | Thalassoma duperrey | 3 | EAST3 | 22 | 602.59 | | | |
| C | Coris venusta | 3 | EAST3 | 1 | 48.38 | | | |
| C | Coris venusta | 3 | EAST3 | 11 | 260.00 | | | |
| C | Coris venusta | 3 | EAST3 | 8 | 75.10 | | | |
| C | Stethojulis balteata | 3 | EAST3 | 1 | 35.76 | | | |
| C | Macropharyngodon geoffroy | 3 | EAST3 | 7 | 40.24 | | | |
| C | Macropharyngodon geoffroy | 3 | EAST3 | 3 | 55.89 | | | |
| C | Anampses chrysocephalus | 3 | EAST3 | 2 | 5.26 | | | |
| C | Plagiotremus ewaensis | 3 | EAST3 | 1 | 2.43 | | | |
| C | Rhinecanthus rectangulus | 3 | EAST3 | 1 | 85.87 | 121 | 7352.85 | 36.1 |
| CF | Chaetodon ornatissimus | 3 | EAST3 | 2 | 138.00 | 2 | 138.00 | 0.7 |
| H | Acanthurus triostegus | 3 | EAST3 | 9 | 1688.42 | | | |
| H | Acanthurus olivaceus | 3 | EAST3 | 3 | 2329.81 | | | |
| H | Acanthurus olivaceus | 3 | EAST3 | 15 | 5898.15 | | | |
| H | Acanthurus olivaceus | 3 | EAST3 | 4 | 2252.68 | | | |
| H | Naso lituratus | 3 | EAST3 | 1 | 127.73 | 32 | 12296.80 | 60.4 |
| O | Melichthys niger | 3 | EAST3 | 1 | 163.34 | | | |
| O | Melichthys vidua | 3 | EAST3 | 2 | 398.06 | 3 | 561.40 | 2.8 |
| P | Chromis vanderbilti | 3 | EAST3 | 20 | 6.32 | 20 | 6.32 | 0.03 |
| | TOTAL | 3 | EAST3 | 178 | 20355.36 | 178 | 20355.36 | 100 |
| | | | | | | | | |
| C | Aphareus furcatus | 4 | EAST4 | 1 | 70.45 | | | |
| C | Parupeneus multifasciatus | 4 | EAST4 | 1 | 54.40 | | | |
| C | Parupeneus multifasciatus | 4 | EAST4 | 1 | 155.42 | | | |
| C | Parupeneus multifasciatus | 4 | EAST4 | 2 | 54.23 | | | |
| C | Forcipiger flavissimus | 4 | EAST4 | 2 | 18.30 | | | |
| C | Paracirrhites arcatus | 4 | EAST4 | 4 | 65.39 | | | |
| C | Thalassoma duperrey | 4 | EAST4 | 14 | 383.47 | | | |
| C | Thalassoma duperrey | 4 | EAST4 | 14 | 769.28 | | | |
| C | Thalassoma duperrey | 4 | EAST4 | 4 | 388.21 | | | |
| C | Gomphosus varius | 4 | EAST4 | 3 | 33.12 | | | |
| C | Gomphosus varius | 4 | EAST4 | 1 | 39.39 | | | |
| C | Stethojulis balteata | 4 | EAST4 | 4 | 143.05 | | | |
| C | Halichoeres ornatissimus | 4 | EAST4 | 1 | 25.14 | 52 | 2199.87 | 41.8 |
| CF | Chaetodon ornatissimus | 4 | EAST4 | 2 | 138.00 | | | |
| CF | Chaetodon multicinctus | 4 | EAST4 | 7 | 91.21 | 9 | 229.21 | 4.4 |
| H | Calotomus carolinus | 4 | EAST4 | 1 | 72.28 | | | |
| H | Calotomus carolinus | 4 | EAST4 | 1 | 34.69 | | | |
| H | Scarus psittacus | 4 | EAST4 | 1 | 37.87 | | | |
| H | Scarus psittacus | 4 | EAST4 | 3 | 43.84 | | | |
| H | Scarus rubroviolaceus | 4 | EAST4 | 1 | 85.39 | | | |
| H | Scarus rubroviolaceus | 4 | EAST4 | 5 | 93.17 | | | |
| H | Acanthurus nigrofuscus | 4 | EAST4 | 7 | 167.28 | | | |
| H | Acanthurus nigrofuscus | 4 | EAST4 | 35 | 497.45 | | | |
| H | Acanthurus olivaceus | 4 | EAST4 | 1 | 563.17 | | | |
| H | Ctenochaetus strigosus | 4 | EAST4 | 5 | 134.22 | | | |
| H | Ctenochaetus strigosus | 4 | EAST4 | 9 | 136.79 | | | |
| H | Naso lituratus | 4 | EAST4 | 5 | 638.67 | 74 | 2504.83 | 47.6 |
| O | Stegastes fasciolatus | 4 | EAST4 | 1 | 14.76 | | | |
| O | Melichthys vidua | 4 | EAST4 | 1 | 296.24 | | | |
| O | Canthigaster jactator | 4 | EAST4 | 2 | 15.18 | 4 | 326.18 | 6.2 |
| | TOTAL | 4 | EAST4 | 139 | 5260.09 | 139 | 5260.09 | 100 |

| GRP | 18-Aug-16<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Lutjanus kasmira | 5 | KO1 | 255 | 28039.47 | | | |
| C | Monotaxis grandoculis | 5 | KO1 | 3 | 1432.59 | | | |
| C | Plectroglyphidodon johnstonianu | 5 | KO1 | 3 | 5.17 | | | |
| C | Paracirrhites arcatus | 5 | KO1 | 1 | 16.35 | | | |
| C | Thalassoma duperrey | 5 | KO1 | 16 | 1552.83 | | | |
| C | Thalassoma duperrey | 5 | KO1 | 13 | 356.08 | | | |
| C | Thalassoma duperrey | 5 | KO1 | 13 | 714.34 | | | |
| C | Thalassoma ballieui | 5 | KO1 | 1 | 102.61 | | | |
| C | Thalassoma ballieui | 5 | KO1 | 1 | 256.15 | | | |
| C | Gomphosus varius | 5 | KO1 | 1 | 22.60 | | | |
| C | Gomphosus varius | 5 | KO1 | 1 | 11.04 | | | |
| C | Stethojulis balteata | 5 | KO1 | 3 | 107.29 | | | |
| C | Zanclus cornutus | 5 | KO1 | 3 | 312.47 | | | |
| C | Sufflamen bursa | 5 | KO1 | 1 | 144.65 | 315 | 33073.63 | 78.6 |
| CF | Chaetodon unimaculatus | 5 | KO1 | 2 | 50.61 | | | |
| CF | Chaetodon trifasciatus | 5 | KO1 | 1 | 22.36 | | | |
| CF | Chaetodon quadrimaculatus | 5 | KO1 | 1 | 25.30 | | | |
| CF | Chaetodon multicinctus | 5 | KO1 | 6 | 78.18 | | | |
| CF | Chaetodon multicinctus | 5 | KO1 | 4 | 90.23 | 14 | 266.68 | 0.6 |
| H | Acanthurus achilles | 5 | KO1 | 1 | 61.53 | | | |
| H | Acanthurus nigrofuscus | 5 | KO1 | 48 | 1147.06 | | | |
| H | Acanthurus nigrofuscus | 5 | KO1 | 21 | 298.47 | | | |
| H | Acanthurus olivaceus | 5 | KO1 | 3 | 1179.63 | | | |
| H | Ctenochaetus strigosus | 5 | KO1 | 3 | 396.40 | | | |
| H | Ctenochaetus strigosus | 5 | KO1 | 21 | 563.72 | | | |
| H | Ctenochaetus strigosus | 5 | KO1 | 38 | 2502.87 | | | |
| H | Zebrasoma flavescens | 5 | KO1 | 2 | 106.56 | | | |
| H | Zebrasoma flavescens | 5 | KO1 | 4 | 37.94 | | | |
| H | Naso lituratus | 5 | KO1 | 1 | 127.73 | 142 | 6421.91 | 15.3 |
| O | Stegastes fasciolatus | 5 | KO1 | 5 | 73.82 | | | |
| O | Melichthys niger | 5 | KO1 | 9 | 2232.28 | | | |
| O | Canthigaster jactator | 5 | KO1 | 1 | 3.56 | 15 | 2309.66 | 5.5 |
| | TOTAL | 5 | KO1 | 486 | 42071.88 | 486 | 42071.88 | 100 |
| | | | | | | | | |
| C | Forcipiger flavissimus | 6 | KO2 | 1 | 9.15 | | | |
| C | Chaetodon auriga | 6 | KO2 | 1 | 48.39 | | | |
| C | Chaetodon lunula | 6 | KO2 | 1 | 35.99 | | | |
| C | Labroides phthirophagus | 6 | KO2 | 3 | 1.88 | | | |
| C | Thalassoma duperrey | 6 | KO2 | 10 | 273.90 | | | |
| C | Thalassoma duperrey | 6 | KO2 | 8 | 776.42 | | | |
| C | Thalassoma duperrey | 6 | KO2 | 6 | 329.69 | | | |
| C | Zanclus cornutus | 6 | KO2 | 5 | 520.79 | | | |
| C | Sufflamen bursa | 6 | KO2 | 1 | 85.87 | 36 | 2082.09 | 4.2 |
| CF | Chaetodon unimaculatus | 6 | KO2 | 6 | 151.82 | | | |
| CF | Chaetodon quadrimaculatus | 6 | KO2 | 1 | 25.30 | | | |
| CF | Chaetodon multicinctus | 6 | KO2 | 6 | 78.18 | 13 | 255.31 | 0.5 |
| H | Calotomus carolinus | 6 | KO2 | 1 | 707.00 | | | |
| H | Scarus psittacus | 6 | KO2 | 1 | 554.69 | | | |
| H | Acanthurus triostegus | 6 | KO2 | 7 | 1313.21 | | | |
| H | Acanthurus triostegus | 6 | KO2 | 49 | 4900.70 | | | |
| H | Acanthurus leucopareius | 6 | KO2 | 12 | 2792.10 | | | |
| H | Acanthurus leucopareius | 6 | KO2 | 6 | 400.44 | | | |
| H | Acanthurus nigrofuscus | 6 | KO2 | 23 | 326.89 | | | |
| H | Acanthurus nigrofuscus | 6 | KO2 | 17 | 406.25 | | | |
| H | Acanthurus nigroris | 6 | KO2 | 27 | 10561.33 | | | |
| H | Acanthurus nigroris | 6 | KO2 | 9 | 1550.68 | | | |
| H | Acanthurus olivaceus | 6 | KO2 | 17 | 4448.34 | | | |
| H | Acanthurus olivaceus | 6 | KO2 | 21 | 11826.58 | | | |
| H | Ctenochaetus strigosus | 6 | KO2 | 17 | 2246.27 | | | |
| H | Ctenochaetus strigosus | 6 | KO2 | 18 | 1185.57 | | | |
| H | Ctenochaetus strigosus | 6 | KO2 | 16 | 429.50 | | | |
| H | Zebrasoma flavescens | 6 | KO2 | 9 | 85.36 | | | |
| H | Zebrasoma flavescens | 6 | KO2 | 4 | 213.12 | | | |
| H | Zebrasoma flavescens | 6 | KO2 | 4 | 104.12 | 258 | 44052.16 | 89.8 |
| O | Stegastes fasciolatus | 6 | KO2 | 1 | 25.98 | | | |
| O | Melichthys niger | 6 | KO2 | 13 | 2123.36 | 14 | 2149.34 | 4.4 |
| P | Abudefduf abdominalis | 6 | KO2 | 16 | 501.32 | 16 | 501.32 | 1.0 |
| | TOTAL | 6 | KO2 | 337 | 49040.23 | 337 | 49040.23 | 100 |

| GRP | 18-Aug-16<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Myripristis amaenus | 7 | KAHE1D | 7 | 574.58 | | | |
| C | Parupeneus multifasciatus | 7 | KAHE1D | 1 | 27.12 | | | |
| C | Parupeneus multifasciatus | 7 | KAHE1D | 2 | 192.16 | | | |
| C | Forcipiger flavissimus | 7 | KAHE1D | 1 | 9.15 | | | |
| C | Chaetodon lunula | 7 | KAHE1D | 3 | 107.98 | | | |
| C | Plectroglyphidodon imparipennis | 7 | KAHE1D | 1 | 0.86 | | | |
| C | Cirrhitus pinnulatus | 7 | KAHE1D | 1 | 44.59 | | | |
| C | Thalassoma duperrey | 7 | KAHE1D | 15 | 824.23 | | | |
| C | Thalassoma duperrey | 7 | KAHE1D | 19 | 1843.99 | | | |
| C | Gomphosus varius | 7 | KAHE1D | 2 | 78.79 | | | |
| C | Coris gaimard | 7 | KAHE1D | 3 | 137.97 | | | |
| C | Stethojulis balteata | 7 | KAHE1D | 2 | 71.53 | | | |
| C | Zanclus cornutus | 7 | KAHE1D | 1 | 104.16 | | | |
| C | Rhinecanthus rectangulus | 7 | KAHE1D | 1 | 85.87 | | | |
| C | Sufflamen bursa | 7 | KAHE1D | 6 | 515.24 | 65 | 4618.22 | 28.4 |
| CF | Chaetodon ornatissimus | 7 | KAHE1D | 4 | 276.01 | | | |
| CF | Chaetodon quadrimaculatus | 7 | KAHE1D | 4 | 101.22 | 8 | 377.22 | 2.3 |
| H | Scarus psittacus | 7 | KAHE1D | 3 | 237.80 | | | |
| H | Acanthurus triostegus | 7 | KAHE1D | 12 | 555.78 | | | |
| H | Acanthurus triostegus | 7 | KAHE1D | 3 | 12.71 | | | |
| H | Acanthurus leucopareius | 7 | KAHE1D | 1 | 66.74 | | | |
| H | Acanthurus nigrofuscus | 7 | KAHE1D | 42 | 1003.68 | | | |
| H | Acanthurus nigrofuscus | 7 | KAHE1D | 16 | 227.40 | | | |
| H | Acanthurus nigrofuscus | 7 | KAHE1D | 9 | 488.27 | | | |
| H | Acanthurus olivaceus | 7 | KAHE1D | 8 | 379.82 | | | |
| H | Acanthurus olivaceus | 7 | KAHE1D | 4 | 78.97 | | | |
| H | Ctenochaetus strigosus | 7 | KAHE1D | 5 | 329.32 | | | |
| H | Ctenochaetus strigosus | 7 | KAHE1D | 48 | 1288.51 | | | |
| H | Naso lituratus | 7 | KAHE1D | 3 | 109.03 | 154 | 4778.04 | 29.4 |
| O | Stegastes fasciolatus | 7 | KAHE1D | 7 | 181.86 | | | |
| O | Melichthys niger | 7 | KAHE1D | 19 | 3103.37 | | | |
| O | Melichthys niger | 7 | KAHE1D | 31 | 3089.31 | | | |
| O | Cantherhines sandwichiensis | 7 | KAHE1D | 1 | 82.05 | | | |
| O | Canthigaster jactator | 7 | KAHE1D | 4 | 14.25 | 62 | 6470.84 | 39.8 |
| | TOTAL | 7 | KAHE1D | 289 | 16244.33 | 289 | 16244.33 | 100 |
| | | | | | | | | |
| C | Cephalopholis argus | 8 | KAHE5B | 1 | 87.31 | | | |
| C | Decapterus macarellus | 8 | KAHE5B | 5 | 417.22 | | | |
| C | Parupeneus multifasciatus | 8 | KAHE5B | 1 | 54.40 | | | |
| C | Parupeneus multifasciatus | 8 | KAHE5B | 1 | 155.42 | | | |
| C | Plectroglyphidodon johnstonianu | 8 | KAHE5B | 5 | 8.61 | | | |
| C | Plectroglyphidodon imparipennis | 8 | KAHE5B | 2 | 1.72 | | | |
| C | Paracirrhites arcatus | 8 | KAHE5B | 2 | 16.24 | | | |
| C | Paracirrhites forsteri | 8 | KAHE5B | 1 | 78.83 | | | |
| C | Thalassoma duperrey | 8 | KAHE5B | 4 | 388.21 | | | |
| C | Thalassoma duperrey | 8 | KAHE5B | 10 | 549.49 | | | |
| C | Thalassoma duperrey | 8 | KAHE5B | 11 | 301.30 | | | |
| C | Thalassoma duperrey | 8 | KAHE5B | 13 | 145.12 | | | |
| C | Gomphosus varius | 8 | KAHE5B | 1 | 22.60 | | | |
| C | Stethojulis balteata | 8 | KAHE5B | 2 | 71.53 | | | |
| C | Stethojulis balteata | 8 | KAHE5B | 1 | 72.39 | | | |
| C | Macropharyngodon geoffroy | 8 | KAHE5B | 1 | 42.90 | | | |
| C | Macropharyngodon geoffroy | 8 | KAHE5B | 1 | 18.63 | | | |
| C | Zanclus cornutus | 8 | KAHE5B | 2 | 208.32 | | | |
| C | Rhinecanthus rectangulus | 8 | KAHE5B | 3 | 257.62 | | | |
| C | Sufflamen bursa | 8 | KAHE5B | 3 | 257.62 | 70 | 3155.47 | 25.3 |
| CF | Chaetodon multicinctus | 8 | KAHE5B | 2 | 26.06 | | | |
| CF | Pervagor spilosoma | 8 | KAHE5B | 1 | 16.22 | 3 | 42.28 | 0.3 |
| H | Scarus psittacus | 8 | KAHE5B | 1 | 79.27 | | | |
| H | Acanthurus triostegus | 8 | KAHE5B | 26 | 1204.19 | | | |
| H | Acanthurus nigrofuscus | 8 | KAHE5B | 22 | 525.73 | | | |
| H | Acanthurus nigrofuscus | 8 | KAHE5B | 20 | 284.25 | | | |
| H | Acanthurus olivaceus | 8 | KAHE5B | 10 | 1635.16 | | | |
| H | Acanthurus olivaceus | 8 | KAHE5B | 7 | 3942.19 | | | |
| H | Zebrasoma flavescens | 8 | KAHE5B | 3 | 159.84 | | | |
| H | Naso lituratus | 8 | KAHE5B | 1 | 36.34 | | | |
| H | Naso lituratus | 8 | KAHE5B | 2 | 623.23 | | | |
| H | Naso lituratus | 8 | KAHE5B | 1 | 72.58 | | | |
| H | Naso unicornis | 8 | KAHE5B | 1 | 389.42 | 94 | 8952.22 | 71.8 |
| O | Stegastes fasciolatus | 8 | KAHE5B | 1 | 7.39 | | | |
| O | Cantherhines sandwichiensis | 8 | KAHE5B | 3 | 246.15 | | | |
| O | Canthigaster jactator | 8 | KAHE5B | 3 | 10.69 | 7 | 264.23 | 2.1 |
| P | Chromis vanderbilti | 8 | KAHE5B | 178 | 56.23 | 178 | 56.23 | 0.5 |
| | TOTAL | 8 | KAHE5B | 352 | 12470.44 | 352 | 12470.44 | 100 |

| GRP | 18-Aug-16<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Lutjanus kasmira | 9 | KAHE7B | 12 | 1319.50 | | | |
| C | Mulloides flavolineatus | 9 | KAHE7B | 42 | 11312.32 | | | |
| C | Parupeneus pleurostigma | 9 | KAHE7B | 1 | 58.01 | | | |
| C | Parupeneus multifasciatus | 9 | KAHE7B | 1 | 235.75 | | | |
| C | Parupeneus multifasciatus | 9 | KAHE7B | 1 | 54.40 | | | |
| C | Forcipiger flavissimus | 9 | KAHE7B | 4 | 36.60 | | | |
| C | Chaetodon auriga | 9 | KAHE7B | 2 | 96.78 | | | |
| C | Thalassoma duperrey | 9 | KAHE7B | 1 | 97.05 | | | |
| C | Thalassoma duperrey | 9 | KAHE7B | 4 | 219.80 | | | |
| C | Gomphosus varius | 9 | KAHE7B | 1 | 39.39 | | | |
| C | Coris venusta | 9 | KAHE7B | 2 | 96.76 | | | |
| C | Macropharyngodon geoffroy | 9 | KAHE7B | 4 | 3.08 | | | |
| C | Sufflamen bursa | 9 | KAHE7B | 4 | 343.49 | 79 | 13912.93 | 87.7 |
| CF | Chaetodon multicinctus | 9 | KAHE7B | 2 | 26.06 | | | |
| CF | Chaetodon multicinctus | 9 | KAHE7B | 1 | 0.83 | 3 | 26.89 | 0.2 |
| H | Acanthurus nigrofuscus | 9 | KAHE7B | 6 | 143.38 | | | |
| H | Acanthurus nigrofuscus | 9 | KAHE7B | 1 | 54.25 | | | |
| H | Acanthurus nigrofuscus | 9 | KAHE7B | 2 | 28.43 | | | |
| H | Acanthurus olivaceus | 9 | KAHE7B | 2 | 327.03 | | | |
| H | Acanthurus olivaceus | 9 | KAHE7B | 2 | 1126.34 | | | |
| H | Zebrasoma flavescens | 9 | KAHE7B | 1 | 1.69 | 14 | 1681.12 | 10.6 |
| O | Melichthys vidua | 9 | KAHE7B | 1 | 199.03 | 1 | 199.03 | 1.3 |
| P | Dascyllus albisella | 9 | KAHE7B | 3 | 9.26 | | | |
| P | Chromis vanderbilti | 9 | KAHE7B | 133 | 42.01 | 136 | 51.28 | 0.3 |
| | TOTAL | 9 | KAHE7B | 233 | 15871.25 | 233 | 15871.25 | 100 |
| | | | | | | | | |
| C | Mulloides flavolineatus | 10 | KAHE7C | 1 | 365.21 | | | |
| C | Plectroglyphidodon imparipennis | 10 | KAHE7C | 1 | 0.86 | | | |
| C | Paracirrhites arcatus | 10 | KAHE7C | 4 | 32.47 | | | |
| C | Thalassoma duperrey | 10 | KAHE7C | 2 | 22.33 | | | |
| C | Coris venusta | 10 | KAHE7C | 1 | 9.39 | | | |
| C | Sufflamen bursa | 10 | KAHE7C | 4 | 343.49 | 13 | 773.75 | 44.0 |
| CF | Pervagor spilosoma | 10 | KAHE7C | 1 | 16.22 | 1 | 16.22 | 0.9 |
| H | Acanthurus olivaceus | 10 | KAHE7C | 1 | 163.52 | | | |
| H | Naso lituratus | 10 | KAHE7C | 1 | 72.58 | | | |
| H | Naso lituratus | 10 | KAHE7C | 1 | 205.99 | | | |
| H | Naso unicornis | 10 | KAHE7C | 1 | 389.42 | 4 | 831.51 | 47.3 |
| O | Melichthys vidua | 10 | KAHE7C | 1 | 124.35 | | | |
| O | Canthigaster jactator | 10 | KAHE7C | 1 | 3.56 | 2 | 127.91 | 7.3 |
| P | Dascyllus albisella | 10 | KAHE7C | 1 | 0.80 | | | |
| P | Chromis vanderbilti | 10 | KAHE7C | 29 | 9.16 | 30 | 9.96 | 0.6 |
| | TOTAL | 10 | KAHE7C | 50 | 1759.35 | 50 | 1759.35 | 100 |
| | | | | | | | | |
| C | Thalassoma duperrey | 11 | KAHE7D | 1 | 3.15 | | | |
| C | Sufflamen bursa | 11 | KAHE7D | 2 | 171.75 | 3 | 174.90 | 100.0 |
| | TOTAL | 11 | KAHE7D | 3 | 174.90 | 3 | 174.90 | 100 |

| GRP | 18-Aug-16<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Gymnothorax meleagris | 12 | KAHE7E | 1 | 1814.37 | | | |
| C | Gymnothorax meleagris | 12 | KAHE7E | 1 | 24.76 | | | |
| C | Apogon kallopterus | 12 | KAHE7E | 3 | 12.55 | | | |
| C | Parupeneus pleurostigma | 12 | KAHE7E | 1 | 30.44 | | | |
| C | Parupeneus multifasciatus | 12 | KAHE7E | 1 | 27.12 | | | |
| C | Parupeneus multifasciatus | 12 | KAHE7E | 17 | 187.88 | | | |
| C | Parupeneus multifasciatus | 12 | KAHE7E | 15 | 46.79 | | | |
| C | Parupeneus multifasciatus | 12 | KAHE7E | 4 | 217.60 | | | |
| C | Parupeneus multifasciatus | 12 | KAHE7E | 5 | 777.11 | | | |
| C | Paracirrhites arcatus | 12 | KAHE7E | 3 | 10.34 | | | |
| C | Cirrhitops fasciatus | 12 | KAHE7E | 2 | 7.50 | | | |
| C | Bodianus bilunulatus | 12 | KAHE7E | 1 | 0.52 | | | |
| C | Thalassoma duperrey | 12 | KAHE7E | 2 | 194.10 | | | |
| C | Thalassoma duperrey | 12 | KAHE7E | 5 | 136.95 | | | |
| C | Thalassoma duperrey | 12 | KAHE7E | 2 | 22.33 | | | |
| C | Coris gaimard | 12 | KAHE7E | 1 | 45.99 | | | |
| C | Anampses chrysocephalus | 12 | KAHE7E | 5 | 5.09 | | | |
| C | Halichoeres ornatissimus | 12 | KAHE7E | 1 | 9.52 | | | |
| C | Zanclus cornutus | 12 | KAHE7E | 2 | 208.32 | | | |
| C | Sufflamen bursa | 12 | KAHE7E | 8 | 686.99 | | | |
| C | Sufflamen fraenatus | 12 | KAHE7E | 1 | 329.34 | 81 | 4795.58 | 58.8 |
| CF | Chaetodon multicinctus | 12 | KAHE7E | 3 | 2.48 | 3 | 2.48 | 0.03 |
| H | Calotomus carolinus | 12 | KAHE7E | 3 | 40.39 | | | |
| H | Acanthurus triostegus | 12 | KAHE7E | 1 | 187.60 | | | |
| H | Acanthurus nigrofuscus | 12 | KAHE7E | 24 | 25.05 | | | |
| H | Acanthurus nigrofuscus | 12 | KAHE7E | 1 | 14.21 | | | |
| H | Acanthurus olivaceus | 12 | KAHE7E | 2 | 327.03 | | | |
| H | Acanthurus olivaceus | 12 | KAHE7E | 1 | 393.21 | | | |
| H | Ctenochaetus strigosus | 12 | KAHE7E | 9 | 7.84 | | | |
| H | Zebrasoma flavescens | 12 | KAHE7E | 9 | 15.19 | 50 | 1010.53 | 12.4 |
| O | Melichthys niger | 12 | KAHE7E | 1 | 99.66 | | | |
| O | Melichthys niger | 12 | KAHE7E | 10 | 1633.35 | | | |
| O | Melichthys vidua | 12 | KAHE7E | 2 | 398.06 | | | |
| O | Canthigaster jactator | 12 | KAHE7E | 1 | 2.21 | 14 | 2133.28 | 26.2 |
| P | Chromis vanderbilti | 12 | KAHE7E | 656 | 207.22 | | | |
| P | Chromis hanui | 12 | KAHE7E | 11 | 8.21 | 667 | 215.44 | 2.6 |
| | TOTAL | 12 | KAHE7E | 815 | 8157.30 | 815 | 8157.30 | 100 |
| | | | | | | | | |
| C | Lutjanus kasmira | 13 | KAHE10 | 175 | 19242.77 | | | |
| C | Parupeneus multifasciatus | 13 | KAHE10 | 1 | 3.12 | | | |
| C | Parupeneus multifasciatus | 13 | KAHE10 | 1 | 155.42 | | | |
| C | Parupeneus multifasciatus | 13 | KAHE10 | 2 | 54.23 | | | |
| C | Parupeneus multifasciatus | 13 | KAHE10 | 1 | 96.08 | | | |
| C | Parupeneus bifasciatus | 13 | KAHE10 | 1 | 176.01 | | | |
| C | Chaetodon auriga | 13 | KAHE10 | 2 | 194.15 | | | |
| C | Plectroglyphidodon imparipennis | 13 | KAHE10 | 3 | 2.59 | | | |
| C | Paracirrhites arcatus | 13 | KAHE10 | 1 | 8.12 | | | |
| C | Thalassoma duperrey | 13 | KAHE10 | 11 | 604.44 | | | |
| C | Thalassoma duperrey | 13 | KAHE10 | 10 | 273.90 | | | |
| C | Thalassoma duperrey | 13 | KAHE10 | 8 | 89.31 | | | |
| C | Thalassoma duperrey | 13 | KAHE10 | 7 | 679.36 | | | |
| C | Stethojulis balteata | 13 | KAHE10 | 1 | 35.76 | | | |
| C | Zanclus cornutus | 13 | KAHE10 | 1 | 104.16 | | | |
| C | Rhinecanthus rectangulus | 13 | KAHE10 | 1 | 85.87 | | | |
| C | Sufflamen bursa | 13 | KAHE10 | 4 | 578.60 | | | |
| C | Sufflamen bursa | 13 | KAHE10 | 6 | 515.24 | | | |
| C | Sufflamen fraenatus | 13 | KAHE10 | 2 | 289.30 | 238 | 23188.44 | 83.9 |
| CF | Chaetodon multicinctus | 13 | KAHE10 | 1 | 13.03 | 1 | 13.03 | 0.0 |
| H | Acanthurus triostegus | 13 | KAHE10 | 20 | 926.30 | | | |
| H | Acanthurus nigrofuscus | 13 | KAHE10 | 16 | 382.35 | | | |
| H | Acanthurus nigrofuscus | 13 | KAHE10 | 12 | 170.55 | | | |
| H | Acanthurus olivaceus | 13 | KAHE10 | 1 | 563.17 | | | |
| H | Acanthurus olivaceus | 13 | KAHE10 | 1 | 47.48 | | | |
| H | Acanthurus olivaceus | 13 | KAHE10 | 1 | 261.67 | | | |
| H | Naso lituratus | 13 | KAHE10 | 2 | 255.47 | | | |
| H | Naso lituratus | 13 | KAHE10 | 4 | 290.34 | | | |
| H | Naso unicornis | 13 | KAHE10 | 1 | 190.74 | 58 | 3088.07 | 11.2 |
| O | Stegastes fasciolatus | 13 | KAHE10 | 5 | 129.90 | | | |
| O | Melichthys vidua | 13 | KAHE10 | 2 | 398.06 | | | |
| O | Cantherhines sandwichiensis | 13 | KAHE10 | 1 | 82.05 | 8 | 610.01 | 2.2 |
| P | Chaetodon miliaris | 13 | KAHE10 | 2 | 42.34 | | | |
| P | Dascyllus albisella | 13 | KAHE10 | 14 | 43.24 | | | |
| P | Abudefduf abdominalis | 13 | KAHE10 | 16 | 501.32 | | | |
| P | Chromis vanderbilti | 13 | KAHE10 | 12 | 3.79 | | | |
| P | Chromis ovalis | 13 | KAHE10 | 14 | 161.84 | 58 | 752.52 | 2.7 |
| | TOTAL | 13 | KAHE10 | 363 | 27652.07 | 363 | 27652.07 | 100 |

| GRP | 18-Aug-16<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Parupeneus multifasciatus | 14 | NANA1 | 1 | 27.12 | | | |
| C | Parupeneus multifasciatus | 14 | NANA1 | 2 | 22.10 | | | |
| C | Parupeneus multifasciatus | 14 | NANA1 | 2 | 310.84 | | | |
| C | Parupeneus multifasciatus | 14 | NANA1 | 1 | 54.40 | | | |
| C | Plectroglyphidodon imparipennis | 14 | NANA1 | 4 | 3.45 | | | |
| C | Thalassoma duperrey | 14 | NANA1 | 7 | 384.64 | | | |
| C | Thalassoma duperrey | 14 | NANA1 | 7 | 78.14 | | | |
| C | Thalassoma duperrey | 14 | NANA1 | 5 | 136.95 | | | |
| C | Thalassoma duperrey | 14 | NANA1 | 15 | 47.26 | | | |
| C | Thalassoma duperrey | 14 | NANA1 | 1 | 97.05 | | | |
| C | Thalassoma trilobatum | 14 | NANA1 | 2 | 111.97 | | | |
| C | Halichoeres ornatissimus | 14 | NANA1 | 1 | 25.14 | 48 | 1299.07 | 78.0 |
| CF | Chaetodon ornatissimus | 14 | NANA1 | 2 | 138.00 | | | |
| CF | Chaetodon multicinctus | 14 | NANA1 | 1 | 0.83 | 3 | 138.83 | 8.3 |
| H | Acanthurus nigrofuscus | 14 | NANA1 | 1 | 23.90 | | | |
| H | Acanthurus nigrofuscus | 14 | NANA1 | 4 | 30.10 | | | |
| H | Naso lituratus | 14 | NANA1 | 1 | 127.73 | | | |
| H | Naso lituratus | 14 | NANA1 | 1 | 36.34 | 7 | 218.07 | 13.1 |
| P | Chromis vanderbilti | 14 | NANA1 | 28 | 8.84 | 28 | 8.84 | 0.5 |
| | TOTAL | 14 | NANA1 | 86 | 1664.82 | 86 | 1664.82 | 100 |
| | | | | | | | | |
| C | Lutjanus kasmira | 15 | NANA2 | 1 | 190.65 | | | |
| C | Monotaxis grandoculis | 15 | NANA2 | 5 | 3355.58 | | | |
| C | Parupeneus multifasciatus | 15 | NANA2 | 1 | 54.40 | | | |
| C | Paracirrhites arcatus | 15 | NANA2 | 1 | 8.12 | | | |
| C | Paracirrhites forsteri | 15 | NANA2 | 1 | 39.65 | | | |
| C | Labroides phthirophagus | 15 | NANA2 | 1 | 0.63 | | | |
| C | Thalassoma duperrey | 15 | NANA2 | 1 | 27.39 | | | |
| C | Thalassoma duperrey | 15 | NANA2 | 4 | 388.21 | | | |
| C | Thalassoma duperrey | 15 | NANA2 | 2 | 109.90 | | | |
| C | Halichoeres ornatissimus | 15 | NANA2 | 1 | 9.52 | | | |
| C | Halichoeres ornatissimus | 15 | NANA2 | 1 | 25.14 | | | |
| C | Rhinecanthus rectangulus | 15 | NANA2 | 1 | 45.36 | | | |
| C | Sufflamen bursa | 15 | NANA2 | 5 | 429.37 | | | |
| C | Sufflamen fraenatus | 15 | NANA2 | 1 | 144.65 | 26 | 4828.55 | 15.1 |
| CF | Chaetodon ornatissimus | 15 | NANA2 | 2 | 138.00 | 2 | 138.00 | 0.4 |
| H | Acanthurus leucopareius | 15 | NANA2 | 43 | 10005.04 | | | |
| H | Acanthurus nigrofuscus | 15 | NANA2 | 4 | 217.01 | | | |
| H | Acanthurus nigrofuscus | 15 | NANA2 | 10 | 238.97 | | | |
| H | Acanthurus nigrofuscus | 15 | NANA2 | 7 | 99.49 | | | |
| H | Acanthurus nigroris | 15 | NANA2 | 2 | 1094.38 | | | |
| H | Acanthurus olivaceus | 15 | NANA2 | 23 | 12952.92 | | | |
| H | Acanthurus blochii | 15 | NANA2 | 3 | 1360.78 | | | |
| H | Ctenochaetus strigosus | 15 | NANA2 | 6 | 161.06 | | | |
| H | Ctenochaetus strigosus | 15 | NANA2 | 4 | 30.30 | | | |
| H | Ctenochaetus strigosus | 15 | NANA2 | 2 | 131.73 | | | |
| H | Naso lituratus | 15 | NANA2 | 1 | 127.73 | 105 | 26419.42 | 82.6 |
| O | Stegastes fasciolatus | 15 | NANA2 | 2 | 29.53 | | | |
| O | Melichthys niger | 15 | NANA2 | 4 | 398.62 | | | |
| O | Melichthys niger | 15 | NANA2 | 1 | 163.34 | | | |
| O | Canthigaster jactator | 15 | NANA2 | 1 | 7.59 | 8 | 599.07 | 1.9 |
| P | Chromis vanderbilti | 15 | NANA2 | 23 | 7.27 | 23 | 7.27 | 0.02 |
| | TOTAL | 15 | NANA2 | 164 | 31992.31 | 164 | 31992.31 | 100 |

| GRP | 18-Aug-16<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Tylosurus crocodilus | 16 | PIPE | 4 | 18406.73 | | | |
| C | Myripristis amaenus | 16 | PIPE | 49 | 4022.06 | | | |
| C | Aulostomus chinensis | 16 | PIPE | 3 | 336.85 | | | |
| C | Lutjanus kasmira | 16 | PIPE | 201 | 11527.86 | | | |
| C | Lutjanus kasmira | 16 | PIPE | 210 | 23091.33 | | | |
| C | Monotaxis grandoculis | 16 | PIPE | 1 | 34.79 | | | |
| C | Mulloides flavolineatus | 16 | PIPE | 80 | 29216.71 | | | |
| C | Mulloides vanicolensis | 16 | PIPE | 35 | 3168.81 | | | |
| C | Mulloides vanicolensis | 16 | PIPE | 160 | 36370.70 | | | |
| C | Mulloides vanicolensis | 16 | PIPE | 23 | 1161.92 | | | |
| C | Parupeneus cyclostomus | 16 | PIPE | 1 | 88.57 | | | |
| C | Chaetodon fremblii | 16 | PIPE | 1 | 20.91 | | | |
| C | Chaetodon auriga | 16 | PIPE | 1 | 48.39 | | | |
| C | Plectroglyphidodon johnstonianu | 16 | PIPE | 4 | 6.89 | | | |
| C | Paracirrhites arcatus | 16 | PIPE | 1 | 16.35 | | | |
| C | Thalassoma duperrey | 16 | PIPE | 55 | 5337.86 | | | |
| C | Thalassoma duperrey | 16 | PIPE | 50 | 2747.44 | | | |
| C | Thalassoma duperrey | 16 | PIPE | 40 | 1095.62 | | | |
| C | Gomphosus varius | 16 | PIPE | 15 | 339.01 | | | |
| C | Gomphosus varius | 16 | PIPE | 4 | 248.12 | | | |
| C | Stethojulis balteata | 16 | PIPE | 3 | 217.17 | | | |
| C | Macropharyngodon geoffroy | 16 | PIPE | 3 | 128.71 | | | |
| C | Zanclus cornutus | 16 | PIPE | 4 | 416.63 | | | |
| C | Sufflamen bursa | 16 | PIPE | 8 | 686.99 | | | |
| C | Sufflamen fraenatus | 16 | PIPE | 2 | 449.59 | 958 | 139186.00 | 87.3 |
| CF | Cantherhines dumerili | 16 | PIPE | 1 | 301.33 | 1 | 301.33 | 0.2 |
| H | Scarus sordidus | 16 | PIPE | 1 | 1427.57 | | | |
| H | Scarus sordidus | 16 | PIPE | 3 | 420.02 | | | |
| H | Scarus psittacus | 16 | PIPE | 1 | 1437.46 | | | |
| H | Acanthurus nigrofuscus | 16 | PIPE | 40 | 568.51 | | | |
| H | Acanthurus nigrofuscus | 16 | PIPE | 65 | 1553.31 | | | |
| H | Acanthurus nigrofuscus | 16 | PIPE | 8 | 434.02 | | | |
| H | Acanthurus nigroris | 16 | PIPE | 2 | 344.60 | | | |
| H | Ctenochaetus strigosus | 16 | PIPE | 18 | 483.19 | | | |
| H | Ctenochaetus strigosus | 16 | PIPE | 9 | 592.78 | | | |
| H | Naso lituratus | 16 | PIPE | 4 | 290.34 | | | |
| H | Naso unicornis | 16 | PIPE | 1 | 190.74 | 152 | 7742.54 | 4.9 |
| O | Stegastes fasciolatus | 16 | PIPE | 12 | 311.76 | | | |
| O | Melichthys niger | 16 | PIPE | 9 | 1470.02 | | | |
| O | Melichthys vidua | 16 | PIPE | 3 | 597.09 | | | |
| O | Cantherhines sandwichiensis | 16 | PIPE | 3 | 246.15 | 27 | 2625.03 | 1.6 |
| P | Chaetodon kleini | 16 | PIPE | 12 | 78.70 | | | |
| P | Chaetodon miliaris | 16 | PIPE | 17 | 359.86 | | | |
| P | Dascyllus albisella | 16 | PIPE | 37 | 114.27 | | | |
| P | Abudefduf abdominalis | 16 | PIPE | 25 | 783.31 | | | |
| P | Abudefduf vaigensis | 16 | PIPE | 75 | 2349.94 | | | |
| P | Chromis ovalis | 16 | PIPE | 231 | 4605.84 | | | |
| P | Naso hexacanthus | 16 | PIPE | 3 | 220.07 | | | |
| P | Naso brevirostris | 16 | PIPE | 2 | 246.24 | | | |
| P | Naso brevirostris | 16 | PIPE | 12 | 880.30 | 414 | 9638.53 | 6.0 |
| | TOTAL | 16 | PIPE | 1552 | 159493.42 | 1552 | 159493.42 | 100 |

**15 MARCH 2017 FIELD DATA**

| GRP | 15-Mar-17 SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP BIOMASS | GROUP PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Parupeneus multifasciatus | 1 | EAST1 | 1 | 96.08 | | | |
| C | Parupeneus multifasciatus | 1 | EAST1 | 1 | 54.40 | | | |
| C | Plectroglyphidodon imparipennis | 1 | EAST1 | 2 | 1.72 | | | |
| C | Paracirrhites arcatus | 1 | EAST1 | 2 | 16.24 | | | |
| C | Bodianus bilunulatus | 1 | EAST1 | 1 | 1141.37 | | | |
| C | Labroides phthirophagus | 1 | EAST1 | 3 | 1.88 | | | |
| C | Thalassoma duperrey | 1 | EAST1 | 4 | 44.65 | | | |
| C | Thalassoma duperrey | 1 | EAST1 | 6 | 582.31 | | | |
| C | Thalassoma duperrey | 1 | EAST1 | 1 | 27.39 | | | |
| C | Stethojulis balteata | 1 | EAST1 | 1 | 35.76 | | | |
| C | Halichoeres ornatissimus | 1 | EAST1 | 1 | 16.45 | | | |
| C | Halichoeres ornatissimus | 1 | EAST1 | 1 | 9.52 | | | |
| C | Rhinecanthus rectangulus | 1 | EAST1 | 5 | 429.37 | | | |
| C | Rhinecanthus rectangulus | 1 | EAST1 | 2 | 90.72 | 31 | 2547.88 | 9.5 |
| CF | Chaetodon unimaculatus | 1 | EAST1 | 2 | 50.61 | | | |
| CF | Chaetodon quadrimaculatus | 1 | EAST1 | 2 | 50.61 | 4 | 101.22 | 0.4 |
| H | Scarus sordidus | 1 | EAST1 | 1 | 140.01 | | | |
| H | Scarus sordidus | 1 | EAST1 | 2 | 152.03 | | | |
| H | Acanthurus triostegus | 1 | EAST1 | 17 | 3189.23 | | | |
| H | Acanthurus triostegus | 1 | EAST1 | 23 | 2300.33 | | | |
| H | Acanthurus nigrofuscus | 1 | EAST1 | 21 | 1139.30 | | | |
| H | Acanthurus nigrofuscus | 1 | EAST1 | 10 | 238.97 | | | |
| H | Acanthurus nigroris | 1 | EAST1 | 3 | 802.05 | | | |
| H | Acanthurus olivaceus | 1 | EAST1 | 23 | 12952.92 | | | |
| H | Acanthurus dussumieri | 1 | EAST1 | 2 | 653.19 | | | |
| H | Acanthurus blochii | 1 | EAST1 | 3 | 1360.78 | | | |
| H | Ctenochaetus strigosus | 1 | EAST1 | 5 | 134.22 | | | |
| H | Naso lituratus | 1 | EAST1 | 3 | 617.96 | | | |
| H | Naso lituratus | 1 | EAST1 | 3 | 217.75 | 116 | 23898.74 | 89.3 |
| O | Melichthys vidua | 1 | EAST1 | 1 | 199.03 | | | |
| O | Canthigaster jactator | 1 | EAST1 | 1 | 3.56 | 2 | 202.59 | 0.8 |
| P | Chromis vanderbilti | 1 | EAST1 | 62 | 19.59 | 62 | 19.59 | 0.1 |
| | TOTAL | 1 | EAST1 | 215 | 26770.01 | 215 | 26770.01 | 100 |
| | | | | | | | | |
| C | Plectroglyphidodon johnstonianus | 2 | EAST2 | 2 | 3.44 | | | |
| C | Plectroglyphidodon imparipennis | 2 | EAST2 | 1 | 0.86 | | | |
| C | Paracirrhites arcatus | 2 | EAST2 | 1 | 16.35 | | | |
| C | Labroides phthirophagus | 2 | EAST2 | 2 | 1.26 | | | |
| C | Thalassoma duperrey | 2 | EAST2 | 9 | 494.54 | | | |
| C | Thalassoma duperrey | 2 | EAST2 | 5 | 136.95 | | | |
| C | Gomphosus varius | 2 | EAST2 | 1 | 11.04 | | | |
| C | Gomphosus varius | 2 | EAST2 | 1 | 22.60 | | | |
| C | Halichoeres ornatissimus | 2 | EAST2 | 2 | 32.90 | | | |
| C | Rhinecanthus rectangulus | 2 | EAST2 | 3 | 257.62 | | | |
| C | Rhinecanthus rectangulus | 2 | EAST2 | 1 | 45.36 | | | |
| C | Sufflamen fraenatus | 2 | EAST2 | 1 | 85.87 | 29 | 1108.80 | 2.3 |
| CF | Chaetodon unimaculatus | 2 | EAST2 | 6 | 151.82 | | | |
| CF | Chaetodon ornatissimus | 2 | EAST2 | 4 | 276.01 | | | |
| CF | Chaetodon quadrimaculatus | 2 | EAST2 | 2 | 50.61 | | | |
| CF | Cantherhines dumerili | 2 | EAST2 | 1 | 194.98 | 13 | 673.42 | 1.4 |
| H | Acanthurus triostegus | 2 | EAST2 | 3 | 138.95 | | | |
| H | Acanthurus triostegus | 2 | EAST2 | 34 | 3400.48 | | | |
| H | Acanthurus leucopareius | 2 | EAST2 | 5 | 1163.38 | | | |
| H | Acanthurus leucopareius | 2 | EAST2 | 7 | 467.18 | | | |
| H | Acanthurus leucopareius | 2 | EAST2 | 6 | 796.20 | | | |
| H | Acanthurus nigrofuscus | 2 | EAST2 | 36 | 270.89 | | | |
| H | Acanthurus nigrofuscus | 2 | EAST2 | 18 | 430.15 | | | |
| H | Acanthurus nigroris | 2 | EAST2 | 4 | 689.19 | | | |
| H | Acanthurus nigroris | 2 | EAST2 | 2 | 782.32 | | | |
| H | Acanthurus olivaceus | 2 | EAST2 | 52 | 29284.85 | | | |
| H | Acanthurus olivaceus | 2 | EAST2 | 26 | 6803.34 | | | |
| H | Acanthurus blochii | 2 | EAST2 | 1 | 453.59 | | | |
| H | Zebrasoma flavescens | 2 | EAST2 | 2 | 106.56 | | | |
| H | Naso lituratus | 2 | EAST2 | 5 | 1029.94 | | | |
| H | Naso lituratus | 2 | EAST2 | 1 | 448.94 | | | |
| H | Naso lituratus | 2 | EAST2 | 5 | 362.92 | 207 | 46628.89 | 95.8 |
| O | Melichthys vidua | 2 | EAST2 | 1 | 199.03 | | | |
| O | Canthigaster jactator | 2 | EAST2 | 1 | 3.56 | 2 | 202.59 | 0.4 |
| P | Chromis vanderbilti | 2 | EAST2 | 210 | 66.34 | 210 | 66.34 | 0.1 |
| | TOTAL | 2 | EAST2 | 461 | 48680.04 | 461 | 48680.04 | 100 |

| GRP | 15-Mar-17<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Lutjanus fulvus | 3 | EAST3 | 1 | 155.61 | | | |
| C | Parupeneus multifasciatus | 3 | EAST3 | 4 | 108.47 | | | |
| C | Plectroglyphidodon johnstonianı | 3 | EAST3 | 4 | 3.45 | | | |
| C | Paracirrhites arcatus | 3 | EAST3 | 1 | 16.35 | | | |
| C | Bodianus bilunulatus | 3 | EAST3 | 1 | 1462.82 | | | |
| C | Labroides phthirophagus | 3 | EAST3 | 2 | 1.26 | | | |
| C | Thalassoma duperrey | 3 | EAST3 | 15 | 824.23 | | | |
| C | Thalassoma duperrey | 3 | EAST3 | 5 | 485.26 | | | |
| C | Thalassoma duperrey | 3 | EAST3 | 15 | 410.86 | | | |
| C | Gomphosus varius | 3 | EAST3 | 4 | 44.17 | | | |
| C | Stethojulis balteata | 3 | EAST3 | 4 | 143.05 | | | |
| C | Sufflamen bursa | 3 | EAST3 | 2 | 171.75 | | | |
| C | Sufflamen fraenatus | 3 | EAST3 | 1 | 144.65 | 59 | 3971.91 | 16.8 |
| CF | Chaetodon ornatissimus | 3 | EAST3 | 2 | 138.00 | | | |
| CF | Chaetodon multicinctus | 3 | EAST3 | 6 | 78.18 | 8 | 216.18 | 0.9 |
| H | Scarus sordidus | 3 | EAST3 | 2 | 2855.14 | | | |
| H | Scarus sordidus | 3 | EAST3 | 1 | 775.07 | | | |
| H | Scarus rubroviolaceus | 3 | EAST3 | 2 | 2320.02 | | | |
| H | Acanthurus leucopareius | 3 | EAST3 | 1 | 232.68 | | | |
| H | Acanthurus nigrofuscus | 3 | EAST3 | 28 | 210.69 | | | |
| H | Acanthurus nigrofuscus | 3 | EAST3 | 46 | 1099.26 | | | |
| H | Acanthurus nigroris | 3 | EAST3 | 4 | 2188.77 | | | |
| H | Acanthurus olivaceus | 3 | EAST3 | 11 | 6194.87 | | | |
| H | Ctenochaetus strigosus | 3 | EAST3 | 15 | 987.97 | | | |
| H | Ctenochaetus strigosus | 3 | EAST3 | 5 | 37.88 | | | |
| H | Ctenochaetus strigosus | 3 | EAST3 | 23 | 617.41 | | | |
| H | Zebrasoma flavescens | 3 | EAST3 | 5 | 130.15 | | | |
| H | Naso lituratus | 3 | EAST3 | 2 | 145.17 | 145 | 17795.07 | 75.2 |
| O | Melichthys niger | 3 | EAST3 | 7 | 1143.35 | | | |
| O | Melichthys vidua | 3 | EAST3 | 3 | 373.04 | | | |
| O | Cantherhines sandwichiensis | 3 | EAST3 | 1 | 131.57 | 11 | 1647.96 | 7.0 |
| P | Chaetodon miliaris | 3 | EAST3 | 2 | 42.34 | 2 | 42.34 | 0.2 |
| | TOTAL | 3 | EAST3 | 225 | 23673.46 | 225 | 23673.46 | 100 |
| | | | | | | | | |
| C | Lutjanus fulvus | 4 | EAST4 | 1 | 155.61 | | | |
| C | Parupeneus multifasciatus | 4 | EAST4 | 3 | 9.36 | | | |
| C | Parupeneus multifasciatus | 4 | EAST4 | 2 | 54.23 | | | |
| C | Paracirrhites arcatus | 4 | EAST4 | 2 | 32.70 | | | |
| C | Pseudocheilinus octotaenia | 4 | EAST4 | 1 | 14.41 | | | |
| C | Thalassoma duperrey | 4 | EAST4 | 7 | 191.73 | | | |
| C | Thalassoma duperrey | 4 | EAST4 | 2 | 109.90 | | | |
| C | Thalassoma duperrey | 4 | EAST4 | 9 | 100.47 | | | |
| C | Halichoeres ornatissimus | 4 | EAST4 | 3 | 28.57 | | | |
| C | Zanclus cornutus | 4 | EAST4 | 2 | 208.32 | | | |
| C | Rhinecanthus rectangulus | 4 | EAST4 | 2 | 171.75 | | | |
| C | Sufflamen fraenatus | 4 | EAST4 | 1 | 329.34 | | | |
| C | Sufflamen fraenatus | 4 | EAST4 | 1 | 224.79 | 36 | 1631.17 | 4.1 |
| CF | Chaetodon ornatissimus | 4 | EAST4 | 2 | 138.00 | 2 | 138.00 | 0.3 |
| H | Scarus rubroviolaceus | 4 | EAST4 | 2 | 3672.76 | | | |
| H | Acanthurus triostegus | 4 | EAST4 | 2 | 200.03 | | | |
| H | Acanthurus nigrofuscus | 4 | EAST4 | 9 | 67.72 | | | |
| H | Acanthurus nigrofuscus | 4 | EAST4 | 17 | 406.25 | | | |
| H | Acanthurus olivaceus | 4 | EAST4 | 44 | 24779.49 | | | |
| H | Acanthurus olivaceus | 4 | EAST4 | 9 | 2355.00 | | | |
| H | Zebrasoma flavescens | 4 | EAST4 | 1 | 53.28 | | | |
| H | Naso lituratus | 4 | EAST4 | 10 | 3116.14 | 94 | 34650.68 | 87.8 |
| O | Melichthys niger | 4 | EAST4 | 17 | 2776.70 | | | |
| O | Melichthys vidua | 4 | EAST4 | 1 | 199.03 | | | |
| O | Canthigaster jactator | 4 | EAST4 | 4 | 14.25 | 22 | 2989.98 | 7.6 |
| P | Chromis vanderbilti | 4 | EAST4 | 155 | 48.96 | 155 | 48.96 | 0.1 |
| | TOTAL | 4 | EAST4 | 309 | 39458.79 | 309 | 39458.79 | 100 |

| GRP | 15-Mar-17<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Lutjanus fulvus | 5 | KO1 | 1 | 104.24 | | | |
| C | Lutjanus kasmira | 5 | KO1 | 180 | 19792.57 | | | |
| C | Lutjanus kasmira | 5 | KO1 | 115 | 2973.59 | | | |
| C | Monotaxis grandoculis | 5 | KO1 | 1 | 326.42 | | | |
| C | Forcipiger flavissimus | 5 | KO1 | 1 | 9.15 | | | |
| C | Plectroglyphidodon johnstonianu | 5 | KO1 | 3 | 5.17 | | | |
| C | Paracirrhites arcatus | 5 | KO1 | 1 | 16.35 | | | |
| C | Paracirrhites arcatus | 5 | KO1 | 2 | 16.24 | | | |
| C | Thalassoma duperrey | 5 | KO1 | 4 | 219.80 | | | |
| C | Thalassoma duperrey | 5 | KO1 | 1 | 97.05 | | | |
| C | Thalassoma duperrey | 5 | KO1 | 8 | 219.12 | | | |
| C | Thalassoma duperrey | 5 | KO1 | 2 | 22.33 | | | |
| C | Gomphosus varius | 5 | KO1 | 1 | 11.04 | | | |
| C | Zanclus cornutus | 5 | KO1 | 1 | 104.16 | | | |
| C | Sufflamen bursa | 5 | KO1 | 1 | 85.87 | 322 | 24003.10 | 87.8 |
| CF | Chaetodon multicinctus | 5 | KO1 | 4 | 52.12 | 4 | 52.12 | 0.2 |
| H | Scarus rubroviolaceus | 5 | KO1 | 1 | 43.92 | | | |
| H | Acanthurus nigrofuscus | 5 | KO1 | 23 | 549.63 | | | |
| H | Acanthurus nigrofuscus | 5 | KO1 | 24 | 180.59 | | | |
| H | Ctenochaetus strigosus | 5 | KO1 | 14 | 375.81 | | | |
| H | Ctenochaetus strigosus | 5 | KO1 | 16 | 1053.84 | | | |
| H | Ctenochaetus strigosus | 5 | KO1 | 5 | 660.67 | | | |
| H | Zebrasoma flavescens | 5 | KO1 | 4 | 37.94 | | | |
| H | Naso lituratus | 5 | KO1 | 1 | 72.58 | 88 | 2974.98 | 10.9 |
| O | Melichthys niger | 5 | KO1 | 1 | 163.34 | | | |
| O | Canthigaster jactator | 5 | KO1 | 5 | 11.03 | 6 | 174.36 | 0.6 |
| P | Abudefduf abdominalis | 5 | KO1 | 4 | 125.33 | 4 | 125.33 | 0.5 |
| | TOTAL | 5 | KO1 | 424 | 27329.89 | 424 | 27329.89 | 100 |
| | | | | | | | | |
| C | Gymnothorax undulatus | 6 | KO2 | 1 | 3989.72 | | | |
| C | Scorpaenopsis diabolus | 6 | KO2 | 1 | 3436.33 | | | |
| C | Forcipiger flavissimus | 6 | KO2 | 1 | 9.15 | | | |
| C | Plectroglyphidodon johnstonianu | 6 | KO2 | 6 | 10.33 | | | |
| C | Plectroglyphidodon imparipennis | 6 | KO2 | 1 | 0.86 | | | |
| C | Paracirrhites arcatus | 6 | KO2 | 2 | 16.24 | | | |
| C | Thalassoma duperrey | 6 | KO2 | 4 | 388.21 | | | |
| C | Thalassoma duperrey | 6 | KO2 | 7 | 384.64 | | | |
| C | Thalassoma duperrey | 6 | KO2 | 7 | 191.73 | | | |
| C | Gomphosus varius | 6 | KO2 | 4 | 44.17 | | | |
| C | Zanclus cornutus | 6 | KO2 | 1 | 54.90 | | | |
| C | Sufflamen bursa | 6 | KO2 | 2 | 171.75 | 37 | 8698.03 | 30.9 |
| CF | Chaetodon unimaculatus | 6 | KO2 | 2 | 50.61 | | | |
| CF | Chaetodon quadrimaculatus | 6 | KO2 | 2 | 50.61 | 4 | 101.22 | 0.4 |
| H | Scarus sordidus | 6 | KO2 | 1 | 775.07 | | | |
| H | Scarus psittacus | 6 | KO2 | 1 | 79.27 | | | |
| H | Acanthurus achilles | 6 | KO2 | 1 | 116.74 | | | |
| H | Acanthurus nigrofuscus | 6 | KO2 | 24 | 180.59 | | | |
| H | Acanthurus nigrofuscus | 6 | KO2 | 24 | 573.53 | | | |
| H | Acanthurus olivaceus | 6 | KO2 | 27 | 15205.60 | | | |
| H | Ctenochaetus strigosus | 6 | KO2 | 7 | 53.03 | | | |
| H | Ctenochaetus strigosus | 6 | KO2 | 7 | 461.05 | | | |
| H | Ctenochaetus strigosus | 6 | KO2 | 7 | 924.94 | | | |
| H | Ctenochaetus strigosus | 6 | KO2 | 7 | 187.91 | | | |
| H | Zebrasoma flavescens | 6 | KO2 | 2 | 52.06 | | | |
| H | Naso lituratus | 6 | KO2 | 1 | 72.58 | 109 | 18682.37 | 66.4 |
| O | Melichthys niger | 6 | KO2 | 4 | 653.34 | | | |
| O | Canthigaster jactator | 6 | KO2 | 2 | 7.12 | 6 | 660.47 | 2.3 |
| P | Chromis vanderbilti | 6 | KO2 | 12 | 3.79 | 12 | 3.79 | 0.01 |
| | TOTAL | 6 | KO2 | 168 | 28145.87 | 168 | 28145.87 | 100 |

| GRP | 15-Mar-17<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Myripristis amaenus | 7 | KAHE1D | 15 | 1231.24 | | | |
| C | Lutjanus kasmira | 7 | KAHE1D | 5 | 129.29 | | | |
| C | Mulloides flavolineatus | 7 | KAHE1D | 30 | 2503.34 | | | |
| C | Mulloides vanicolensis | 7 | KAHE1D | 90 | 8148.36 | | | |
| C | Parupeneus multifasciatus | 7 | KAHE1D | 2 | 54.23 | | | |
| C | Parupeneus multifasciatus | 7 | KAHE1D | 1 | 54.40 | | | |
| C | Chaetodon lunula | 7 | KAHE1D | 1 | 35.99 | | | |
| C | Labroides phthirophagus | 7 | KAHE1D | 2 | 1.26 | | | |
| C | Thalassoma duperrey | 7 | KAHE1D | 13 | 1261.68 | | | |
| C | Thalassoma duperrey | 7 | KAHE1D | 8 | 219.12 | | | |
| C | Thalassoma duperrey | 7 | KAHE1D | 9 | 494.54 | | | |
| C | Gomphosus varius | 7 | KAHE1D | 8 | 88.33 | | | |
| C | Gomphosus varius | 7 | KAHE1D | 3 | 67.80 | | | |
| C | Rhinecanthus rectangulus | 7 | KAHE1D | 2 | 171.75 | | | |
| C | Sufflamen bursa | 7 | KAHE1D | 3 | 136.09 | | | |
| C | Sufflamen bursa | 7 | KAHE1D | 1 | 85.87 | 193 | 14683.29 | 46.1 |
| CF | Chaetodon ornatissimus | 7 | KAHE1D | 2 | 138.00 | 2 | 138.00 | 0.4 |
| H | Acanthurus nigrofuscus | 7 | KAHE1D | 98 | 2341.91 | | | |
| H | Ctenochaetus strigosus | 7 | KAHE1D | 48 | 1288.51 | | | |
| H | Ctenochaetus strigosus | 7 | KAHE1D | 86 | 5664.39 | | | |
| H | Zebrasoma flavescens | 7 | KAHE1D | 1 | 26.03 | | | |
| H | Naso lituratus | 7 | KAHE1D | 4 | 290.34 | 237 | 9611.17 | 30.2 |
| O | Stegastes fasciolatus | 7 | KAHE1D | 12 | 311.76 | | | |
| O | Melichthys niger | 7 | KAHE1D | 40 | 6533.42 | | | |
| O | Melichthys vidua | 7 | KAHE1D | 1 | 124.35 | 53 | 6969.53 | 21.9 |
| P | Abudefduf abdominalis | 7 | KAHE1D | 7 | 219.33 | | | |
| P | Chromis ovalis | 7 | KAHE1D | 33 | 195.75 | 40 | 415.08 | 1.3 |
| | TOTAL | 7 | KAHE1D | 525 | 31817.08 | 525 | 31817.08 | 100 |
| | | | | | | | | |
| C | Parupeneus multifasciatus | 8 | KAHE5B | 1 | 54.40 | | | |
| C | Parupeneus multifasciatus | 8 | KAHE5B | 1 | 155.42 | | | |
| C | Forcipiger flavissimus | 8 | KAHE5B | 3 | 27.45 | | | |
| C | Plectroglyphidodon johnstonianu | 8 | KAHE5B | 2 | 3.44 | | | |
| C | Plectroglyphidodon imparipennis | 8 | KAHE5B | 2 | 1.72 | | | |
| C | Paracirrhites arcatus | 8 | KAHE5B | 2 | 32.70 | | | |
| C | Thalassoma duperrey | 8 | KAHE5B | 3 | 164.85 | | | |
| C | Thalassoma duperrey | 8 | KAHE5B | 1 | 27.39 | | | |
| C | Thalassoma duperrey | 8 | KAHE5B | 1 | 97.05 | | | |
| C | Stethojulis balteata | 8 | KAHE5B | 1 | 35.76 | | | |
| C | Halichoeres ornatissimus | 8 | KAHE5B | 1 | 25.14 | | | |
| C | Zanclus cornutus | 8 | KAHE5B | 3 | 312.47 | | | |
| C | Rhinecanthus rectangulus | 8 | KAHE5B | 2 | 90.72 | | | |
| C | Sufflamen bursa | 8 | KAHE5B | 2 | 171.75 | 25 | 1200.27 | 21.9 |
| CF | Chaetodon unimaculatus | 8 | KAHE5B | 2 | 50.61 | | | |
| CF | Chaetodon quadrimaculatus | 8 | KAHE5B | 2 | 50.61 | | | |
| CF | Pervagor melanocephalus | 8 | KAHE5B | 1 | 9.75 | 5 | 110.97 | 2.0 |
| H | Scarus sordidus | 8 | KAHE5B | 6 | 456.08 | | | |
| H | Scarus psittacus | 8 | KAHE5B | 1 | 79.27 | | | |
| H | Scarus psittacus | 8 | KAHE5B | 1 | 144.94 | | | |
| H | Acanthurus nigrofuscus | 8 | KAHE5B | 61 | 1457.72 | | | |
| H | Acanthurus olivaceus | 8 | KAHE5B | 1 | 163.52 | | | |
| H | Acanthurus olivaceus | 8 | KAHE5B | 1 | 563.17 | | | |
| H | Ctenochaetus strigosus | 8 | KAHE5B | 3 | 80.53 | | | |
| H | Naso lituratus | 8 | KAHE5B | 2 | 411.98 | | | |
| H | Naso unicornis | 8 | KAHE5B | 1 | 190.74 | 77 | 3547.95 | 64.9 |
| O | Stegastes fasciolatus | 8 | KAHE5B | 2 | 51.96 | | | |
| O | Melichthys vidua | 8 | KAHE5B | 1 | 199.03 | | | |
| O | Cantherhines sandwichiensis | 8 | KAHE5B | 3 | 246.15 | | | |
| O | Canthigaster jactator | 8 | KAHE5B | 3 | 10.69 | 9 | 507.83 | 9.3 |
| P | Chromis vanderbilti | 8 | KAHE5B | 88 | 27.80 | | | |
| P | Chromis hanui | 8 | KAHE5B | 1 | 0.75 | | | |
| P | Naso brevirostris | 8 | KAHE5B | 1 | 73.36 | 90 | 101.90 | 1.9 |
| | TOTAL | 8 | KAHE5B | 206 | 5468.92 | 206 | 5468.92 | 100 |

| GRP | 15-Mar-17<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Saurida gracilis | 9 | KAHE7B | 1 | 51.93 | | | |
| C | Lutjanus kasmira | 9 | KAHE7B | 1 | 190.65 | | | |
| C | Monotaxis grandoculis | 9 | KAHE7B | 1 | 34.79 | | | |
| C | Mulloides flavolineatus | 9 | KAHE7B | 1 | 618.55 | | | |
| C | Parupeneus multifasciatus | 9 | KAHE7B | 1 | 27.12 | | | |
| C | Forcipiger flavissimus | 9 | KAHE7B | 3 | 27.45 | | | |
| C | Plectroglyphidodon imparipennis | 9 | KAHE7B | 1 | 0.86 | | | |
| C | Paracirrhites arcatus | 9 | KAHE7B | 1 | 8.12 | | | |
| C | Paracirrhites forsteri | 9 | KAHE7B | 1 | 39.65 | | | |
| C | Thalassoma duperrey | 9 | KAHE7B | 2 | 22.33 | | | |
| C | Thalassoma duperrey | 9 | KAHE7B | 1 | 97.05 | | | |
| C | Thalassoma duperrey | 9 | KAHE7B | 1 | 27.39 | | | |
| C | Thalassoma duperrey | 9 | KAHE7B | 6 | 18.90 | | | |
| C | Coris venusta | 9 | KAHE7B | 2 | 173.73 | | | |
| C | Stethojulis balteata | 9 | KAHE7B | 1 | 35.76 | | | |
| C | Stethojulis balteata | 9 | KAHE7B | 1 | 72.39 | | | |
| C | Sufflamen bursa | 9 | KAHE7B | 5 | 429.37 | | | |
| C | Sufflamen fraenatus | 9 | KAHE7B | 1 | 85.87 | 31 | 1961.90 | 81.0 |
| CF | Chaetodon ornatissimus | 9 | KAHE7B | 2 | 16.43 | 2 | 16.43 | 0.7 |
| H | Acanthurus nigrofuscus | 9 | KAHE7B | 7 | 167.28 | | | |
| H | Acanthurus nigrofuscus | 9 | KAHE7B | 6 | 45.15 | | | |
| H | Acanthurus nigrofuscus | 9 | KAHE7B | 1 | 54.25 | | | |
| H | Naso unicornis | 9 | KAHE7B | 1 | 73.36 | 15 | 340.04 | 14.0 |
| P | Chaetodon kleini | 9 | KAHE7B | 4 | 26.23 | | | |
| P | Dascyllus albisella | 9 | KAHE7B | 23 | 71.03 | | | |
| P | Chromis vanderbilti | 9 | KAHE7B | 21 | 6.63 | | | |
| P | Chromis hanui | 9 | KAHE7B | 1 | 0.75 | 49 | 104.64 | 4.3 |
| | TOTAL | 9 | KAHE7B | 97 | 2423.02 | 97 | 2423.02 | 100 |
| | | | | | | | | |
| C | Parupeneus multifasciatus | 10 | KAHE7C | 1 | 472.94 | | | |
| C | Parupeneus multifasciatus | 10 | KAHE7C | 1 | 96.08 | | | |
| C | Forcipiger flavissimus | 10 | KAHE7C | 6 | 54.90 | | | |
| C | Thalassoma duperrey | 10 | KAHE7C | 2 | 54.78 | | | |
| C | Coris venusta | 10 | KAHE7C | 1 | 48.38 | | | |
| C | Coris gaimard | 10 | KAHE7C | 2 | 278.26 | | | |
| C | Sufflamen bursa | 10 | KAHE7C | 4 | 343.49 | 17 | 1348.84 | 35.2 |
| H | Acanthurus triostegus | 10 | KAHE7C | 11 | 1100.16 | | | |
| H | Acanthurus nigrofuscus | 10 | KAHE7C | 4 | 30.10 | | | |
| H | Acanthurus nigrofuscus | 10 | KAHE7C | 5 | 119.49 | | | |
| H | Acanthurus nigroris | 10 | KAHE7C | 1 | 54.25 | | | |
| H | Acanthurus olivaceus | 10 | KAHE7C | 3 | 1179.63 | 24 | 2483.62 | 64.8 |
| P | Dascyllus albisella | 10 | KAHE7C | 2 | 1.61 | 2 | 1.61 | 0.04 |
| | TOTAL | 10 | KAHE7C | 43 | 3834.07 | 43 | 3834.07 | 100 |
| | | | | | | | | |
| C | Paracirrhites arcatus | 11 | KAHE7D | 1 | 3.45 | | | |
| C | Sufflamen bursa | 11 | KAHE7D | 1 | 85.87 | | | |
| C | Sufflamen fraenatus | 11 | KAHE7D | 1 | 85.87 | 3 | 175.19 | 94.3 |
| O | Canthigaster jactator | 11 | KAHE7D | 3 | 10.69 | 3 | 10.69 | 5.7 |
| | TOTAL | 11 | KAHE7D | 6 | 185.88 | 6 | 185.88 | 100 |

| GRP | 15-Mar-17<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Aulostomus chinensis | 12 | KAHE7E | 1 | 4.76 | | | |
| C | Caranx melampygus | 12 | KAHE7E | 1 | 81.59 | | | |
| C | Parupeneus pleurostigma | 12 | KAHE7E | 1 | 58.01 | | | |
| C | Parupeneus multifasciatus | 12 | KAHE7E | 5 | 55.26 | | | |
| C | Parupeneus multifasciatus | 12 | KAHE7E | 7 | 189.82 | | | |
| C | Plectroglyphidodon johnstonianu | 12 | KAHE7E | 2 | 1.72 | | | |
| C | Paracirrhites arcatus | 12 | KAHE7E | 1 | 8.12 | | | |
| C | Paracirrhites arcatus | 12 | KAHE7E | 3 | 10.34 | | | |
| C | Labroides phthirophagus | 12 | KAHE7E | 1 | 0.19 | | | |
| C | Pseudocheilinus octotaenia | 12 | KAHE7E | 4 | 57.64 | | | |
| C | Thalassoma duperrey | 12 | KAHE7E | 2 | 194.10 | | | |
| C | Thalassoma duperrey | 12 | KAHE7E | 7 | 191.73 | | | |
| C | Thalassoma duperrey | 12 | KAHE7E | 3 | 164.85 | | | |
| C | Thalassoma duperrey | 12 | KAHE7E | 8 | 89.31 | | | |
| C | Pseudojuloides cerasinus | 12 | KAHE7E | 8 | 25.20 | | | |
| C | Stethojulis balteata | 12 | KAHE7E | 3 | 43.23 | | | |
| C | Macropharyngodon geoffroy | 12 | KAHE7E | 4 | 22.99 | | | |
| C | Halichoeres ornatissimus | 12 | KAHE7E | 3 | 13.22 | | | |
| C | Zanclus cornutus | 12 | KAHE7E | 2 | 109.80 | | | |
| C | Sufflamen bursa | 12 | KAHE7E | 3 | 257.62 | | | |
| C | Sufflamen fraenatus | 12 | KAHE7E | 1 | 329.34 | 70 | 1908.83 | 40.0 |
| CF | Chaetodon multicinctus | 12 | KAHE7E | 8 | 53.25 | 8 | 53.25 | 1.1 |
| H | Scarus sordidus | 12 | KAHE7E | 1 | 13.73 | | | |
| H | Acanthurus triostegus | 12 | KAHE7E | 14 | 1400.20 | | | |
| H | Acanthurus nigrofuscus | 12 | KAHE7E | 7 | 52.67 | | | |
| H | Acanthurus nigrofuscus | 12 | KAHE7E | 8 | 191.18 | | | |
| H | Ctenochaetus strigosus | 12 | KAHE7E | 8 | 6.97 | | | |
| H | Ctenochaetus strigosus | 12 | KAHE7E | 4 | 30.30 | | | |
| H | Zebrasoma flavescens | 12 | KAHE7E | 1 | 53.28 | | | |
| H | Naso lituratus | 12 | KAHE7E | 1 | 72.58 | | | |
| H | Naso lituratus | 12 | KAHE7E | 1 | 205.99 | | | |
| H | Naso lituratus | 12 | KAHE7E | 1 | 36.34 | 46 | 2063.25 | 43.3 |
| O | Melichthys vidua | 12 | KAHE7E | 3 | 597.09 | 3 | 597.09 | 12.5 |
| P | Chaetodon kleini | 12 | KAHE7E | 3 | 19.67 | | | |
| P | Chaetodon miliaris | 12 | KAHE7E | 1 | 21.17 | | | |
| P | Chromis vanderbilti | 12 | KAHE7E | 103 | 32.54 | | | |
| P | Naso hexacanthus | 12 | KAHE7E | 1 | 73.36 | 108 | 146.74 | 3.1 |
| | TOTAL | 12 | KAHE7E | 235 | 4769.16 | 235 | 4769.16 | 100 |
| | | | | | | | | |
| C | Fistularia commersoni | 13 | KAHE10 | 1 | 37.69 | | | |
| C | Lutjanus kasmira | 13 | KAHE10 | 65 | 12392.05 | | | |
| C | Lutjanus kasmira | 13 | KAHE10 | 20 | 1147.05 | | | |
| C | Mulloides vanicolensis | 13 | KAHE10 | 19 | 1720.21 | | | |
| C | Forcipiger flavissimus | 13 | KAHE10 | 1 | 9.15 | | | |
| C | Chaetodon lunula | 13 | KAHE10 | 1 | 35.99 | | | |
| C | Plectroglyphidodon imparipennis | 13 | KAHE10 | 1 | 0.86 | | | |
| C | Paracirrhites arcatus | 13 | KAHE10 | 3 | 49.05 | | | |
| C | Thalassoma duperrey | 13 | KAHE10 | 9 | 246.51 | | | |
| C | Thalassoma duperrey | 13 | KAHE10 | 12 | 659.39 | | | |
| C | Thalassoma duperrey | 13 | KAHE10 | 10 | 970.52 | | | |
| C | Thalassoma duperrey | 13 | KAHE10 | 4 | 44.65 | | | |
| C | Halichoeres ornatissimus | 13 | KAHE10 | 1 | 9.52 | | | |
| C | Sufflamen bursa | 13 | KAHE10 | 9 | 772.86 | 156 | 18095.51 | 74.2 |
| CF | Chaetodon ornatissimus | 13 | KAHE10 | 2 | 138.00 | | | |
| CF | Chaetodon multicinctus | 13 | KAHE10 | 2 | 13.31 | | | |
| CF | Exallias brevis | 13 | KAHE10 | 1 | 29.55 | 5 | 180.87 | 0.7 |
| H | Acanthurus triostegus | 13 | KAHE10 | 8 | 370.52 | | | |
| H | Acanthurus nigrofuscus | 13 | KAHE10 | 31 | 740.81 | | | |
| H | Acanthurus olivaceus | 13 | KAHE10 | 2 | 786.42 | | | |
| H | Naso lituratus | 13 | KAHE10 | 4 | 290.34 | | | |
| H | Naso lituratus | 13 | KAHE10 | 2 | 411.98 | 47 | 2600.06 | 10.7 |
| O | Stegastes fasciolatus | 13 | KAHE10 | 3 | 77.94 | | | |
| O | Melichthys niger | 13 | KAHE10 | 14 | 2286.70 | | | |
| O | Melichthys vidua | 13 | KAHE10 | 1 | 199.03 | 18 | 2563.67 | 10.5 |
| P | Dascyllus albisella | 13 | KAHE10 | 21 | 64.85 | | | |
| P | Abudefduf abdominalis | 13 | KAHE10 | 20 | 626.65 | | | |
| P | Abudefduf vaigensis | 13 | KAHE10 | 6 | 188.00 | | | |
| P | Chromis vanderbilti | 13 | KAHE10 | 28 | 8.84 | | | |
| P | Chromis ovalis | 13 | KAHE10 | 5 | 57.80 | 80 | 946.14 | 3.9 |
| | TOTAL | 13 | KAHE10 | 306 | 24386.25 | 306 | 24386.25 | 100 |

| GRP | 15-Mar-17<br>SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP<br>BIOMASS | GROUP<br>PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Lutjanus kasmira | 14 | NANA1 | 1 | 190.65 | | | |
| C | Parupeneus multifasciatus | 14 | NANA1 | 1 | 96.08 | | | |
| C | Parupeneus multifasciatus | 14 | NANA1 | 1 | 11.05 | | | |
| C | Parupeneus multifasciatus | 14 | NANA1 | 1 | 27.12 | | | |
| C | Plectroglyphidodon johnstonianı | 14 | NANA1 | 1 | 1.72 | | | |
| C | Plectroglyphidodon imparipennis | 14 | NANA1 | 2 | 1.72 | | | |
| C | Paracirrhites arcatus | 14 | NANA1 | 1 | 8.12 | | | |
| C | Thalassoma duperrey | 14 | NANA1 | 9 | 28.35 | | | |
| C | Thalassoma duperrey | 14 | NANA1 | 10 | 273.90 | | | |
| C | Thalassoma duperrey | 14 | NANA1 | 8 | 89.31 | | | |
| C | Plagiotremus ewaensis | 14 | NANA1 | 3 | 0.76 | | | |
| C | Sufflamen bursa | 14 | NANA1 | 1 | 85.87 | 39 | 814.66 | 71.8 |
| H | Acanthurus triostegus | 14 | NANA1 | 1 | 46.32 | | | |
| H | Acanthurus nigrofuscus | 14 | NANA1 | 2 | 15.05 | | | |
| H | Acanthurus nigrofuscus | 14 | NANA1 | 4 | 95.59 | | | |
| H | Ctenochaetus strigosus | 14 | NANA1 | 2 | 15.15 | | | |
| H | Ctenochaetus strigosus | 14 | NANA1 | 5 | 134.22 | 14 | 306.32 | 27.0 |
| O | Canthigaster jactator | 14 | NANA1 | 1 | 3.56 | 1 | 3.56 | 0.3 |
| P | Chromis vanderbilti | 14 | NANA1 | 32 | 10.11 | 32 | 10.11 | 0.9 |
| | TOTAL | 14 | NANA1 | 86 | 1134.66 | 86 | 1134.66 | 100 |
| | | | | | | | | |
| C | Gymnomuraena zebra | 15 | NANA2 | 1 | 754.49 | | | |
| C | Cephalopholis argus | 15 | NANA2 | 1 | 229.32 | | | |
| C | Lutjanus fulvus | 15 | NANA2 | 2 | 311.21 | | | |
| C | Monotaxis grandoculis | 15 | NANA2 | 3 | 2721.55 | | | |
| C | Monotaxis grandoculis | 15 | NANA2 | 8 | 14514.96 | | | |
| C | Parupeneus multifasciatus | 15 | NANA2 | 1 | 96.08 | | | |
| C | Forcipiger flavissimus | 15 | NANA2 | 3 | 27.45 | | | |
| C | Chaetodon lunula | 15 | NANA2 | 5 | 179.97 | | | |
| C | Plectroglyphidodon imparipennis | 15 | NANA2 | 1 | 0.86 | | | |
| C | Paracirrhites forsteri | 15 | NANA2 | 1 | 39.65 | | | |
| C | Bodianus bilunulatus | 15 | NANA2 | 1 | 648.58 | | | |
| C | Thalassoma duperrey | 15 | NANA2 | 4 | 388.21 | | | |
| C | Gomphosus varius | 15 | NANA2 | 1 | 22.60 | | | |
| C | Stethojulis balteata | 15 | NANA2 | 1 | 35.76 | | | |
| C | Halichoeres ornatissimus | 15 | NANA2 | 1 | 16.45 | | | |
| C | Zanclus cornutus | 15 | NANA2 | 2 | 208.32 | 36 | 20195.47 | 47.4 |
| CF | Chaetodon ornatissimus | 15 | NANA2 | 2 | 138.00 | | | |
| CF | Chaetodon multicinctus | 15 | NANA2 | 2 | 13.31 | 4 | 151.32 | 0.4 |
| H | Acanthurus triostegus | 15 | NANA2 | 9 | 900.13 | | | |
| H | Acanthurus leucopareius | 15 | NANA2 | 55 | 7298.52 | | | |
| H | Acanthurus leucopareius | 15 | NANA2 | 6 | 2244.39 | | | |
| H | Acanthurus leucopareius | 15 | NANA2 | 31 | 7212.93 | | | |
| H | Acanthurus nigrofuscus | 15 | NANA2 | 2 | 108.50 | | | |
| H | Acanthurus nigrofuscus | 15 | NANA2 | 28 | 669.12 | | | |
| H | Acanthurus nigroris | 15 | NANA2 | 1 | 102.47 | | | |
| H | Acanthurus olivaceus | 15 | NANA2 | 4 | 2252.68 | | | |
| H | Acanthurus dussumieri | 15 | NANA2 | 2 | 1128.71 | | | |
| H | Ctenochaetus strigosus | 15 | NANA2 | 3 | 80.53 | 141 | 21997.98 | 51.6 |
| O | Stegastes fasciolatus | 15 | NANA2 | 4 | 59.05 | | | |
| O | Melichthys niger | 15 | NANA2 | 1 | 163.34 | | | |
| O | Canthigaster jactator | 15 | NANA2 | 3 | 10.69 | 8 | 233.07 | 0.5 |
| P | Chromis vanderbilti | 15 | NANA2 | 44 | 13.90 | | | |
| P | Chromis hanui | 15 | NANA2 | 2 | 1.49 | 46 | 15.39 | 0.04 |
| | TOTAL | 15 | NANA2 | 235 | 42593.24 | 235 | 42593.24 | 100 |

| GRP | 15-Mar-17 SPECIES | RB | STATION | NO. | BIOMASS | NO. IND | GROUP BIOMASS | GROUP PERCENT |
|---|---|---|---|---|---|---|---|---|
| C | Tylosurus crocodilus | 16 | PIPE | 4 | 3628.74 | | | |
| C | Priacanthus meeki | 16 | PIPE | 1 | 167.58 | | | |
| C | Decapterus macarellus | 16 | PIPE | 90 | 11725.12 | | | |
| C | Caranx melampygus | 16 | PIPE | 6 | 776.21 | | | |
| C | Lutjanus kasmira | 16 | PIPE | 180 | 34316.43 | | | |
| C | Mulloides vanicolensis | 16 | PIPE | 105 | 9506.42 | | | |
| C | Mulloides vanicolensis | 16 | PIPE | 250 | 82843.76 | | | |
| C | Parupeneus multifasciatus | 16 | PIPE | 2 | 471.50 | | | |
| C | Forcipiger flavissimus | 16 | PIPE | 4 | 36.60 | | | |
| C | Plectroglyphidodon johnstonianı | 16 | PIPE | 4 | 6.89 | | | |
| C | Paracirrhites forsteri | 16 | PIPE | 1 | 39.65 | | | |
| C | Thalassoma duperrey | 16 | PIPE | 27 | 2620.40 | | | |
| C | Thalassoma duperrey | 16 | PIPE | 15 | 410.86 | | | |
| C | Thalassoma duperrey | 16 | PIPE | 41 | 2252.90 | | | |
| C | Gomphosus varius | 16 | PIPE | 5 | 113.00 | | | |
| C | Stethojulis balteata | 16 | PIPE | 4 | 289.56 | | | |
| C | Zanclus cornutus | 16 | PIPE | 1 | 54.90 | | | |
| C | Sufflamen bursa | 16 | PIPE | 2 | 171.75 | | | |
| C | Sufflamen bursa | 16 | PIPE | 3 | 136.09 | 745 | 149568.35 | 92.4 |
| CF | Chaetodon multicinctus | 16 | PIPE | 7 | 91.21 | | | |
| CF | Pervagor spilosoma | 16 | PIPE | 1 | 16.22 | 8 | 107.43 | 0.1 |
| H | Scarus sordidus | 16 | PIPE | 1 | 367.02 | | | |
| H | Scarus sordidus | 16 | PIPE | 1 | 775.07 | | | |
| H | Scarus sordidus | 16 | PIPE | 15 | 1140.20 | | | |
| H | Acanthurus nigrofuscus | 16 | PIPE | 9 | 215.07 | | | |
| H | Ctenochaetus strigosus | 16 | PIPE | 3 | 197.59 | | | |
| H | Naso lituratus | 16 | PIPE | 2 | 72.69 | 31 | 2767.64 | 1.7 |
| O | Stegastes fasciolatus | 16 | PIPE | 16 | 415.68 | 16 | 415.68 | 0.3 |
| P | Chaetodon kleini | 16 | PIPE | 5 | 32.79 | | | |
| P | Chaetodon miliaris | 16 | PIPE | 15 | 317.52 | | | |
| P | Dascyllus albisella | 16 | PIPE | 57 | 176.03 | | | |
| P | Abudefduf abdominalis | 16 | PIPE | 25 | 783.31 | | | |
| P | Abudefduf vaigensis | 16 | PIPE | 60 | 1879.95 | | | |
| P | Chromis ovalis | 16 | PIPE | 25 | 498.47 | | | |
| P | Chromis ovalis | 16 | PIPE | 85 | 4005.74 | | | |
| P | Chromis ovalis | 16 | PIPE | 120 | 1387.16 | | | |
| P | Chromis agilis | 16 | PIPE | 12 | 8.96 | 404 | 9089.94 | 5.6 |
| | TOTAL | 16 | PIPE | 1204 | 161949.05 | 1204 | 161949.05 | 100 |