CAMPBELL INDUSTRIAL PARK (CIP) GENERATING STATION
COMMUNITY BENEFITS PROGRAM

2022 REEF FISHES MONITORING
REPORT

Prepared For:

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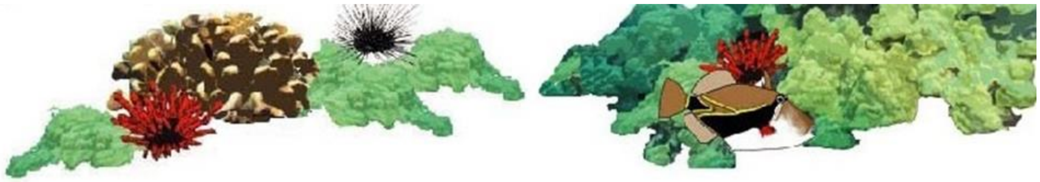

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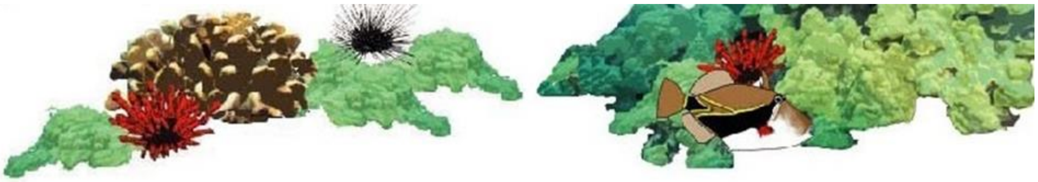
EXECUTIVE SUMMARY

Hawaiian Electric Company, Inc.'s (Hawaiian Electric's) Campbell Industrial Park (CIP) Generating Station quarterly ecological monitoring was initiated to monitor changes in biological communities with the startup of the generating facility at CIP, Barbers Point in West Oʻahu in 2010. Fourteen annual reports have been submitted between 2007 and 2021. The current 2022 report is the fifteenth in this series. The CIP Generating Station's wastewater is permitted to be discharged into two underground injection control (UIC) wells onsite; no effluent discharges to the ocean are permitted. The coral reef fish community monitoring continues as a commitment and benefit to the West Oʻahu community. Sixteen permanently marked monitoring stations extend from Barbers Point in the southeast to Nanakuli in the northwest, a distance of 7.9 kilometers (4.9 miles). These monitoring stations are located in depths between 5 meters (m) (16.4 feet) and 12 m (39.4 feet). In 2019, the number of monitoring stations was reduced from 16 to 14 based on comparability of biomass (mean standing crop) of fishes, abundance (mean number of individual fish), mean number of fish species, similarity of habitat, and spatial proximity. In 2020, the number of monitoring stations was further reduced to 12, elimating stations Kahe 7C and 10C. The monitoring stations are located within four geographic groups (East, Koʻolina, Kahe, and Nanakuli) within the nearshore and are analyzed to determine similarities based on historical data. The removal of four monitoring stations, East 2 and Kahe 7C, 7D, and 10C, are reflected in this report. Four monitoring events were conducted in 2022: May, June, August and October, with an average reported from the pooled surveys.

Hawaiian Electric has collected data on fish and benthic communities in the nearshore vicinity of the Kahe Generating Station (KGS) since the mid-1970's. This long-term dataset documented severe changes following storms and hurricanes not related to the operation of KGS. Eight of the KGS monitoring stations (Kahe group) overlap with stations from this CIP Generating Station monitoring to provide a robust record of trends and patterns in fish community factors and their environmental and meteorological influences.

Fish community composition and biomass remained similar from the 2021 to 2022 surveys. In both 2021 and 2022, the brown surgeonfish *maʻiʻi,* contribute most heavily to the abundance. In 2022, the invasive *taʻape* (*Lutjanus kasmira,* bluestripe snapper) dominated the biomass (16.9%). Other fishes contributing to the biomass in 2022 were *māiʻiʻi* (*Acanthurus nigrofuscus*, brown surgeonfish), and *hīnālea lauwili* (saddle wrasse, *Thalassoma duperrey*). This varies slightly from the common contributors of biomass in 2021: *taʻape* (*L. kasmira*, bluestripe snapper), *naʻenaʻe* (*A. olivaceus*, orangeband surgeonfish), *humuhumuʻelʻele (Melichthys niger,* black durgon), *mamo* (*A. vaigiensis*, Indo-Pacific sergeant), *maikoiko* (*Acanthurus leucopareius*, whitebar surgeonfish), and *maʻiʻi* (*A. nigrofuscus*, brown surgeonfish). However, in 2021 no single species dominated the biomass. The total number of fish species recorded in 2022 (113 species) is similar to the number recorded in 2021 (101 species). Trophic regimes remain fairly constant throughout the two years, with herbivores and invertebrate feeders making up the majority of both mean abundance and mean biomass.



Similar to the past two annual reports, the Ko'Olina group exhibits a higher number of fish species, individuals and biomass as compared to the East (Kalaeloa), Kahe and Nanakuli group stations. The only significant difference observed between these four stations is Ko'Olina, having significantly greater herbivore biomass when compared to Kahe. The KGS discharge pipe (Pipe) station is significantly higher in fish biomass when compared to Nanakuli and Kahe, higher in fish abundance when compared to East, and higher in diversity of fishes as compared to the East and Nanakuli. Although not signficant, the abundance, biomass, and diversity of fishes are much higher at the Pipe than at other groups, a statistical difference is not found between some groups due to high variabilty within the dataset. This high variability between fish surveys and years is due to low diversity, abundance and biomass of fishes within the East, Kahe and Nanakuli groups likely resulting from the poorly developed coral communities. The greater number of years surveyed, the lower the variability and increase in statistical power. This strengthens the confidence of results by providing additional data across years. Pipe was the only transect to experience a significant decrease in overall fish biomass from 2021 to 2022 surveys. It is important to note that the biomass in 2021 was significanlty greater than in 2020, suggesting the increased biomass in 2021 may be an anomaly. The total number of individual fishes and number of species at Pipe transect did not differ between the 2022 and 2021 surveys. East 1 experienced a significant decline in fish abundance between 2022 and 2021 surveys, while other East transects observed no change. The number of species present along transects was siginficantly greater at Kahe 7B and Nanakuli 1, when compared to the previous year. Overall Nanakuli transects (control) saw no significant declines in biomass, abudance, or diversity of fishes in 2022.

Fish populations are heavily influenced by spatial complexity. The topographic relief provided by the KGS Pipe provides protection from predators and habitat complexity that is known to be highly correlated with fish populations. In addition, numerous spinner dolphins, green turtles, and Hawaiian monk seals are observed throughout the surveys at the KGS Pipe. Periodic storms and hurricanes contribute to the lack of spatial relief through breakage and removal of coral colonies and shifting of sands. The poorly developed benthic communities at the Kahe stations are reflected in the lack of fishes as compared to more well-developed benthos as found at the Ko'Olina and Pipe stations. The 2022 surveys found no significant change in fish community factors which can be attributed to the operation of KGS or CIP Generating Station facilities.

Key Points

- The dominant species in individual number observed in 2022 were similar to those reported in 2020 and 2021: brown surgeonfish (*mā'i'i'i*, *A. nigrofuscus*), blackfin chromis (*Chromis vanderbilti*) (small size, large schools), bluestripe snapper (*ta'ape*, *L. kasmira*), and saddle wrasse (*hīnālea lauwili*, *T. duperrey*).
- Biomass is contributed mainly by the bluestripe snapper (*ta'ape, L. kasmira,* invasive), brown surgeonfish (*mā'i'i'i*, *A. nigrofuscus*), saddle wrasse (*hīnālea lauwili*, *T. duperrey*), and orangeband surgeonfish (*na'ena'e, A. olivaceus*).
- The number of species of fishes recorded in 2020 surveys (118 species) was similar to that of 2021 (101 species) and 2022 (113 speices).

- A few significant shifts at the transect level were found between 2021 and 2022 surveys in trophic feeding guilds: Ko‘Olina 1, Kahe 7B, Kahe 7E had significantly less herbivore biomass in 2022, when compared to 2021. Herbivores and invertebrate feeders consistently dominate. Herbivores experienced a shift in biomass from 49% dominance in 2021 to 41% dominance in 2022.
- The 2022 surveys found no significant change in fish communities that can be attributed to the Hawaiian Electric’s KGS or CIP Generating Station facilities.

Field Photo 1. Species diversity is highest at the Pipe site in 2022, 113 different fish species were recorded at the 12 stations.

INTRODUCTION

Rationale and Historical Background for the Reef Fishes Monitoring Program

The Hawaiian Electric Company, Inc. (Hawaiian Electric) Campbell Industrial Park (CIP) Generating Station began service in 2010 with a 120-megawatt (MW) combustion turbine and two auxiliary 2 MW diesel engine generators. In contrast to the nearby Kahe Generating Station (KGS), the CIP Generating Station does not discharge effluent into the ocean. Instead, the CIP Generating Station is permitted to discharge effluent (approximately 600 gallons per minute [gpm]) from the production of electricity into two permitted injection wells onsite. This eliminates or greatly reduces any deleterious impacts to the adjacent nearshore marine environment. The development of this electric generating facility initiated an environmental monitoring program with a focus on determining any temporal or spatial changes in fish communities. The spatial extent of the quarterly surveys range from Kalaeloa (Barbers Point) in the southeast direction to Nanakuli in the northwest, a distance of 4.9 miles (7.9 kilometers (km)). Eight of the monitoring stations along this coastline have been surveyed since 2008. The remaining stations were established in the 1970s for Hawaiian Electric’s KGS monitoring program. These stations range in depth from 16.4 feet (ft.) (5 meters (m)) to 39.4 ft. (12 m). Prior to construction of the CIP Generating Station, baseline surveys were conducted in 2007, followed by continued monitoring during the construction phase in 2009 (Brock 2019). Quarterly monitoring continued once the plant was fully operational in 2010 and has been consecutively monitored thereafter (Brock 2019). This statistical record of long-term fish monitoring has increased in value with the onset of acute events including storms, hurricanes, temperature anomalies, flooding, and other stochastic events. This has allowed an understanding of fish community impact and subsequent recovery along this coastline. Reassessments of previous monitoring stations in the Kahe area have increased the value of this database due to comparable surveys conducted by Hawaiian Electric in this region in the 1970s and 1980s, providing over five decades of information on fish community structure. Fish assemblage factors including biomass, abundance, trophic levels, and species composition accurately assess populations and determine change across sites and across time. Surveys continue as a benefit to the community of the West side of O‘ahu.

Field Photo 2. The Kahe Generating Station is located in a short valley between Kahe Point and Nānākuli on the Wai‘anae coast of the Island of O‘ahu, approximately 18 miles west of Honolulu (October 2022).

Accuracy in determining fish populations depend on the number and size of transects and whether transect locations are randomly selected, stratified random (e.g. following depth contours), or fixed (returning to the same location over time). Fixed transects may not be representative of the entire community of interest but allow for more accurate repeated measurements and over time increase in statistical power due to a larger sample size. Over time, they can be more characteristic and representative of actually changes. Spatial and temporal variability of fishes can be extremely high due to mobility and large home ranges for some fishes. Many fish species are cryptic, rare or transient. There are also diurnal/nocturnal and seasonal sources of variability. To quantify absolute values for fish populations, an extremely large sample size is required, especially for heterogeneous habitats, that are diverse in substrate types, otherwise relative values, that compare across sites, should be used to determine differences between sites. Surveys repeated consistently over time on a regular basis can also be used to accurately quantify absolute values of what fishes are occurring at a site. The statistical power to detect differences increases with additional surveys due to an increase in the sample size. As the power increases, the chances of detecting a change, if it exists, increases. More samples (more surveys) allow for both large and small changes (effect sizes), regardless of the variability in the data, due to an increase in information.

Numerous methods have been developed for sampling fishes. Method selection depends on the focus of the research and the spatial and temporal scales involved. Comparability of methodology is imperative when making comparisons between and within sites across surveys. Calibration between methodologies and surveyors is vital to assurance of evaluations. This validates that a change detected is not from using dissimilar methods or different divers. Quantitative measurable methodology is vital to any long-term monitoring program.

Qualitative (descriptive, non-numerical data) surveys by subject matter experts:

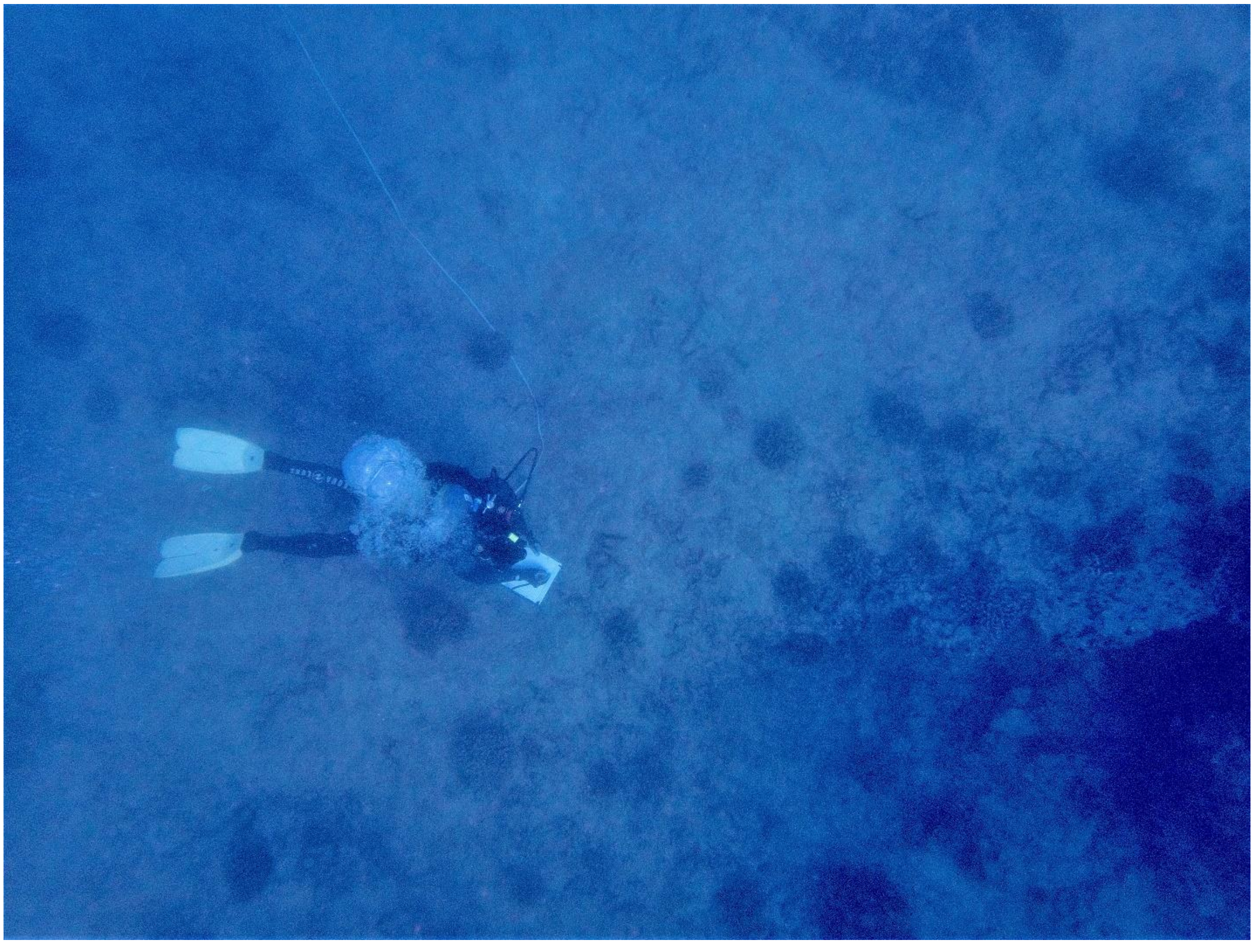
- Are subject to significant surveyor differences;
- Cannot be replicated by others or compared to other studies using quantitative methods;
- Can obtain only certain information (e.g. species presence) and doesn't measure all variables;
- Are effective for large-scale rapid assessment of an area or general conditions;
- Are strongly biased; and
- Result in highly variable observations.

Quantitative (numerical data) surveys:

- Provide species abundance/biomass, most common species;
- Compare to other sites to determine change (seasonality or environmental changes);
- Provide a stable baseline;
- Can verify statistical differences; and
- Are archivable to review data or confirm species or repeat with new objective.

To avoid comparability issues with this dataset, the species abundance method (Brock 2019), adapted from the belt transect method (Brock 1954), has continued throughout this long-standing survey. This is commonly used among researchers and managers throughout the State. This includes a transect length of 164 x 13 ft. (50 m and width of 4 m) an area of 239 square yards (200 square meters [m^2]). This methodology records fish species and estimates length and number of individuals. From this data, fish community factors of abundance, biomass, trophic levels, endemism, diversity, evenness, and size class can be derived.

This species abundance method maximizes data and statistical comparability, allows for length to biomass conversions, and avoids limitations inherent in some other methods. This method includes two measures of abundance: numerical (number of fishes) and biomass (weight of fishes). These are both important population parameters that address different aspects of fish community structure. Unlike the belt transect method, species abundance estimates do not require additional survey time to allow for fish equilibrium to occur. The transect line is spooled out as the survey is conducted to avoid scaring away fishes.



Field Photo 3. Diver conducting fish transect survey at monitoring station East1 in Kalaeloa. Transect length of 164 ft. (50 m) by 13 ft. (4 m) covers an area of 239 yd^2 (200 m^2). Column extends to the surface (October 2022).

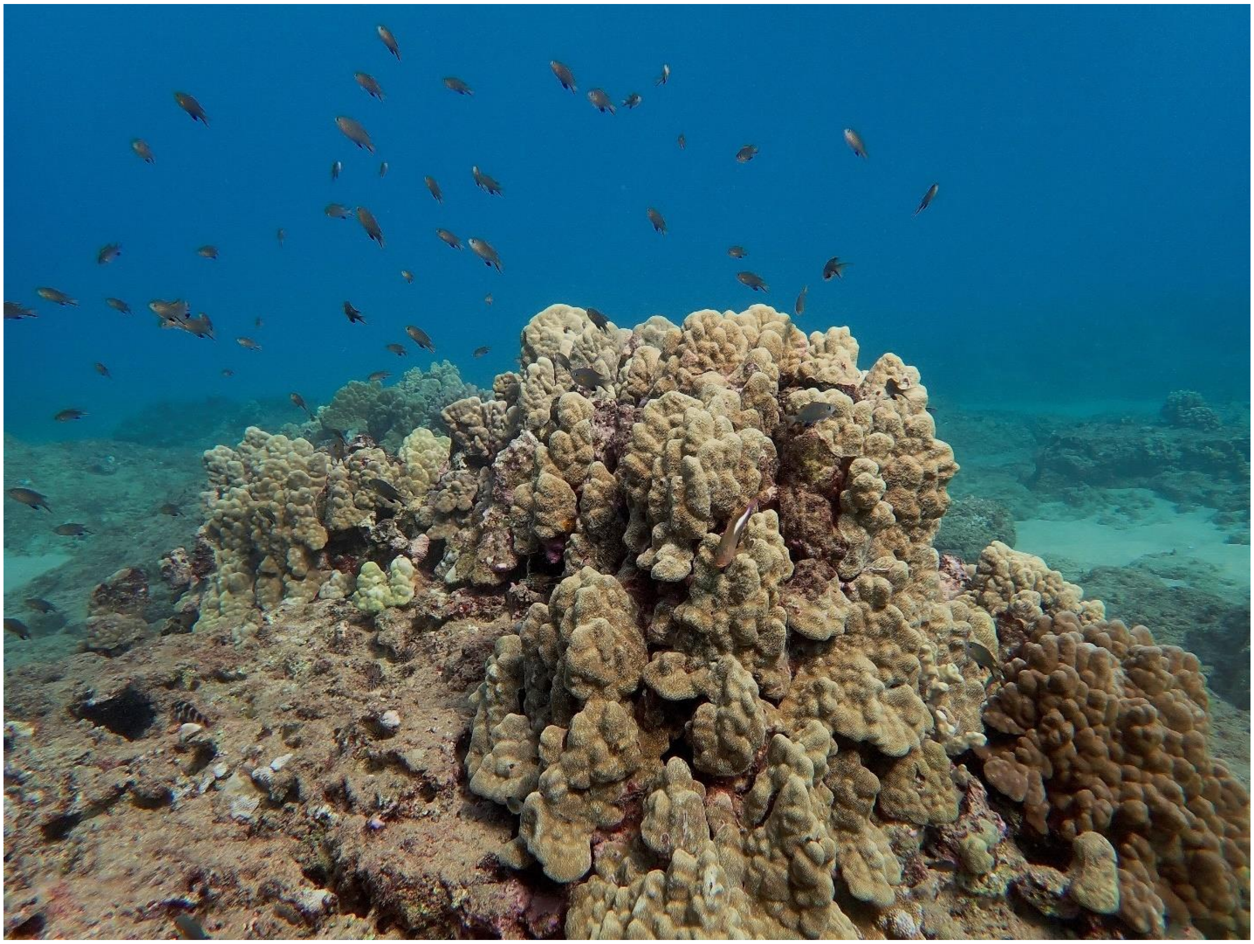
Size structure of fish populations can be an informative means of characterizing fish communities both spatially and temporally. Variations in recruitment processes such as production, transport, settlement, and mortality, can be revealed in missing or reduced size classes. Lack of recruitment can limit population size. Variations in size categories can explain variation in site attached fishes. The condition of different size assemblages can provide clues to causal mechanisms and links to environmental factors. Certain anthropogenic impacts can be detected, including the most influential impact of overfishing, by quantifying absence or highly reduced abundance of food fishes in the larger size classes. Absence or overabundance in certain size groups can predict future trophic structure and species composition. Size classes can directly influence competition, predation, and shifts in community structure.

Field Photo 4. Healthy populations of fishes at the Pipe site (May 2022).

Trophic levels and endemism for fish species are also determined in these surveys. The trophic categories used by Brock (2019) were carnivores, herbivores, planktivores, omnivores, and corallivores. Trophic categories from 2019 forward are herbivores, invertebrate feeders, zooplanktivores, and piscivores. These categories are similar to the functional groups used by Brock (2019) but are now comparable on a Statewide spatial scale over a similar temporal scale. Fish assemblage organization including trophic structure is dependent more on local than regional conditions. Thus, these assemblages are more susceptible to local disturbances of fishing pressure, pollution, eutrophication or sedimentation, which can cause major shifts in trophic levels. Declines in apex predators (piscivores) are the most highly evident when comparing feeding guilds in the Main Hawaiian Islands (MHI) as compared with Papahānaumokuākea in the Northwestern Hawaiian Islands (NWHI). Large apex predators, primarily jacks and sharks, comprise over half of the total biomass in the NWHI (54%), while contributing only a small percentage (3%) in the MHI (Friedlander & DeMartini 2002).
Both terrestrial and marine endemism in the Hawaiian Islands is high compared to the rest of the world, due to geographic isolation that restricts gene flow and favors speciation where species evolve over time. Of the 680 species of fishes in Hawaiʻi, 20% are endemic, found exclusively in Hawaiʻi. The overall marine environment has an average of 25% endemism with an endemism

rate of 20% for algae, fishes and mollusks and 40% for crustaceans. There are no endemic echinoderms and very low endemism of pelagics due to their mobility. Endemism is restricted to the species and subspecies level with no endemic families and only three endemic genera. There are no single island endemics and corals are depauperate (lacking in number of species), missing many of the genus found elsewhere in the Pacific. There are few endemic species in a genus, only one or two. In contrast, a terrestrial genus has approximately 100 endemics.
Endemism is a biologically relevant attribute in examining fish assemblages. It relates to conservation of biodiversity, genetic connectivity and spatial patterns of recruitment. Historically, endemic comparisons have been based solely on presence/absence data due to lack of quantitative data. Yet, endemism evaluations are more statistically meaningful when incorporating numerical and biomass densities which allow for inclusion of spatial patterns (Friedlander & DeMartini 2004).

Field Photo 5. Many endemic and indigenous fish species can be found in the Hawaiian Islands. (Kahe 1, August 2022)



Field Photo 6. The Oval or Hawaiian Chromis is commonly found in aggregations where they feed on zooplankton. They are native to Hawai‘i and found nowhere else in the world. Adults are bluish-grey in color while juveniles have bright yellow and blue dorsal stripes that gradually fade (Kahe 7B, August 2022).

Field Photo 7. *Parupeneus multifaciatus*, the manybar goatfish, *moano* at the Pipe site where they feed on small invertebrates (June 2022)

Introduced species have become common on reefs in the MHI. Most snappers occurring in Hawai‘i have historically been highly prized food fishes. Pink snapper, *Pristipomoides filamentosus* (‘opakapaka), Crimson jobfish, *Etelis carbunculus* (ehu), Ruby snapper *Etelis coruscans* (onaga), and Long-tailed Red snapper inhabit depths of over 60 m. The Division of Aquatic Resources originally known as the Hawai‘i Fish and Game introduced three shallow water snappers from the South Pacific and Mexico in the mid-1950s and early 1960s in hopes of stimulating the commercial fisheries. These are among the 11 demersal species introduced within a 5-year period. *Lutjanus kasmira* (*ta‘ape*) the Blue-stripe snapper and *L. fulvus* (to’au) the Black-tail snapper have become widely established, while the third species, *L. gibbus*, the Humpback red snapper, is extremely rare. The more common of the non-native snappers, *L. kasmira*, (*ta‘ape*) was introduced from the Marquesas in 1958, while *L. fulvus* (*to‘au*) was imported two years earlier in 1956. Although only 3,200 *L. kasmira* (bluestripe snapper, *ta‘ape*) were released on the island of O‘ahu, they have increased their range to include the entire Hawaiian archipelago. The peacock grouper *Cephalopholis argus* (*roi*) introduced by the state for commercial purposes in 1956 from Moorea, French Polynesia, originally had more popularity as a food fish than the introduced snappers. Its attractiveness as a food fish rapidly declined as cases of ciguatera poisoning increased. This opportunistic feeder is perceived by many local fishermen as unsafe to consume and in direct competition with them because it preys upon native fish species. Contrary to popular belief, Dierking et al. (2005) found that the majority of *roi* (peacock grouper) are relatively safe to consume, with approximately 4% containing levels of toxin high enough to cause ciguatera poisoning. However, 20% of samples contained some level of ciguatoxin. Although a strong site specific correlation occurred with the highest percentage of toxic *roi* found on the island of Hawaiʻi, nearly all of the 28 locations tested on several islands contained fish that tested positive for ciguatoxins. Due to its carnivorous nature and presence of ciguatoxin, numerous efforts to cull this fish from the nearshore reefs have been initiated through community projects including "Kill Roi Day" on the island of Maui, "Roi Round-up" on the island of Hawaiʻi, and "Kauaʻi no ka Roi" on the island of Kauaʻi. None of these introduced species has been widely accepted as a food fish among the local population or become successful in the commercial fisheries and the ecological effects of these aliens have only recently been realized. Histological reports from Work et al. (2003) found that nearly half of the *L. kasmira* (*taʻape*) examined from Oʻahu were infected with an apicomplexan protozoan. Furthermore, 26% were infected with an epitheliocystic-like organism with potential transmission to endemic reef fishes. In addition, *L. kasmira* (*taʻape*) from Hilo were found to host the nematode *Spirocamallanus istiblenni* (Font and Rigby 2000). Species of goatfish *Mulloides flavolineatus* (*weke*), Yellowstripe goatfish and *Parupeneus porphyreus* (*kūmū*), Whitesaddle goatfish, popular food fishes, may be displaced by *L. kasmira* (*taʻape*), Bluestripe snapper which has also expanded its range into deeper water where *P. filamentosa* (*ʻopakapaka*), Pink snapper reside. Friedlander and Parrish (1998) looked at patterns of habitat use to determine predation and resource competition between *L. kasmira* (*taʻape*), bluestripe snapper and several native species within Hanalei Bay, Kauaʻi, but found no strong ecological relationships.

Field Photo 8. The Division of Aquatic Resources originally known as the Hawai‘i Fish and Game introduced three shallow water snappers from the South Pacific and Mexico in the mid-1950s and early 1960s in hopes of stimulating the commercial fisheries. L. kasmira (*Ta‘ape)* the Blue-stripe snapper (shown above) and L. fulvus (*to‘au*) the Black-tail snapper have become invasive and widely established, while the third species, the Humpback red snapper, is extremely rare. Since its introduction to O‘ahu from the Marquesas in 1958, this invasive species has increased their range to include the entire Hawaiian archipelago (August 2022, Pipe).

Diversity plays an important role in many ecological and conservation issues. Thus, it is included in this report. It can be a significant factor in assessing the efficacy of management efforts. Reductions in diversity can be indicative of fishing pressure since it can selectively remove specific species. Other anthropogenic impacts, such as eutrophication and sedimentation, can also result in phase shifts that impact fish diversity. Natural conditions can also determine diversity. Areas sheltered from high wave energy have previously been reported to maintain higher fish populations and exhibited greater species diversity in the Hawaiian Islands (Friedlander & Parrish 1998; Friedlander et al. 2003). This can be attributed to reduced habitat complexity in high-energy environments. Seasonal variability in wave impacts can structure the physiography of reefs, reducing habitat and spatial complexity for fishes through a dominance of encrusting morphologies of corals.

Field Photo 9. Diversity of fishes is important to the health of coral reefs. Mixed schools of fishes at this site in Kalaeloa include racoon butterflyfishes, orangeband surgeonfishes, and a cleaner wrasse (East 3 Kalaeloa, October 2022).

This annual report (Rodgers et al. 2022 survey) includes a quantitative analyses of the fish populations along the Kalaeloa-Ko ʻOlina-Kahe-Nanakuli nearshore corridor and a comparison with the previous annual surveys conducted.

Natural Events and Human Impacts to Hawaiian Coral Reefs

Climate change has increased ocean temperatures and changed the ocean chemistry. This is due to the anthropogenic input of emissions into the atmosphere. The oceans absorb much of the carbon dioxide (CO_2) emitted. These global impacts are the ones most critical to address. But the local impacts affecting the main Hawaiian Islands cannot be ignored. These problems that add to the decline of fisheries include invasive species, sedimentation, nutrification, pollution, fishing pressure and others.

Both physical and biological processes control species distribution and abundance and other aspects of community structure. On a large scale, physical factors dominate, while at a local scale, biological interactions may control species composition. Physical processes include environmental stress/disturbance, climate, wave exposure, transport processes (dispersal), depth, temperature, salinity, light and oxygen levels. Biological processes include predator/prey relationships, competition, reproduction, recruitment, consumer/resource interactions and food availability.

Field Photo 10. Corals provide fish communities shelter from predators and a source of food. The more complex the habitat, the greater the diversity and abundance of fishes as seen here at Kalaeloa East 5. Size and structure of holes in the reef are related to the size and abundance of the fishes (May 2022).

<u>Fishing Pressure</u>

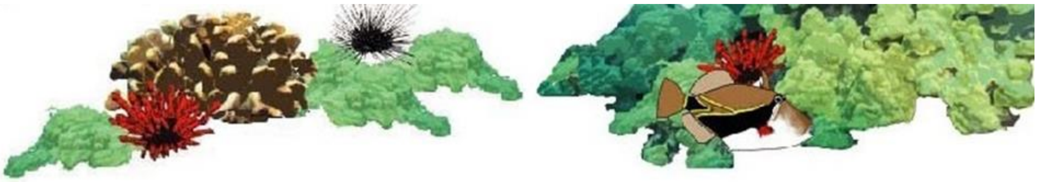
An expansion of commercial and recreational fisheries with more effective and efficient methods and increased economic pressure have led to worldwide overfishing. Nearly 70% of fish stocks are considered to be below sustainable levels. Both pelagic and coastal fish abundance have experienced extensive declines on a global scale. Fishing pressure has also caused severe depletion of fish stocks on a local scale. Recent research provides overwhelming evidence of the impact of overfishing in the MHI (Friedlander et al. 2017). It is based on the largest database of its kind including data from over 25,000 surveys and assembled and analyzed by the Fisheries Ecology Research Laboratory. Among the local pressures impacting Hawaiʻi's reefs, overfishing is clearly the primary forcing function of fish declines. The link between food fish populations and human population is strongly evident while fishes not targeted for food show no connection with populated areas. Reefs off highly populated regions have only a small fraction of food fishes than at remote reefs in the MHI such as at Niʻihau, Kahoʻolawe, and N. Molokaʻi.

Compared with Papahānaumokuākea in the NWHIs, the fish biomass is 10 times higher than off O‘ahu. Total catch is considerably lower even with greater fishing effort. The shift is towards smaller, younger individuals and away from larger, piscivorous fishes. If fishes high on the trophic level are targeted, it is only sustainable under low fishing pressure. Many coastal fish populations have decreased to levels below the ability to replenish themselves (Friedlander and DeMartini, 2002). This report describes the fishing pressure at Kalaeloa, Ko ‘Olina, Kahe, and the Kahe Pipeline by examining the ratio between food (resource) and non-food fishes non-resource).

The dynamic nature of coral reefs and associated fish populations keep the marine environment in a constant state of flux. Changes in species abundance, size structure, and trophic levels occur frequently, causing community shifts. These processes can be a result of long-term impacts or stochastic events. The likelihood of recovery is higher from an acute event than from a chronic event. Chronic cases have only shown recovery of reefs after other anthropogenic or natural stressors ceased and where the physical or biological environments have not been altered (Connell, 1997; Erftemeijer et al., 2012; Philipp and Fabricius, 2003).

<u>Influential Factors Controlling Reef Communities</u>

Stratification of coral reef organisms is controlled principally by depth, topographical complexity, and wave regimes. Accretion, growth, and community structure of most coral reefs in the Hawaiian Islands are primarily under the control of wave forces (Grigg, 1998). The dominant wave regimes show quite different patterns of wave height, wave periodicity, intensity and seasonality (Jokiel, 2006) and slight differences in exposure, and have a profound impact on reef coral development (Storlazzi et al., 2005). Large waves and strong currents in exposed areas flush contaminants from reefs. However, anthropogenic impacts can dominate in environments where wave forces are not the major controlling factor. To develop a measure of reef condition, Rodgers (2005) used 43 different factors to understand what the most important factors were that influence coral reef communities. Parametric (multiple regression) and non-parametric statistical analyses (principal components analysis, and non-metric multidimensional scaling) were used to determine which environmental factors were most important in structuring coral and fish assemblages. Coral reefs involve multifaceted interactions and each factor alone is a weak predictor of any of the response variables; however, in combination these factors explained a large percent of the variability. Both natural factors such as spatial complexity, waves, and depth and anthropogenic factors such as human population, silt and organics explained most of the variability in fishes and coral (Figure 1).



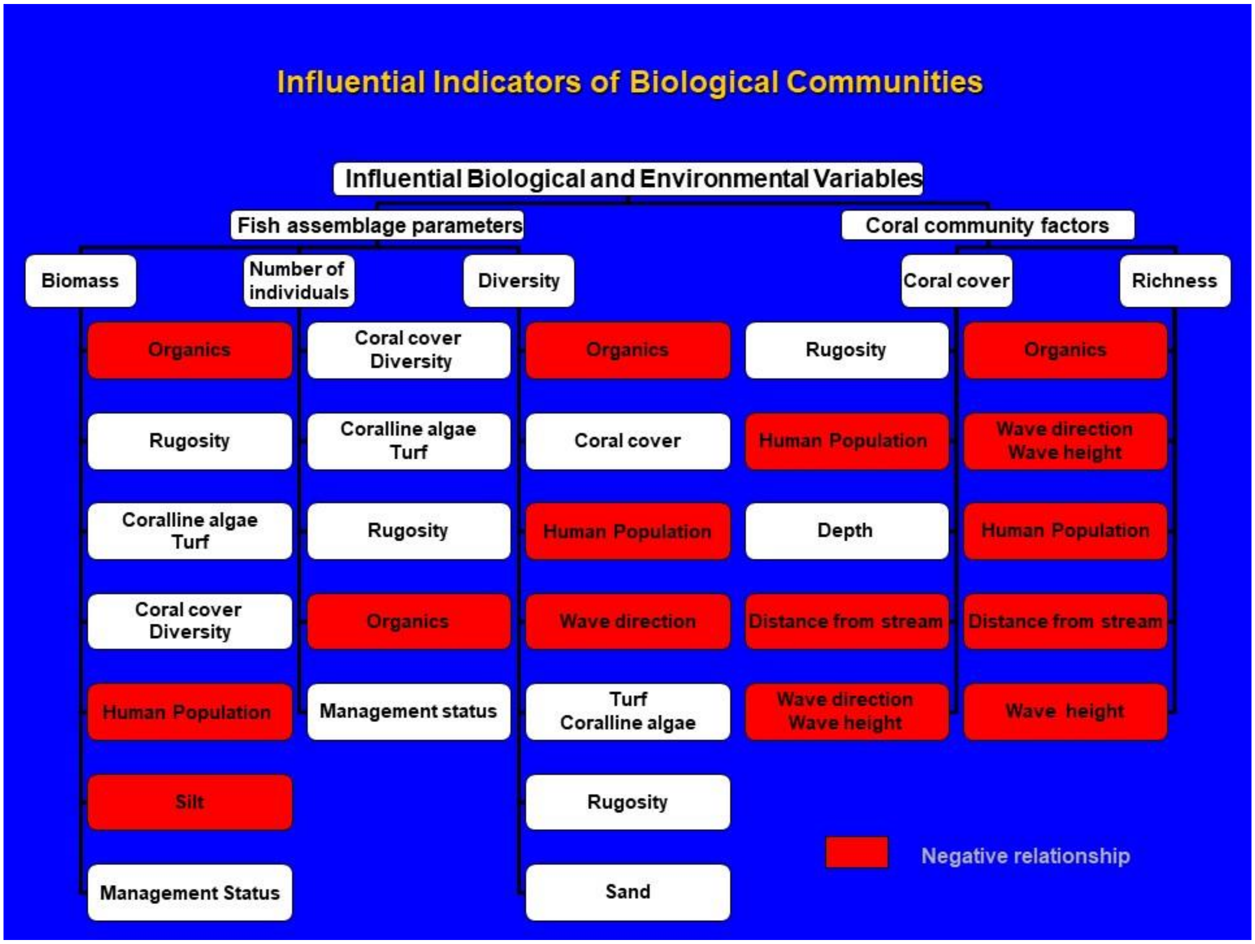
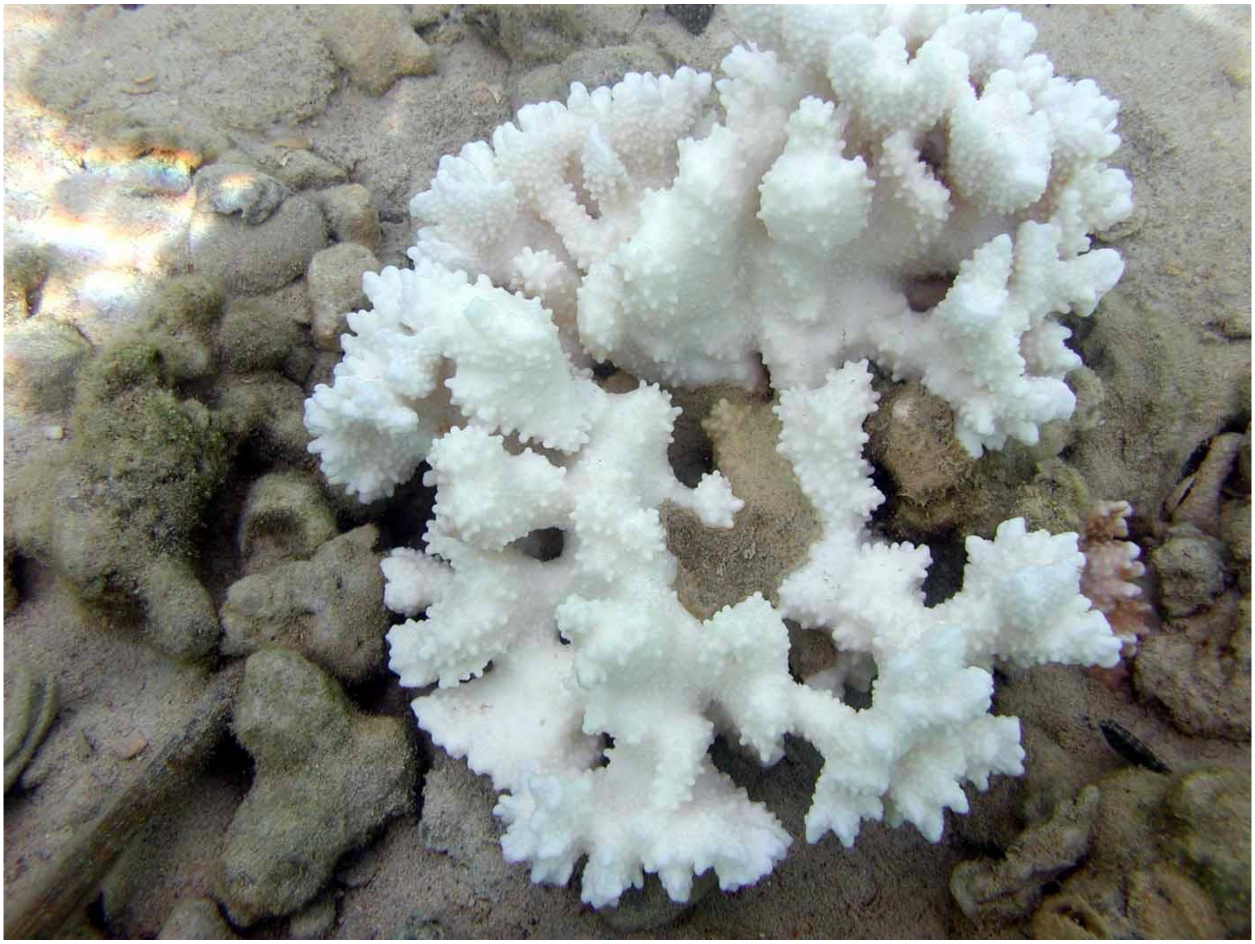


Figure 1. Primary forcing functions driving reef fish biomass, abundance and diversity and coral cover and richness in the main Hawaiian Islands. These top variables are most influential to fish and coral populations. Influential factors negatively correlated with fish or coral parameters are colored red. For example, the higher the organics or human population, the lower the fish and coral assemblages.

These influential factors can be less significant when stochastic events occur. Hurricanes have been documented as a major influence on coral reef communities (Heron et al., 2008). Hurricanes can have devastating effects (mechanical breakage, sedimentation, nutrification) but have also been documented to ameliorate coral bleaching (Manzello et al., 2007). Hurricanes absorb energy from the surface and reduce temperatures through evaporative cooling. They can cause upwelling by bringing deeper, cooler waters to shallower depths and a reduction in irradiance levels through cloud shading can decrease temperatures. However, in shallow waters, hurricanes can destroy corals through wave damage and cause mortality of recruits through sand scour. As the frequency and intensity of climate impacts accelerate, Hawai‘i is experiencing more severe and intense storms, hurricanes, and flood events. For example, bleaching events were unknown to science until 1983. The first widespread coral bleaching event in the MHIs occurred in 1996 where although bleaching was extensive, mortality was low because temperatures quickly returned to normal. Then in 2004 and 2006 the corals in Papahānaumokuākea in the NWHI experienced major bleaching. Hawai‘i then escaped the major

bleaching that was occurring in many regions worldwide that devastated many reefs for the next decade due to our geographic location and a downturn of temperature since 1998. It wasn’t until 2014 and 2015 that Hawai‘i experienced another widespread bleaching event where severe mortality occurred. The coral mortality was 50% on the Kona coast and nearly 35% statewide (Kramer et al. 2016). It had been predicted that a bleaching event would impact the Hawaiian Islands once every 25-30 years (Mora et al. 2014). More recent predictive modeling based on the National Oceanic and Atmospheric Administration (NOAA) Coral Watch data is forecasting 6-year intervals between widespread bleaching events (Eakin et al. 2019). The International Panel on Climate Change, a group of renown scientists from over 40 countries recently announced their predictions based on tens of thousands of scientific papers. Their prediction states that if drastic changes are not made within 11 years, 99% of the world’s coral reefs will be gone within a generation. Many fishes rely on coral reefs to survive. Coral reefs provide protection from predators and food for many species including obligate corallivores. The recovery process following these bleaching, hurricane, and flood events have been well documented. Successional patterns of recovery have been documented globally and in the Hawaiian Islands (Blumenstock et al. 1961, Ball et al. 1967, Perkins and Enos 1968, Stoddard 1969, Maragos et al. 1973, Grigg and Maragos 1974, Ogg and Koslow 1978, Woodley et al. 1981, Walsh 1983, Harmelin-Vivien and Laboute 1986, Done et al. 1991, Dollar and Tribble 1993, Skirving et al. 2019). The CIP and the Kahe Marine Monitoring Projects have provided the opportunity to follow coral recovery subsequent to Hurricanes Iwa and Iniki (Noda 1983, Brock 2019).



Field Photo 11. Bleached coral shows the white skeleton through the transparent tissues. A number of environmental stressors initiate bleaching. Continued stress will lead to death. Photo from Kāne‘ohe Bay 2015 bleaching event used as example. Bleaching at West shore sites in 2022, was negligible.

Hawaiian Electric’s Biological Communities Monitoring Program

The consistent and continued monitoring of benthic and fish communities provides a comprehensive record of spatial and temporal change during the construction of the Kahe Generating Station. Compliance with the National Pollutant Discharge Elimination System (NPDES) permit to allow thermally elevated seawater discharge for cooling purposes has been strictly adhered to throughout the period of construction and operation. Well-designed benthic and fish surveys within the zone of mixing, adjacent areas, and comparable reference sites allow for comparisons over space and time. The sample size, frequency of monitoring, and duration of surveys makes this program one of the longest and most valuable records in the Hawaiian Islands.

Fish populations are highly variable, requiring numerous transects to quantify absolute values of fish communities. A large sample size is necessary due to the high variability among fish assemblages. Many rare, cryptic or mobile species can be under reported and the power to accurately detect absolute fish abundances can be extremely low. Variation in numbers can be attributed to differences in visibility and natural fluctuations that are typically observed in temporally spaced censuses of highly mobile reef organisms. Although fish populations vary considerably both spatially and temporally, statistical power increases over a time series as additional data are acquired, as with the CIP monitoring dataset. With five decades of survey data, the power to detect differences increased considerably. Data, surveyor, and methodological compatibility were maintained to assure statistical significance and quality assurance and control. In long-term monitoring programs such as this program, methodological consistency is crucial. Coral and fish survey procedures and data assessment have and continue to maintain this consistency annually using uniform methodology. The variation of long-term monitoring of fish surveys was determined through statistical analyses of prior surveys with current surveys between observers (Keoki and Yuko Stender/ Anita Tsang). In addition, a surveyor with similar expertise as the original surveyor was selected to continue fish community assessments. To interpret any environmental changes observed, it is vital to have qualified expertise in each area of the marine field. Low surveyor variation in this long-term monitoring record of nearly half a century is imperative to maintain, since annual variability can often obscure trends and patterns.

Historical Surveys to Date

KGS began operation in 1963. The later expansion of the KGS to include six generating units required an environmental impact statement (EIS) compiled by Sterns-Roger, Inc. in 1973. The EIS included prior baseline conditions from reports submitted by Marine Advisors (1964), B.K. Dynamics (1971), and URS Research Co. (1973). During the station expansion and relocation of the shoreline outfall to the present location offshore, numerous NPDES marine monitoring reports described the Kahe physical and biological environment (Coles and McCain, 1973; Coles and Fukuda, 1975, 1983, 1984; Environmental Department, 1976; McCain, 1977; Coles, 1979, 1980; Coles et al., 1981, 1982, 1985, 1986; Fukuda and Oda, 1987; Hawaiian Electric Environmental Department 1988-2019: 31 reports). Surveys detected a decline of 20% in the coral communities in proximity to the KGS outfall from 1973 to 1977 (Coles 1979). Once full KGS operations commenced, an increase in coral settlement and growth was reported in proximity to the outfall. This led to the assumption that the construction of the outfall and not the plant operations was responsible for the coral mortality. Fish censusing showed no change as a result of construction or plant operation except on peripheral reefs northeast of the KGS outfall where the abundance and number of species declined once the outfall was operating. The number of shoreline intertidal species increased where affected by the thermal outfall (Coles et al. 1985). Fish surveys conducted since the initial offshore outfall operation in 1976, show fish displacement near the outfall (Coles 1979). The fish population decrease from 1976-1978 was minimal relative to the change following the 1980 Kona storm. Coles et al. (1981) found much greater declines in coral cover, fish populations, and sand redistribution attributed to the 1980 storm than in the seven years previous.

With the addition of the KGS' Unit 6 in 1981, the water flow needed for cooling was increased by 33% above the flow rates for Units 1-5. The rate of flow was subsequently 846 million gallons per day (mgd). The benthic thermal impingement was twice the area, but mainly limited to sand areas offshore. Coral cover and fish populations both declined from previous surveys likely due to the loss of habitat from the 1980 storm (Coles et al. 1982.)

The CIP Generating Station began construction in 2009. Prior to construction, surveys had been conducted in 2007 and 2008 (Brock 2019). Twelve to fifteen stations were surveyed in 2007 and sixteen stations in 2008. The KGS discharge pipe station was added by the third survey and analyzed separately based on the unusual fauna. The high spatial complexity of the artificial structure provided habitat and protection for an extensive and well-developed fish community. During the construction phase in 2009, three fish surveys were completed at all sixteen stations. Operation of the new plant began in 2010. Unlike the KGS, the CIP Generating Station has no direct input into the ocean since it is located well inland. Details of quarterly surveying from 2010 through 2018 can be found in Brock (2019). Environmental and meteorological shifts have been apparent since 2014. The most widespread coral bleaching event occurred in the Hawaiian Archipelago in 2014 and 2015. Simultaneously in 2015, an unprecedented fifteen major storms were recorded. Loss of reef structure from coral mortality following severe bleaching events are strongly correlated to fish community factors (Friedlander et al. 1998). Loss of reef structure can have devastating impacts on fish assemblages.

The increase in ocean temperatures is directly related to the increase in carbon emissions. However, other large-scale weather patterns and global phenomena also affect ocean temperatures. The Pacific Decadal Oscillation (PDO) has been described as a long-lived El Niño-like pattern of Pacific climate variability characterized by widespread variations in Pacific Basin and North American climate. During the past century, two major PDO eras have persisted for 20 to 30 years. Cool PDO regimes prevailed from 1890–1924 and again from 1947–1976, while warm PDO regimes occurred from 1977 through the mid-1990s. A downturn of warm seawater temperature off Hawaiʻi in 1975 and 1998 was experienced as the PDO reversed. The PDO experienced a temporary reprieve of slight cooling due to a downturn of temperature since 1998 at the end of the last cycle of the PDO. Nevertheless, as the bleaching threshold was approached in 1996, there was a reversal of the warming trend that can be attributed to the PDO. Because of the uncertainty of how the PDO works, it is not possible to predict with certainty what will occur. A decline in warming of Hawaiian waters marked the beginning of a 20 to 30 year-long cool phase. This cooling phase which may be currently switching to a warming phase in Hawaiian waters, only served to moderate the local warming trend during the first part of the PDO cool cycle but will accelerate warming as the cycle reverses. Temperatures have been steadily increasing over the past several decades and models predict even more severe bleaching events that are projected to increase in frequency and intensity in the coming decade with concomitant decline in Hawaiian corals. Modeling for Hawaiʻi predicts a statewide bleaching event every six years. Thus far, widespread bleaching events have occurred in 1996, 2006, 2015/16, and 2019. The shorter El Nino/La Nina cycles may have an additive or synchronous effect on ocean temperatures as warm water from the western Pacific moves east. The warm water replaces the cold water, warming the air above it and increasing the amount of air rising in the Intertropical Convergence Zone, intensifying cloudiness and rainfall. These weather phenomena increase ocean temperatures and increase storm activity.

Historical Impacts (Storms, Hurricanes Iwa & Iniki)

The monitoring program at Kahe encompasses stochastic storm events (January 1980, October 1982, August 1992, October 2003) and two major hurricanes (Iwa 1982 and Iniki 1992). The major storm in 1980 had a large impact on the shallow benthic coral community due to wave energy of up to 6 m released at shallower depths. Coral cover declined by nearly 19% following this major storm event (Coles and Fukuda 1984). This was attributed to extensive sand scour and deposition resulting in a coral community compositional shift.

Hurricane Iwa, two years later in 1982, had the opposite effect where sand attenuation occurred revealing substrate previously buried by up to five feet of sand. This hurricane with maximum wave heights of 9 m (Noda 1983) destroyed offshore reefs deeper than 6 m, while sparing coral communities closer to shore (Coles et al. 1985). Subsequent surveys in 1983 validated the observations made shortly after the hurricane. Significant declines of coral, algae, and fishes occurred in regions where hurricane force waves were greatest (Coles et al. 1985). Coral cover offshore from the Kahe facility declined 5.4% in addition to the previous declines of 18.7% attributed to the 1980 storm.

The impact waves have on a reef depends on complex interactions between wave direction, topographical relief, and substrate bathymetry (Dollar and Tribble 1993; Storlazzi et al. 2002, 2005). A wave shadow is created in the lee of the islands, blocking waves that can ameliorate the influence of these waves on reefs (Storlazzi et al. 2005). For example, waves are lessened during north Pacific swells on the south shore of Moloka‘i due to island blockage although refraction does occur on the extreme ends of the coast. In contrast, the west side of O‘ahu, where Kahe is located, is vulnerable to waves and refraction from all directions because it does not fall under this wave shadow. Wave direction can be a strong influence on the level of impact occurring during a storm (Table 1).

Table 1. Waves influencing the main Hawaiian Islands (Jokiel 2008).

	Typical			**Extreme**				
	Height		**Period**	**Height**		**Period**	**Direction**	
Wave Type	**(m)**	**(ft)**	**(s)**	**(m)**	**(ft)**	**(s)**	**Mean**	**Range**
NE Trade wind waves	1.2-3.7	4-12	5-8	4.0-5.5	13-18	9-12	NE 45°	0-90°
North Pacific swell	2.4-4.6	8-15	10-17	4.9-7.6	16-25	18-25	NW 315°	282-45°
Southern swell	0.3-1.2	1-4	12-17	1.5-3.1	5-10	14-25	SSW 190°	236-147°
Kona storm waves	0.9-1.5	3-5	8-10	1.8-3.1	6-10	11-14	SW 210°	258-247°

m=meters, ft=feet, s=seconds

Northeast Trade wind waves: Typical trade winds weaken at night and gradually increase throughout the morning with wind speeds at the maximum in the afternoon. This is related to an increase in wind-driven waves. Offshore waves break and dissipate along the north and east shores of all islands. Islands act as a barrier to surface winds but increase in velocity as they funnel through breaks between islands producing sizable wave chop in channels with distinct boundaries. The October 2003 storm was an extremely destructive northeast wave event due to wave heights well above normal. Damage at Pilaʻa on the north coast of Kauaʻi resulted in a 43% reduction in coral cover with extensive fragmentation. Similar reductions were reported on the northeast facing shore of Oʻahu at Wawamalu near Sandy Beach (Jokiel and Brown 2004).

North Pacific Swells are generated in the North Pacific by winter storms. These can result in breaking inshore waves of over 15 m. This wave energy limits the coral development on north shores of islands where species of high skeletal strength and encrusting or lobate morphologies exist (Storlazzi et al. 2005, Rodgers et al. 2003).

Southern Swell is generated by winter storms in the Antarctic typically reaching the Hawaiian Islands a week following generation, during the Summer and early Fall. These storms weaken due to the spread of energy. This is the reason summer south swells do not typically reach the heights of winter north swells.

Kona Storm Waves can occur anytime of the year, but commonly develop from October through April. Waves are generated by southerly or southwesterly winds that precede cold north winds. Three-meter wave heights can be generated under extreme conditions. The Kona coast of the island of Hawaiʻi experienced 6 m waves that reduced coral cover from 46% to10% following a Kona storm in 1980 (Dollar and Tribble 1993).

Hurricane Waves are less frequent and highly unpredictable. To date hurricanes have followed trajectories that have led to direct reef impact on the islands of Kauaʻi and Oʻahu and less of an effect on the other islands (Schroeder 1998). Central Pacific hurricanes typically originate near Central America or southern Mexico. As they move towards Hawaiʻi over cooler water they lose energy or encounter atmospheric conditions unfavorable to further development. Hawaiʻi's hurricane season is from May through October. Hurricane Iniki (1992) generated powerful waves that fragmented and abraded corals on south Kauaʻi. Terrestrial objects swept onto the reefs added to the damage. However, re-colonization and recovery of corals occurred rapidly and within a decade, many reefs had returned to their prior condition. Hurricane Iniki also had an impact in Kona, Hawaiʻi with declines in coral cover from 15% to 11% (Dollar and Tribble 1993) and Mamala Bay on Oʻahu (Brock 1996) with loss of rugosity and shelter for fishes. Storms and hurricanes have been documented to negatively impact fish communities in west Oʻahu (Brock CIP reports) and elsewhere in Hawaiʻi (Walsh 1983). The Kahe dataset is important in separating these stochastic events from other environmental and anthropogenic factors.

METHODOLOGY

Survey Stations

Eight stations were established in the 1970s prior to construction of the CIP Generating Station and an additional eight stations were added in 2008 prior to the preconstruction monitoring surveys. These stations were established to assess the fish communities in proximity to the CIP and Kahe Generating Stations at Kalaeloa and Kahe. Four stations are near the CIP Generating Station at 7-10 m depths and seven stations are adjacent to the Kahe Generating Station with one monitoring station along the KGS pipeline (5 m -12 m depths). Between these two sets, two stations are located northwest of the Ko ‘Olina and Barber’s Point Harbors between the 1st and 3rd Ko‘Olina lagoons at 7 m and 9 m depths. A reference site outside the KGS zone of mixing was established at Nanakuli (Coles et al. 1985). These two monitoring stations act as a control to assess any changes in fish structure at the other stations.

Sixteen survey stations located along the west coast of O‘ahu from Kalaeloa to Nanakuli have been surveyed quarterly since 2008 by a single surveyor. Subsequent to the departure of the original surveyor in 2019, survey stations were reduced to 14 with the removal of stations East 2 (2) and Kahe 7D (11) and to twelve stations in 2021 (removal of stations 7C and 10C) (Figure 2). This was based on an analysis of historical data to determine proximity and site similarities. Elimination criteria included close proximity and similar habitat to other stations, similar fish composition and comparability. Mean standing crop (biomass), mean number of fishes (abundance), and mean fish species within site groups show within group similarity for each of the four sets of groups (Ko‘Olina, CIP, Nanakuli, and Kahe). These spatial similarities by location were the initial foundation for separation and removal of the stations.

Figure 2. Map showing the southwest coastline of Oʻahu from Kalaeloa (Barbers Point) to Nanakuli Beach Park depicting locations of each of the twelve permanently marked stations monitored in this study.

Survey Methodology

Transect locations were originally stratified by location, proximity to the Kahe and CIP Generating Stations, and hard bottom habitat. The general station location is determined through Global Positioning System (GPS) navigation to within several meters. A marker float is deployed to account for drift during anchoring of the vessel. On the substrate, exact start location has been marked with either a cinder block, a prominent geologic feature, and/or surface triangulations. The bearing direction of the transect was predetermined and followed throughout the entire program.

A modified visual transect (line/belt/strip) (Brock 1954) (species abundance methodology) is employed to quantify fish communities. The fish surveyor spools out the 164 ft (50 m) transect line while recording, species, size (total length [TL] in centimeters [cm]) and the number of individual fishes to 7 ft. (2 m) on each side of the transect line 13 ft. (4 m total width). This eliminates changes in fish behavior and allows fishes to equilibrate from previous activity in contrast to laying a transect prior to the survey. All transects are parallel to shore with the exception of the Kahe discharge pipe that runs perpendicular to the shoreline and is only 34 ft. (10.5 m) in length. The surveyor records on a slate, equipped with underwater writing paper, fish species, size in cm, and number of individuals with the use of self-contained underwater breathing apparatus (SCUBA). All fishes within the linear 239 yards^2 (200 m^2) transect from the benthos to the surface are recorded.

Field Photo 12. Divers are calibrated prior to surveys for quality assurance and quality control. (May 2022, Kahe 7B).

Biomass estimates are derived through total length estimated to the nearest cm in the field and converted to biomass estimates (tons/hectare) using length-weight fitting parameters. In estimating fish biomass from underwater length observations, most fitting parameters are obtained from the Hawai‘i Cooperative Fishery Research Unit (HCFRU) consistent with previous analyses. Additionally, locally unavailable fitting parameters are obtained from Fishbase (www.fishbase.org) whose length-weight relationship is derived from over 1,000 references. Congeners of similar shape within certain genera are used in those rare cases lacking information. Conversions between recorded TL and other length types (e.g. fork length [FL]) contained in databases involve the use of linear regressions and ratios from Fishbase linking length types. The three commonly used measures of fishes are standard length (excludes the caudal fin), total length (from tip of snout to tail tip), and fork length (from tip of snout to deepest notch of the tailfin). A predictive linear regression of logM vs. logL is used in most cases to estimate the fitting parameters of the length-weight relationship. Visual length estimates are converted to weight using the formula $M = a \times L^b$ where M = mass in grams, L = standard length in millimeters (mm) and a and b are fitting parameters. Any anomalous values are detected by calculating a rough estimate for a given body type. The general trend for a 10 cm fish of the common fusiform shape should be approximately 10 g. Any gross deviations are replaced with values from the alternate source.

Trophic levels for fish species have historically been based on reports (Brock 2019). These trophic categories include: herbivores, planktivores, omnivores and carnivores. Herbivorous fishes diet consists primarily of algae, planktivores feed in the water column on detritus and zooplankton, omnivores are described as fishes feeding on a combination of algae and small benthic invertebrates and include corallivores that feed exclusively on corals, and carnivores that eat fish and invertebrates according to Brock (2019). Brock based these functional groups on Hiatt and Strasburg (1960), Hobson (1974), Brock et al. (1979) and Randall (2007). To update the trophic categories and for comparability with other sites throughout the State of Hawai‘i, these categories have been adapted to reflect the trophic levels described in Friedlander et al. (2017). This data is a compilation of over 25 datasets containing greater than 25,000 surveys collected between 2000 and 2018. The Hawai‘i Monitoring and Reporting Collaborative (HIMARC) is a consortium of managers and researchers throughout the Hawaiian Islands that collectively contribute monitoring and assessment data to the largest searchable database for fishes in Hawai‘i. Trophic categories include herbivores, invertebrate feeders, zooplanktivores, and piscivores. These categories are similar to the functional groups used by Brock (2019).

Target fish species were selected to include popular food fishes to determine changes in fishing pressure. The genera selected were Acanthus, Aphareus, Cephalopholis, Caranx, Scarus, Chlorurus, Seriola, Sargocentron, Priacanthus, Kyphosus, Mullodicthys, Parupeneus and Decapterus.

Statistical Methods

Comparative analysis of mean number of fish species documented per transect, mean number of individual fish censused per transect, and mean estimated standing crop (g/m^2) were performed between 2021 and 2022 data to detect any significant differences which may have developed over the year, using an Independent-sample Mann-Whitney U test. The non-parametric Kruskal-

Wallis ANOVA with pairwise comparisons was utilized to detect significant difference between all transects and groupings surveyed in 2022. Transects were grouped according to geographic locations (Table 2) into 5 total groups: East group (East 1, East 3, East 4), Ko‘Olina group (KO 1 and KO 2), Kahe group (1D, 5B, 7B, 7E), Nanakuli group (NANA 1 and NANA 2) and Pipe. These groupings differ from Brock (2019) to make groupings more consistent with location of transect. The 2018 data from Brock’s appendix was re-grouped and descriptive statistics were performed with new group assignments to compare to recent data. Each transect was surveyed four times throughout the year. The four timepoints for the surveys were not found to be statistically different, and therefore time points were pooled within transects and groups for analyses.

Table 2. Latitude and longitude of twelve permanently marked fish monitoring stations surveyed quarterly in this study in 2022.

Station No.	Station Area Name	Grouping	Latitude	Longitude	Remarks
1	East 1	East	21º18.237' N	158º07.024'W	offshore CIP
3	East 3	East	21º18.558'N	158º07.239'W	offshore CIP
4	East 4	East	21 º 18.406'N	158º07.285'W	offshore CIP
5	Ko‘Olina 1	Ko‘Olina	21º19.724'N	158º07.581'W	offshore Ko‘Olina
6	Ko‘Olina 2	Ko‘Olina	21º19.904'N	158º07.693'W	offshore Ko‘Olina
7	Station 1D	Kahe	21º20.763'N	158º07.773'W	Old Hawaiian Electric station
8	Station 5B	Kahe	21º21.145'N	158º07.819'W	Old Hawaiian Electric station
9	Station7B	Kahe	21º21.239'N	158º07.855'W	Old Hawaiian Electric station
12	Station 7E	Kahe	21º21.272'N	158º07.977'W	Old Hawaiian Electric station
14	Nanakuli Control 1	Nanakuli	21º22.329'N	158º08.440'W	Old Hawaiian Electric station
15	Nanakuli Control 2	Nanakuli	21º22.353'N	158º08.462'W	control station
16	Kahe Outfall	Pipe	21º21.193'N	158º07.869'W	north side of outfall

RESULTS AND DISCUSSION

The 2022 data are presented herein along with a comparative analysis to the 2021 data. The complete data set from the four 2022 surveys is given in Appendices A and B.

Transect surveys were performed on May 13, June 8, August 19, and October 31, 2022. The number of fish species, number of fish individuals, and biomass did not differ significantly between survey dates and therefore the four survey dates were pooled for analysis.

OVERALL

Utilizing data from all 60 surveys performed from 2007 to present (Appendix A, 2007-2018 performed by Brock, 2019-2022 by Rodgers), the number of fish species, the number of fish individuals and the biomass was compared between groups of transects: East (3 transects), Ko‘Olina (2 transects), Kahe (4 transects), Nanakuli (2 transects), and Pipe (1 transect). The number of fish species present along transects was greatest at Pipe, followed by Kahe, Ko‘Olina, East, and Nanakuli. The number of species of fishes ($p = 0.006$) and number of fish individuals ($p = 0.003$) was significantly higher at Pipe when compared to the East grouping. The number of species was also significantly greater at Pipe when compared to Nanakuli grouping ($p = 0.009$) (Figures 3 & 4, Table 3). The greatest number of fish individuals and biomass was observed at Pipe, followed by Ko‘Olina, East, Nanakuli, and Kahe. The biomass at Pipe was significanlty greater than both Nanakuli ($p = 0.006$) and Kahe ($p = 0.005$) groupings. In summary, Pipe transect had higher numbers of species, individual fishes, and biomass when compared to all other transects.

A total of 113 different fish species were recorded in 2022 surveys combining all 12 transects. The number of species present in 2021 surveys was 101. Similar to 2021, *mā‘i‘i‘i* (21.2% individuals, 6.1% biomass, *A. nigrofuscus*, brown surgeonfish,) is the dominant fish recorded along transects for number (abundance) in 2022. In 2021 and 2020, *mā‘i‘i‘i* (17.7% and 19.5% respectively, *A. nigrofuscus*, brown surgeonfish) was also the most abundant fish along transects. The biomass in 2022 was dominated by *ta‘ape* (16.9%, *L. kasmira*, bluestripe snapper), followed by *mā‘i‘i‘i* (8.9%, *A. nigrofuscus,* brown surgeonfish) and *hīnālea lauwili* (7.6%, *T. duperrey*, saddle wrasse). The biomass in 2021 was a composition of many fish species with the two highest in biomass being *ta‘ape* (9.5%, *L. kasmira*, bluestripe snapper), and *na‘ena‘e* (8.6%, *A. olivaceus*, orangeband surgeonfish). In 2020, the biomass was dominated by *mā’i’i’i* (9.3%, *A. nigrofuscus,* brown surgeonfish), *ta‘ape* (9.2%, *L. kasmira,* bluestripe snapper), and *na‘ena‘e* (8.8%, *A. olivaceus*, orangeband surgeonfish). Although the most dominant fish contributing to biomass differ between years, main contributors remain the same, *mā‘i‘i‘i, ta‘ape* and *na‘ena‘e*. Since 2020, the majority of individual fishes along transects were herbivores (2022: 34% abundance, 41% biomass; 2021: 34% abundance, 49% biomass; 2020: 45% abundance, 60% biomass) or invertebrate feeders (2022: 38% abundance, 44% biomass; 2021: 38% abundance, 30% biomass; 2020: 38% abundance, 30% biomass). However, zooplanktivores (2022: 26% abundance, 14% biomass; 2021: 28% abundance, 20% biomass; 2020: 15% abundance, 8.7% biomass) and piscivores (2022: 1% abundance, 2% biomass; 2020-21: 1% abundance and biomass) were also present. The abundance and biomass of trophic guilds did not change on the group level, however some transect level changes were noticed between 2021 and 2022 surveys: significantly less herbivore biomass at Ko‘Olina 2 ($p = 0.029$), Kahe 7B ($p = 0.029$), and Kahe 7E ($p = 0.029$) as well as less zooplanktivore biomass at East 1D ($p = 0.029$), Kahe 7E ($p = 0.029$), and Pipe ($p = 0.029$). To determine if there were any statistically significant differences among the mean number of fish species per geographic area, the mean number of individual fish per geographic area or the mean estimated biomass (g/m^2) per geographic area over time, transects were merged into geographic groups (East, Ko‘Olina, Pipe, Kahe, Nanakuli) and pooled over survey dates at each geographic location (four surveys). The twelve sites (Figure 2) were assigned to five geographic locations: (1) East: East 1, East 3, East 4, (2) Ko‘Olina : KO 1 and KO 2, (3) Kahe: 1D, 5B, 7B, 7E, (4) Nanakuli: NANA 1 and NANA 2, and (5) Pipe.

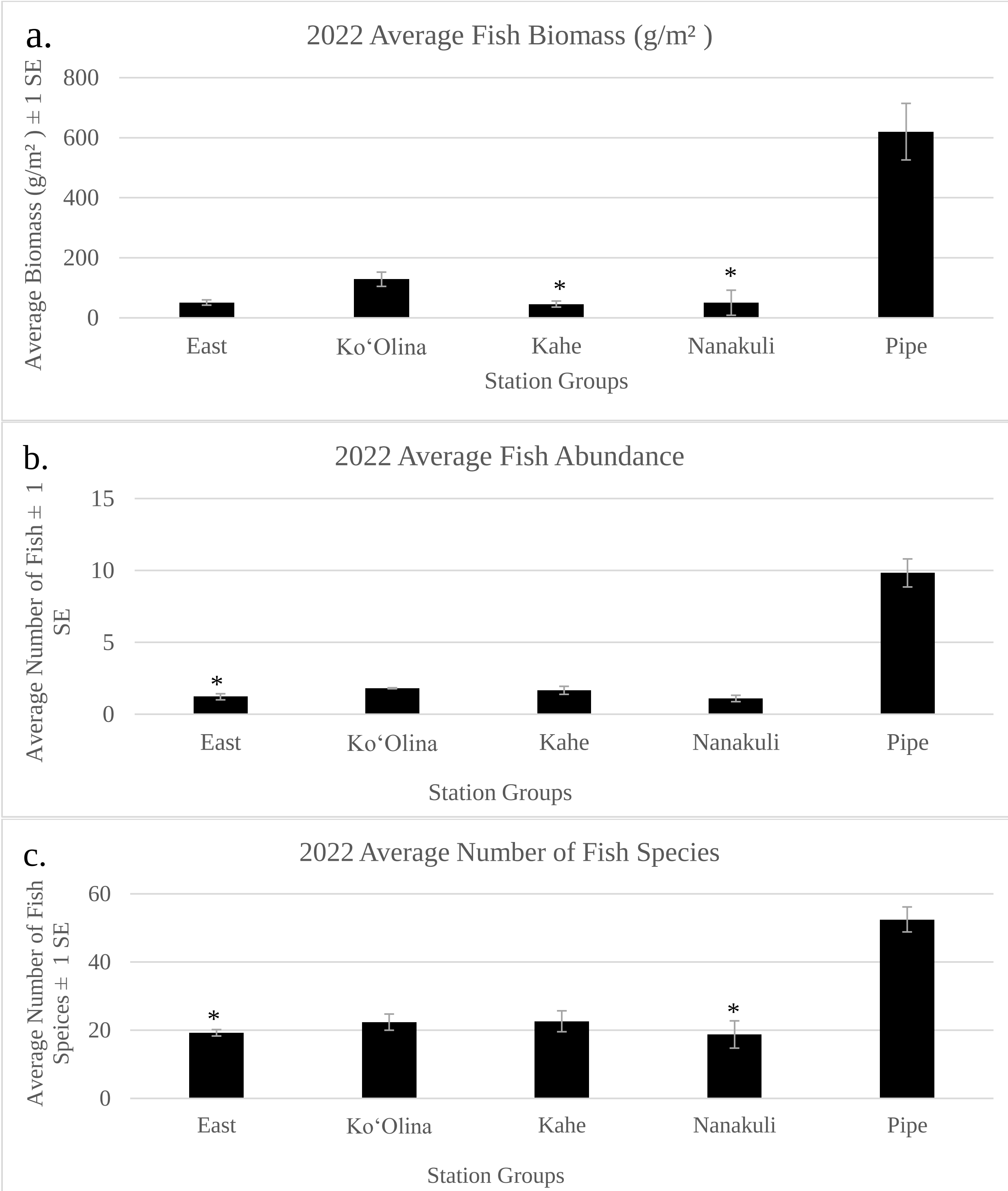


Figure 3. Average fish biomass (a), abundance (b) and number of species (c) per station grouping for 2022 surveys only. Standard error (SE) bars represent $\pm$ 1 SE. Asterisks (*) represent a significant difference from the Pipe transect.

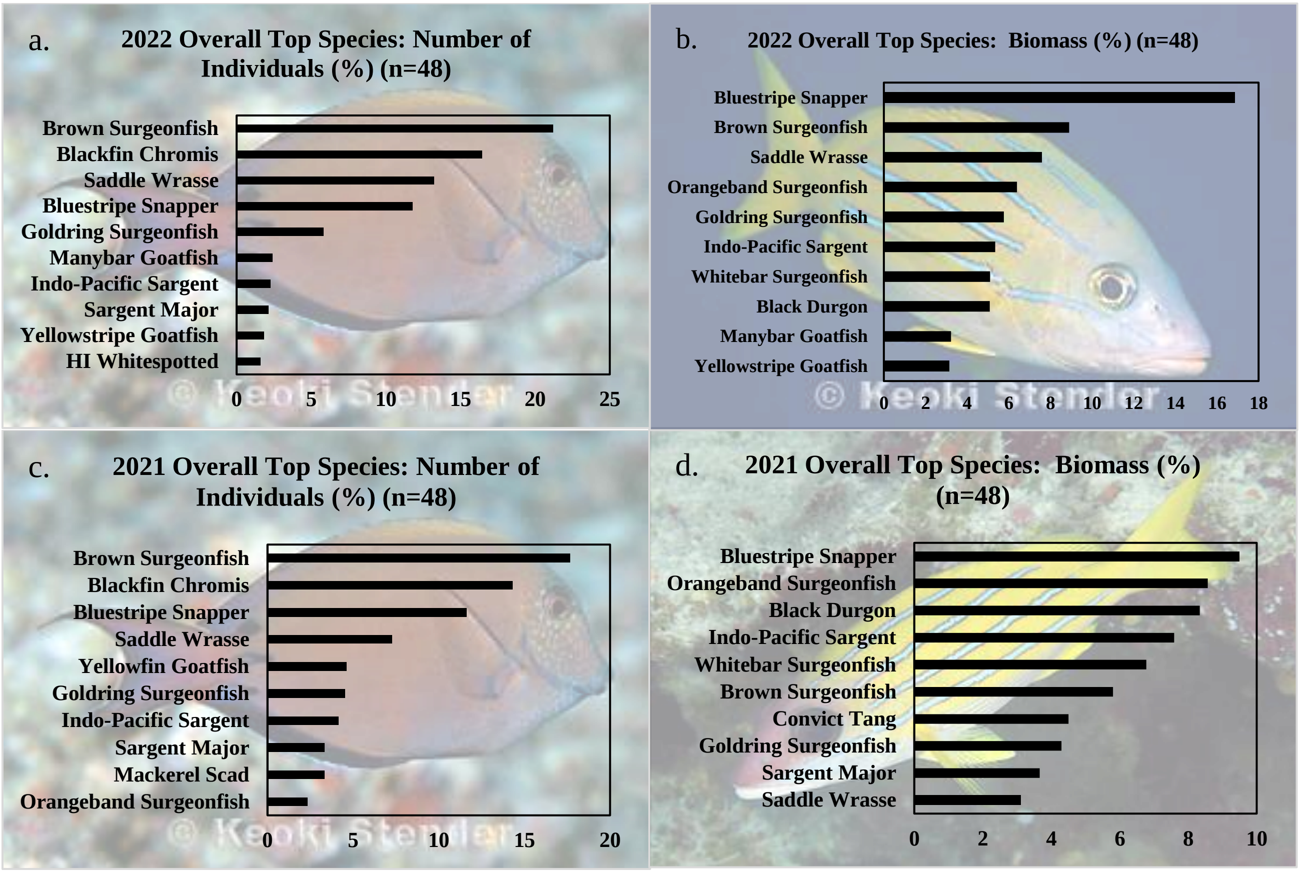


Figure 4. Top ten fish species contributing to number of individual fishes and biomass (%) for survey year 2022 (a, b) and 2021 (c, d).

Table 3. (A) Mean proportion of fish individuals and (B) biomass contributing to each trophic feeding level in 2022. (C) Mean proportion of fish individuals and (D) biomass in each trophic level in 2021.

A. 2022 Trophic Levels: Number of Individuals (%)

Transect Group	Herbivores	Invertebrate Feeders	Piscivores	Zooplanktivores
East	42.5	30.7	2.8	24.0
Ko‘Olina	58.4	33.9	1.3	6.4
Kahe	29.0	26.7	1.0	43.3
Nanakuli	41.4	26.1	1.7	30.8
Pipe	25.6	56.2	0.6	17.6
Total	34.2	38.2	1.2	26.4

B. 2022 Trophic Levels: Mean Biomass (%)

Transect Group	Herbivores	Invertebrate Feeders	Piscivores	Zooplanktivores
East	66.8	27.1	5.3	0.9
Ko‘Olina	72.7	25.7	1.4	0.1
Kahe	51.5	42.0	1.4	5.1
Nanakuli	68.6	23.1	1.1	7.2
Pipe	15.8	62.3	0.7	21.2
Total	40.9	43.8	1.5	13.6

C. 2021 Trophic Levels: Number of Individuals (%)

Transect Group	Herbivores	Invertebrate Feeders	Piscivores	Zooplanktivores
East	40.2	20.0	0.9	38.9
Ko‘Olina	65.1	30.7	0.8	3.4
Kahe	36.1	25.4	1.7	36.8
Nanakuli	66.7	18.6	1.6	13.2
Pipe	16.8	57.4	0.3	25.6
Total	33.9	37.5	0.9	27.7

D. 2021 Trophic Levels: Mean Biomass (%)

Transect Group	Herbivores	Invertebrate Feeders	Piscivores	Zooplanktivores
East	70.1	13.1	2.1	14.7
Ko‘Olina	82.4	16.5	0.0	1.1
Kahe	49.3	25.8	2.0	22.8
Nanakuli	88.8	11.0	0.1	0.1
Pipe	18.0	50.1	0.4	31.4
Total	49.2	30.4	0.9	19.5

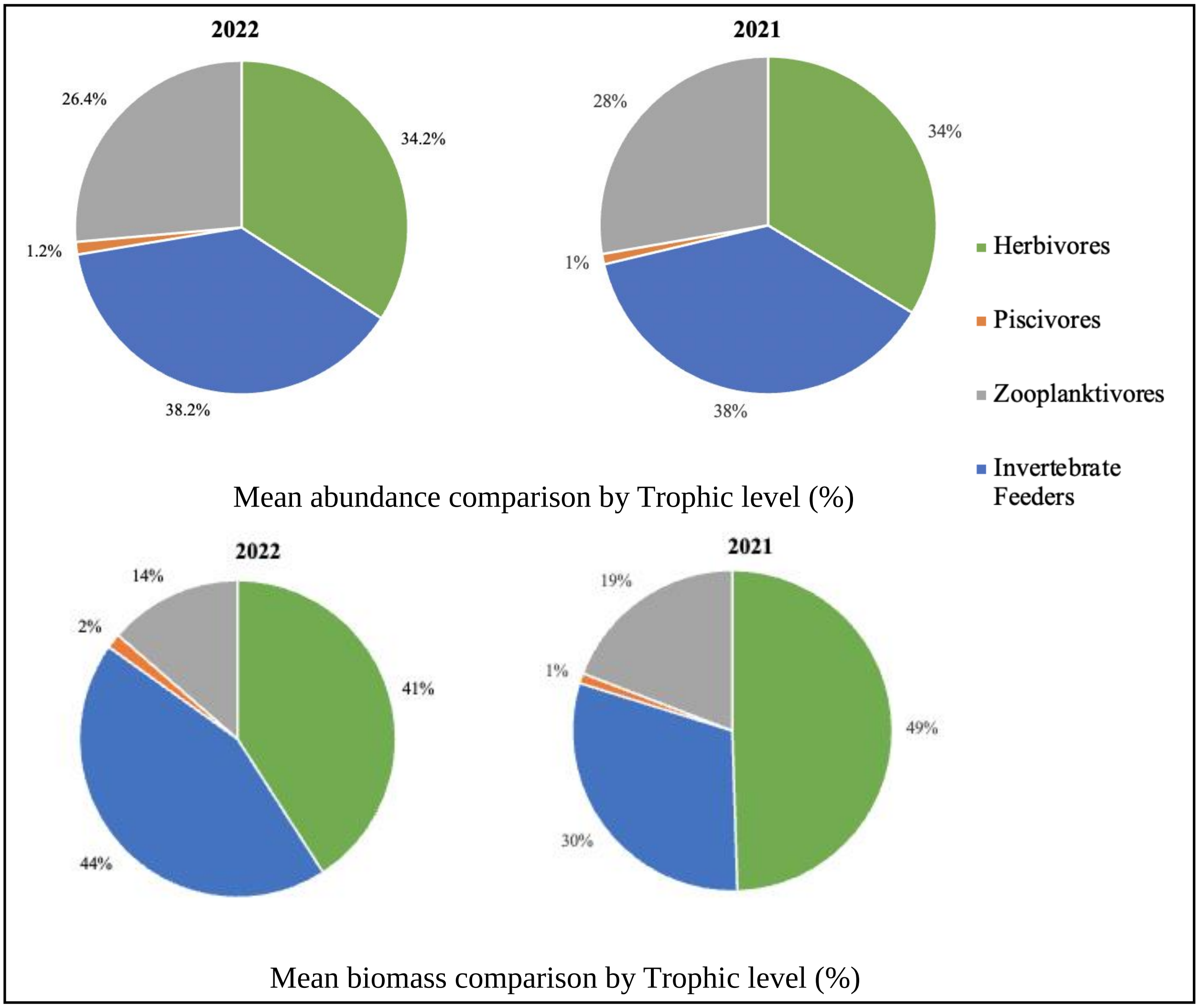
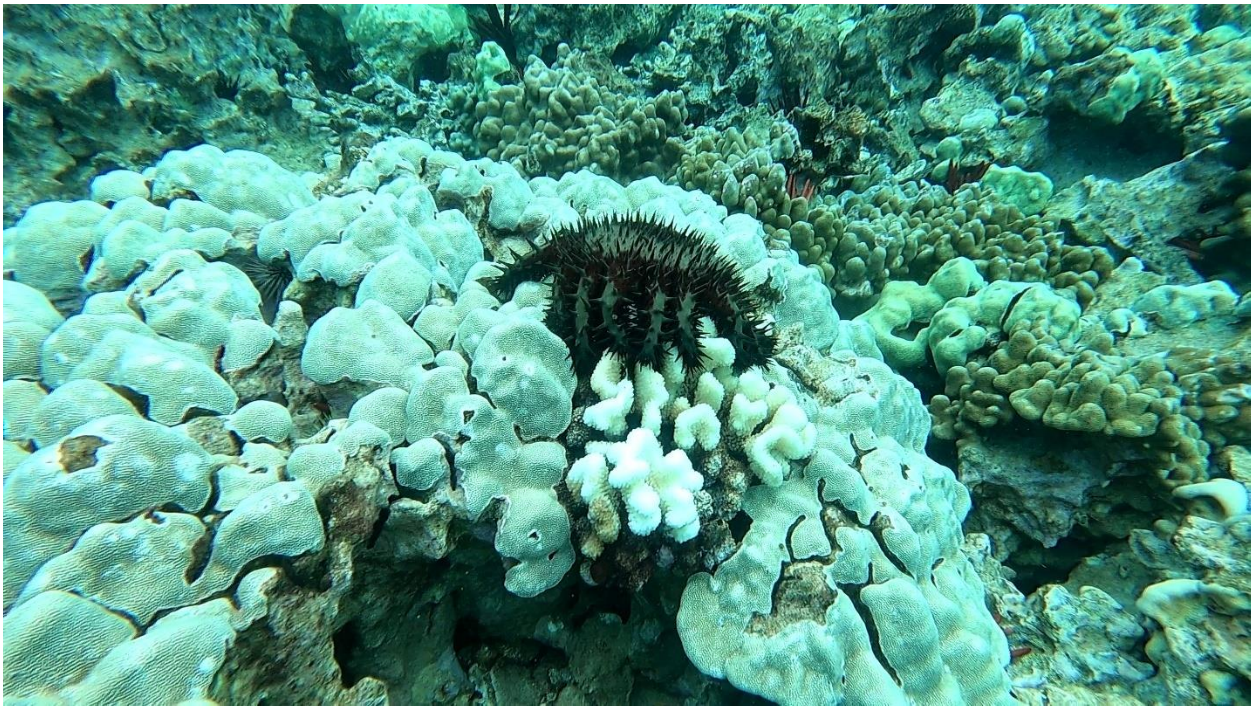


Figure 5. Mean abundance and biomass of each trophic level during 2022 and 2021surveys.



Field Photo 13. The Crown of Thorns Seastar feeding on a Cauliflower coral at Kahe 5B (May 2022).

KALAELOA (Barber's Point, EAST)

In 2020 through 2022, transects East 1, East, 3 and East 4 were surveyed within the East transect grouping. In 2022, East 4 transect had the highest estimated standing crop of all East transects with 67.9 ± 14.9 g/m^2 (grams per square meter) (Figure 6). East 3 had the lowest biomass in 2022 (37.8 ± 9.8 g/m^2). East 1 had intermediate biomass with 47.6 ± 12.6 g/m^2. East group had significantly less fish abundance (p = 0.029, 2021 = 1.7 ± 0.2 individuals/m^2, 2022 = 1.2 ± 0.02 individuals/m^2), and similar mean biomass estimates (2021 = 169.9 ± 49.4 g/m^2, 2022 = 51.1 ± 8.8 g/m^2) and number of fish species (2021 = 20.2 ± 1.4, 2022 = 19.3 ± 0.9) present in 2022 when compared to 2021. At the group level, the number of individual fishes (p = 0.039) and biomass (p = 0.028) at East was significantly higher in 2021 when compared to 2022; there was no difference number of fish speices. Herbivore biomass was also significantly less at the group level in 2022, as compared to 2021 (p = 0.008). Consistent with 2020 and 2021 surveys, fish abundance at all East transects was dominated by *māʻiʻi* (*A. nigrofuscus*, Brown surgeonfish) and the Blackfin Chromis (*Chromis vanderbilti*)(Figure 7). Similar to 2020, the biomass at East transects were dominated by *na'ena'e* (*A. olivaceus*, orange band surgeonfish*)* (Figure 7). This is dissimilar from 2021 surveys where the biomass was dominated by *kala lōlō* (*Naso brevirostris*, Paletail Unicornfish) and *māikoiko* (*Acanthurus leucopareius*, whitebar surgeonfish).

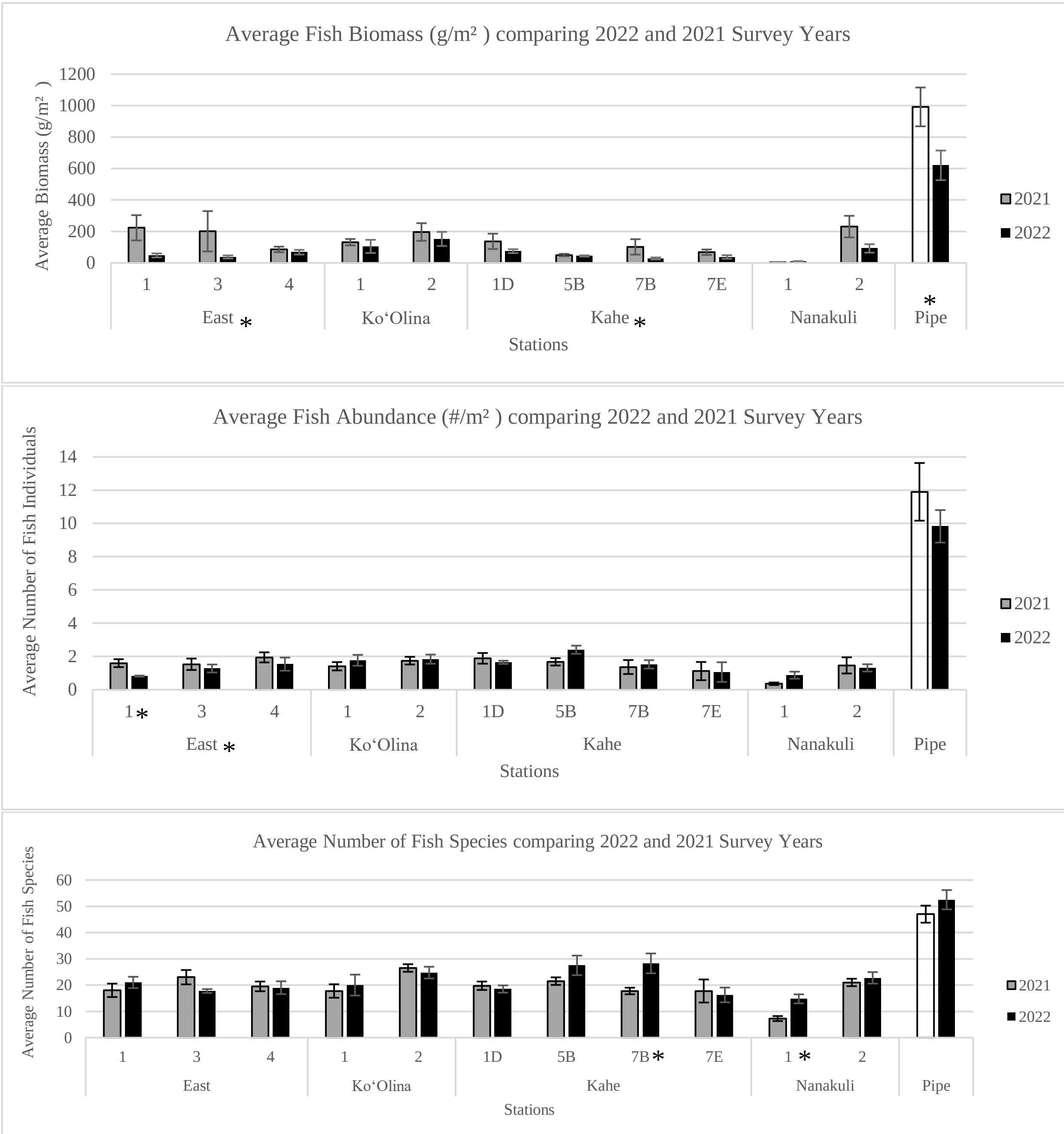


Figure 6. Average fish biomass (a), fish abundance (b) and number of fish species (c) per transect comparing survey years 2022 and 2021. Standard error (SE) bars represent ± 1 SE. An asterisk (*) after the station name or grouping indicates a significant difference between the two survey years.

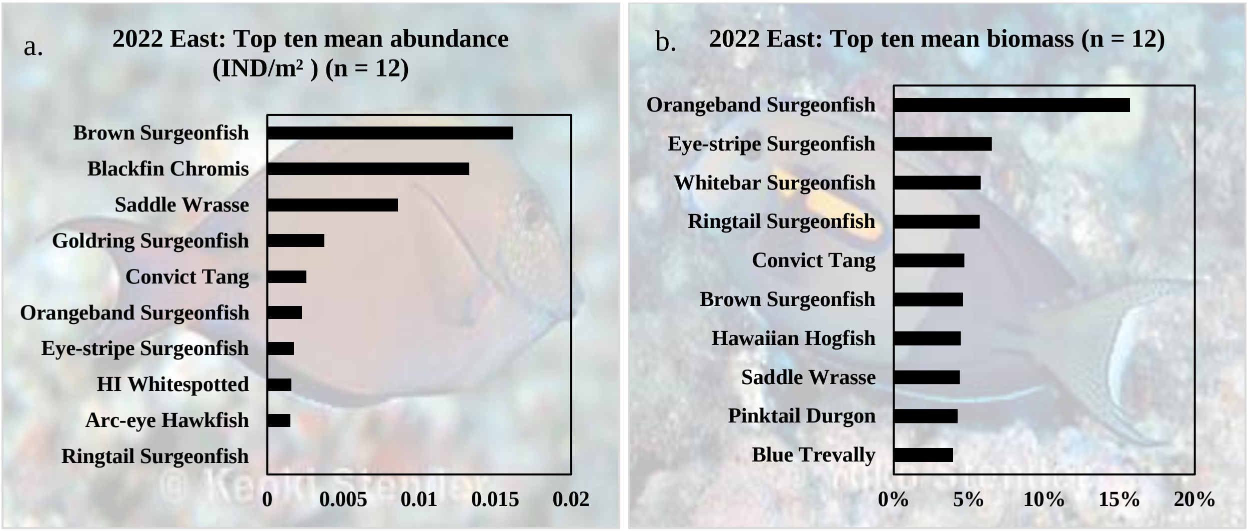
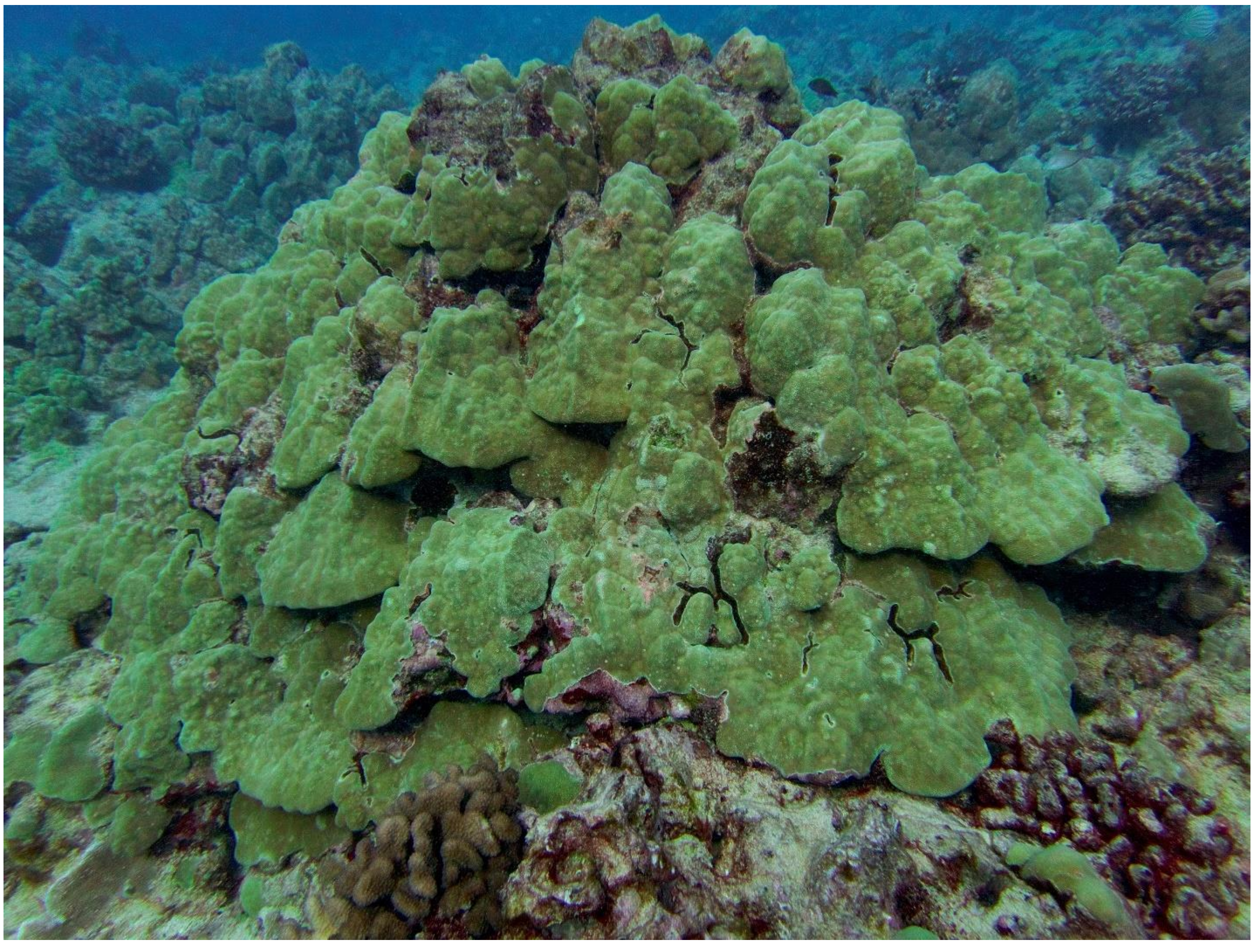


Figure 7. Top ten fishes contributing to mean abundance and biomass at East grouping in 2022. IND/m^2=individuals per square meter, g/m^2=grams per square meter.

Kalaeloa East 1: In 2022, East 1 transect had an average of 102.3 ± 4.2 fish individuals documented, encompassing a total of 34 species of fishes. Although the most abundant fishes changed throughout the survey period, surgeonfish appeared abundant at all four timepoints. In May, 100 fishes of 17 species were noted along transects. The biomass (32.3 g/m^2) was overwhelmingly dominated by *palani* (57.0%, *Acanthurus, dussumieri*, eye-stripe surgeonfish) followed by *na'ena'e* (19.3%, *A. olivaceus*, orange band surgeonfish) and *manini* (12.6%, *Acanthurus triostegus*, convict tang). For May's survey, 109 individuals of 20 species were noted. The *pualu* (29.3%, *Acanthurus blochii*, ringtail surgeonfish), *omilu* (15.1%, *Caranx melampygus*, bluefin trevally), and *māʻiʻiʻi* (13.5%, *A. nigrofuscus,* Brown surgeonfish) dominated the biomass (35.3 g/m^2). August's survey had the highest species diversity, with 26 species ranging over 107 fishes. It also had the highest biomass (79.7 g/m^2) which was dominated by *palani* (19.8%) and *pualu* (13.4%). October's survey found 93 individuals of 21 species. Biomass (42.9 g/m^2) was dominated by *manini* (22.9%), *na'ena'e* (10.2%), *pualu* (12.8%), and the butterflyfish, *kīkākapu* (11.3%, *Chaetodon ornatissimus*, ornate butterflyfish). A significant decrease (p = 0029) in fish abundance was noted between 2021 and 2022; no other differences in biomass or number of speices were observed.

Kalaeloa East 3: The average number of fishes along transect East 3 was 159.8 ± 30.0 individuals of 31 fish species (Figure 6). Along East 3, *māʻi'i'i* (21.7 ± 6.1%, *A. nigrofuscus*, brown surgeonfish) was one of the most consistantly abundant fishes for all survey timepoints (Appendix A). In May, the survey documented 84 fishes of 18 species. Despite having intermediate species diversity, this was the lowest number of fishes observed along the transect for all 2022 timepoints in the East group. Similarly, May's survey had the lowest biomass (14.2 g/m^2), the three fishes responsible for the majority of the biomass during May's survey were the *māʻi'i'i* (32.2%), *hīnālea lauwili* (21.2%, *T. duperrey*, saddle wrasse), and *uhu* (18.6%, *Scarus psittacus*, palenose parrotfish). Although June's survey had the highest abundance (199 fishes of

19 species), the biomass was the second highest of all timepoints (44.9 g/m^2). The two fishes responsible for the majority of the biomass during June's survey were the same as May's: the *hīnālea lauwili* (28.6%) and *māʻi'i'i* (28.1%). In August, 170 individuals of 16 fish species were identified along transect East 3. Four fishes contributed the majority of the biomass (53.9 g/m^2): *na'ena'e* (25.9%, *A. olivaceus*, orangeband surgeonfish), *hīnālea lauwili* (19.5%), *kole* (15.0%, *Ctenochaetus strigosus*, goldring surgeonfish), and *pualu* (11.9%, *A. blochii*, ringtail surgeonfish). The census in October had intermediate biomass (38.3 g/m^2) and abundance (186 individuals). During this survey, 18 fish species were observed; *māʻi'i'i* (17.7%, *A. nigrofuscus*, brown surgeonfish), *humuhumuhiʻukole* (17.6%, *Melichthys vidua*, pinktail durgon), *hīnālea lauwili* (17.3%), and *kole* (14.6%, *Ctenochaetus strigosus*, goldring surgeonfish) encompassed a large portion of the biomass. There were no significant differences in abundance, biomass or species diversity between dates.



Field Photo 14. Large colonies of Lobe coral (*Porites lobata*) at Kalaeloa, Station East 3, June 2022.

Kalaeloa East 4: Despite fluctuations in the number of fish species (19 ± 2.4), number of fish (192.5 ± 49.4) present along transects at each survey date, and biomass (67.9 ± 14.9 g/m^2) of East 4, no significant differences were detected across the time points. In May, 159 individuals of 15 species were recorded along East 4 transects. May had the lowest species diversity of the timepoints. The biomass (84.9 g/m^2) was made up of primarily (61.5%) *na'ena'e* (*A. olivaceus*, orangeband surgeonfish) and *a'awa* (9.1%, *Bodianus albotaeniatus*, Hawaiian hogfish). June's census observed a biomass of 53.9 g/m^2 encompassing 18 species of fishes, with 275 individual fishes. The biomass was dominated by three fishes: *hīnālea lauwili* (30.6%, *Thalassoma duperrey*, saddle wrasse), *na'ena'e* (25.9%, *A. olivaceus*, orangeband surgeonfish), and *mā'i'i'i* (23.4%, *A. nigrofuscus*, brown surgeonfish). August's surveys found the least abundance and biomass of all timepoints, while species richness remained consistent with the prior survey (38.9 g/m^2, 88 individuals, 18 species). The biomass was predominantly *na'ena'e* (35.8%, *A. olivaceus*, orangeband surgeonfish) and *umaumalei* (13.3%, *Naso lituratus*, orangespine unicornfish). October's census had the greatest biomass, number of individuals, and number of species of all timpoints (93.7 g/m^2, 248 individuals, 25 species). The biomass was dominated by *na'ena'e* (55.8%, *A. olivaceus*, orangeband surgeonfish) and *a'awa* (10.1%, *Bodianus albotaeniatus*, Hawaiian hogfish).

Field Photo 15. The spatial complexity at Kalaeloa, Station East 4 includes coral colonies, holes, crevices, overhangs, and caves that have been shown to harbor large fish populations.

KO ʻOLINA

The Koʻ Olina group includes transects KO 1 and KO 2. Average biomass, number of individual fishes, and number of fish species for the Koʻ Olina group were similiar in 2021 (164.1 ± 30.2 g/m^2, 218.5 ± 28.9 individuals, 22.1 ± 2.1 species) when compared to 2022 (128.6 ± 23.7 g/m^2, 225.6 ± 4.4 individuals, 22.4 ± 2.4 species)(Figure 6). In Koʻ Olina group, the most abundant fishes were *kole* (*C. strigosus*, goldring surgeonfish), *hīnālea lauwili* (*Thalassoma duperrey*, saddle wrasse), and *māʻi'i'i* (*A. nigrofuscus*, brown surgeonfish)(Figure 8). *Māikoiko* (*Acanthurus leucopareius*, whitebar surgeonfish), *na'ena'e* (*A. olivaceus*, orangeband surgeonfish), and the invasive *taʻape* (*L. kasmira*, bluestripe snapper) were responsible for much of the biomass (Figure 8).

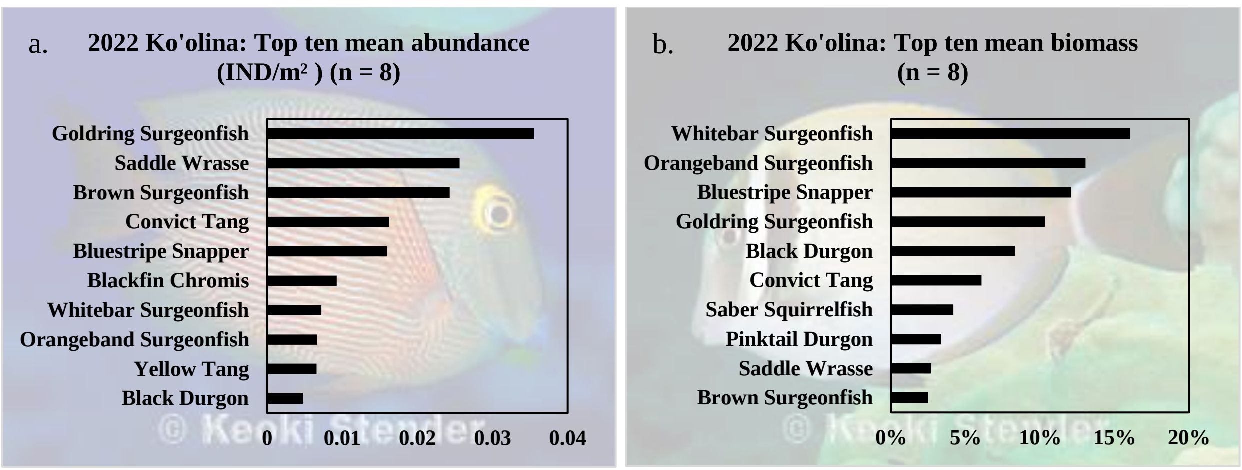
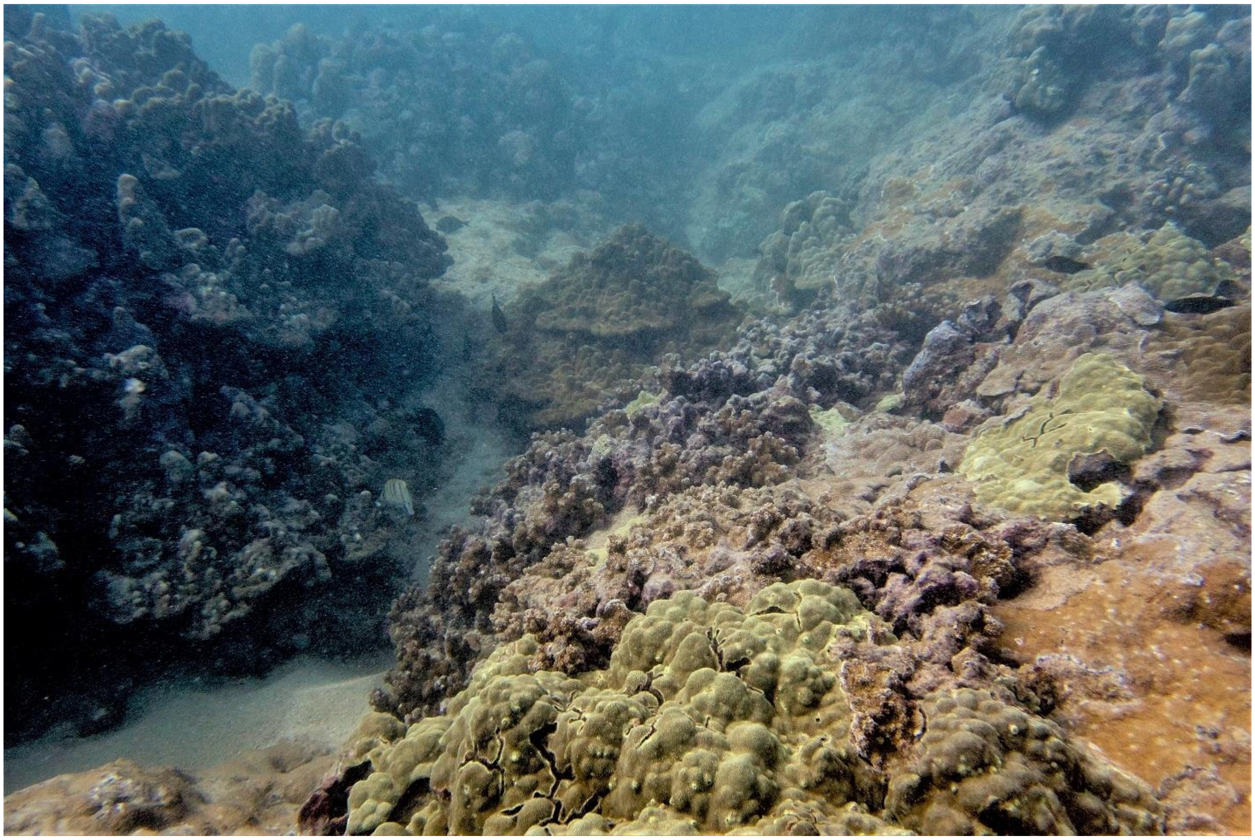


Figure 8. Top ten fish contributing to mean abundance and biomass at Koʻ Olina transect grouping in 2022.

Ko ʻOlina 1: In 2022, KO 1 transect varied in fish biomass, abundance, and species riches over the four survey dates: May = 46.2 g/m^2, 194 individuals, 19 species; June= 68.0 g/m^2, 223 individuals, 15 species; August = 209.0 g/m^2, 318 individuals, 30 species; and October = 96.2 g/m^2, 150 individuals, 16 species. Similar to 2021, *kole* (May: 55.6%, June: 48.5%, August: 23.3%, October: 29.9%, *C. strigosus*, goldring surgeonfish) played a dominant role in each time point's biomass. The May census also found *hīnālea lauwili* (20.4%, *Thalassoma duperrey*, saddle wrasse) and *māʻiʻiʻi* (11.9%, *A. nigrofuscus*, brown surgeonfish) to contribute a large portion of the biomass. During June, *hīnālea lauwili* (18.9%), *humumumuʻelʻele* (12.9%, *Melichthys niger,* black durgon), and *māʻiʻiʻi* (12.3%) also contributed to the biomass. During August's census, the invasive *taʻape* (27.9%, *L. kasmira*, bluestripe snapper) was the most dominate fish in relation to biomass, followed by *kole* (23.3%), and *humumumuʻelʻele* (11.2%). October saw a shift in dominance of the biomass to *humumumuʻelʻele* (30.8%), followed by *kole* (29.9%), and *hīnālea lauwili* (11.0%). No significant differences were noted between populations along transects between 2021 and 2022.



Field Photo 16. The spatial complexity at Ko ʻOlina, Station 1 has habitat that fosters high fish and coral diversity (June 2022).

Ko ʻOlina 2: KO 2 transect in May had the highest biomass (237.4 g/m^2) of all timepoints, and an intermediate number of fishes (220 individuals) and speices (25 species)(Appendix A). Although there were fewer fish, the fish present were large in size. The biomass was dominated by *māikoiko* (37.2%, *Acanthurus leucopareius*, whitebar surgeonfish), *na'ena'e* (22.0%, *A. olivaceus*, orangeband surgeonfish), and *manini* (12.4%, *A. Triostegus*, convict tang). The only difference between population parameters was a significant (p = 0.029) decline in the biomass of herbivores, this will continue to be watched in future years. June's survey had intermediate biomass (153.7 g/m^2), number of fishes (248 individuals) and number of species (23 species). The biomass was dominated by three species of herbivorous fishes: *na'ena'e* (34.0%, *A. olivaceus*, orangeband surgeonfish), *kole* (19.7%, *C. strigosus*, goldring surgeonfish), and *manini* (12.8%, *A. triostegus*, convict tang). Although, the biomass was greatest during May, August's census had the highest number of fishes (297 individuals) and species richness (30 species of fishes). Two species of triggerfish, *humuhumuʻeleʻele* (31.4%, *M. niger*, black durgon) and *humuhumuiʻukole* (10.9%, *Melichthys vidua*, pinktail durgon), were of the top three contributors to biomass (169.3 g/m^2), along with *kole* (19.9%, *C. strigosus*, goldring surgeonfish). October's census had the lowest biomass (49.1 g/m^2), number of individuals (155 fishes), and number of species (21 species) present along the transect. The top three contributors to biomass during October were *kole* (15.1%), *hīnālea lauwili* (12.7%, *T. duperrey*, saddle wrasse), and *māʻiʻiʻi* (11.4%, *A. nigrofuscus*, brown surgeonfish).

Field Photo 17. Ko ‘Olina, Station 2 had the highest number of fishes in May 2022.

KAHE

The Kahe group encompasses four transects: 1D, 5B, 7B, and 7E. Based on comparability of biomass (mean standing crop) of fishes, abundance (mean number of individual fish), mean number of fish species, similarity of habitat, and spatial proximity, Kahe 7D transect was eliminated from surveys after 2018, and subsequently Kahe 7C and 10C were eliminated after the 2020 surveys, therefore they have been removed from group averages. At Kahe stations estimated biomass in 2022 was 46.0 ± 10.1 g/m^2, while in 2021 estimated biomass was 89.1 ± 18.2 g/m^2 (Figure 6). This was a significant decrease in fish biomass in 2022 when compared to 2021 (p = 0.032). Similarly, the biomass of herbivorous (p = 0.004) and zooplanktivorous (p = 0.017) fishes decreased significantly between 2021 and 2022 surveys. The average abundance of fishes in 2021 (1.5 ± 0.2) and 2022 (1.7 ± 0.3) were not significantly different from one another. The average number of species was also similar for the two years (2021: 19.8 ± 1.6, 2022: 22.6 ± 3.1). In 2022 and 2021 blackfin chromis (*C. vanderbilti*) dominated the fish abundance. The biomass in 2022 was largely contributed to by *māikoiko (A. leucopareius*, whitebar surgeonfish) (Figure 9), which differed from 2021 where *opelu* (*Decapterus macarellus*, mackerel scad) was dominant. Both years second highest contributor to biomass was the *humuhumu‘ele‘ele* (*M. niger*, black durgon).

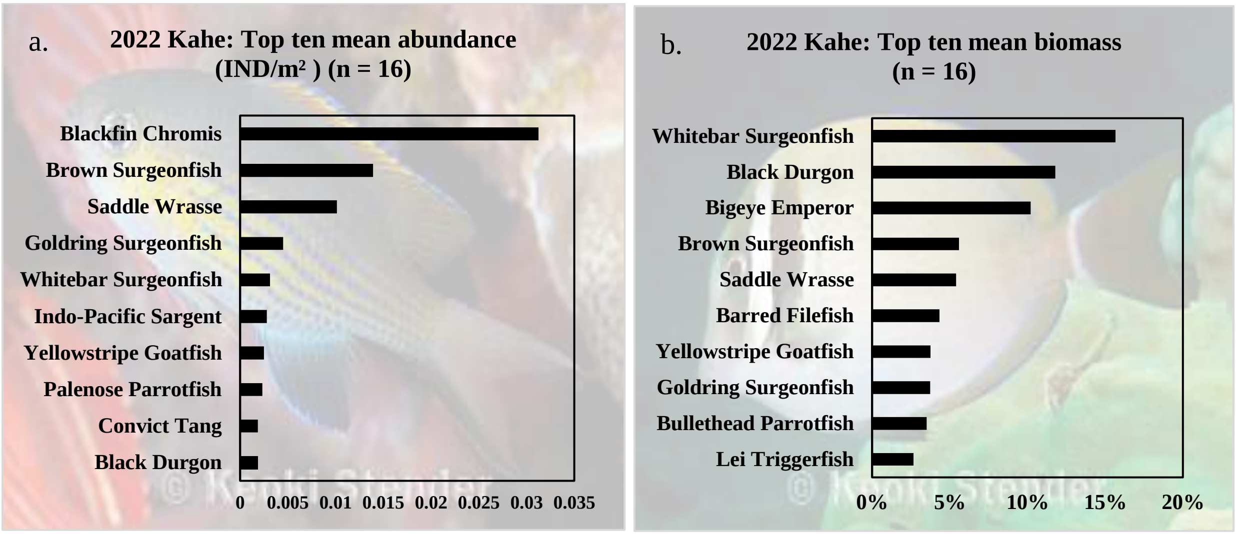


Figure 9. Top ten fish contributing to mean abundance and biomass at Kahe transect grouping in 2022 surveys.

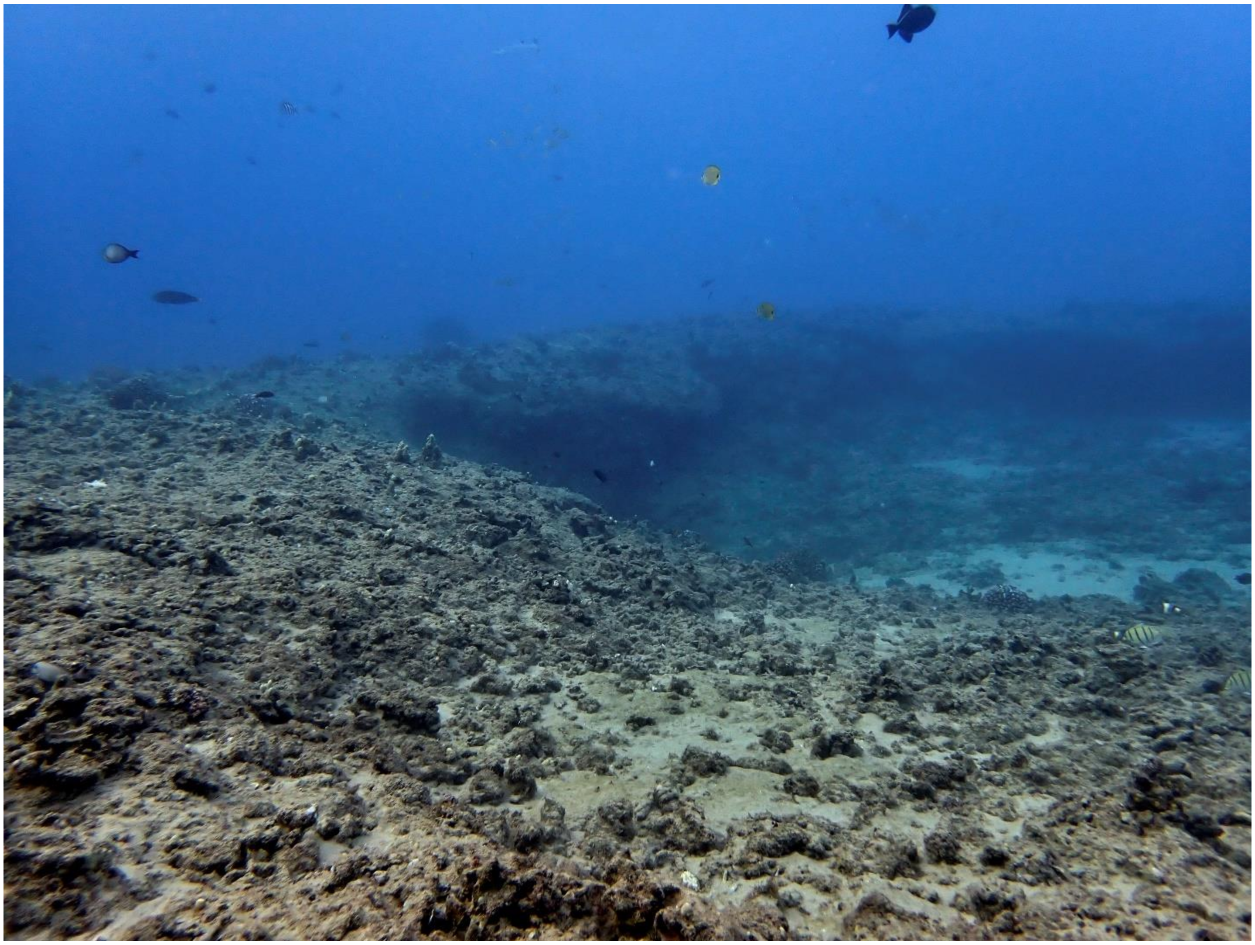
Kahe 1D: Kahe station 1D had the highest average biomass in 2022 when compared to other Kahe transects (May: 78.0 g/m^2, 215 individuals, 16 species, June: 48.9 g/m^2, 223 individuals, 20 species, August: 100.8 g/m^2, 211 individuals, 21 species, October: 71.1 g/m^2, 176 individuals, 17 species. It was also highly variable in number of species and biomass between the four timepoints. In May, the biomass was dominated by four species: *humuhumuʻeleʻele* (26.3%, *M. niger*, black durgon), *hīnālea lauwili* (20.7%, *T. duperrey*, saddle wrasse), *kole* (19.4%, *C. strigosus*, goldring surgeonfish), and *māʻi'i'i* (16.5%, *A. nigrofuscus*, brown surgeonfish). Similarly, in June, *hīnālea lauwili* (27.7%, *T. duperrey*, saddle wrasse), *kole* (19.3%, *C. strigosus*, goldring surgeonfish), and *māʻi'i'i* (19.0%, *A. nigrofuscus*, brown surgeonfish) dominated the biomass. In August, *mu* (28.7%, *Monotaxis grandoculis*, bigeye emperor) was the most dominant fish species, followed by *hīnālea lauwili* (20.7%, *T. duperrey*, saddle wrasse), *kole* (14.9%, *C. strigosus*, goldring surgeonfish), and *humuhumuʻeleʻele* (14.5%, *M. niger*, black durgon). In October, the biomass was dominated by four species: *māikoiko* (31.6%, *A. leucopareius*, whitebar surgeonfish), *humuhumuʻeleʻele* (20.6%, *M. niger*, black durgon), *hīnālea lauwili* (13.7%, *T. duperrey*, saddle wrasse), and , *māʻi'i'i* (12.9%, *A. nigrofuscus*, brown surgeonfish). It is important to note that zooplantivorous biomass decreased significantly between 2021 and 2022 surveys (p = 0.029), and will continue to be monitored in future years. The fishes that contributed most to fish abundance were *māʻi'i'i* (*A. nigrofuscus*, brown surgeonfish), blackfin chromis (*C. vanderbilti*), *hīnālea lauwili* (*T. duperrey*, saddle wrasse), and *kole* (*C. strigosus*, goldring surgeonfish).

Field Photo 18. Kahe 1D has the highest biomass in the Kahe group of transects (June 2022).

Kahe 5B: 5B transect remained realitively stable in regards to fish biomass throughout all four quarterly surveys: May: 53.7 g/m^2, 280 individuals, 32 species, June: 38.4 g/m^2, 238 individuals, 21 species, August: 41.2 g/m^2, 360 individuals, 34 species, October: 41.9 g/m^2, 325 individuals, 23 species. No significant difference between population parameters were detected between 2021 and 2022 surveys. In May, *mā‘i'i'i* (24.1%, *A. nigrofuscus*, brown surgeonfish) and *weke* (18.9%, *Mulloidichthys flavolineatus*, yellowstripe goatfish) comprised the majority of the biomass. *Hīnālea lauwili* (41.3%, *T. duperrey*, saddle wrasse) and *mā‘i‘i‘i* (33.7%, *A. nigrofuscus*, brown surgeonfish) were the top contributers to biomass in June, August (*hīnālea lauwili* (22.7%) and *mā‘i‘i‘i* (22.5%)), and October (*hīnālea lauwili* (16.0%) and *mā‘i‘i‘i* (53.9%)). In August, *uhu* (17.1%, *Chlorurus sordidus*, bullethead parrotfish) was also a large contributor to biomass. Similar to 2020 and 2021, in 2022, the three most abundant fishes along all survey dates were blackfin chromis (*C. vanderbilti*), *mā‘i‘i‘i* (*A. nigrofuscus*, brown surgeonfish), and *hīnālea lauwili* (*T. duperrey*, saddle wrasse). Chromis are small schooling fishes that can contribute strongly to abundance (number of individuals) but make very little contribution to biomass.

Kahe 7B: In 2022, 7B transect saw the highest number of species present when compared to other transects, with the exception of Pipe station. This species richness was significantly (p = 0.029) greater when compared to 2021. Although species richness was high, the biomass of herbivores experienced a significant (p = 0.029) decline from 2021's survey. Biomass and abundance of fishes along 7B were intermediate to low compared to other transects throughout time: May: 18.3 g/m^2, 122 individuals, 26 species, June: 20.1 g/m^2, 174 individuals, 24 species, August: 31.0 g/m^2, 243 individuals, 25 species, October: 42.3 g/m^2, 224 individuals, 38 species. During the May survey, the biomass was dominated by *na'ena'e* (20.9%, *A. olivaceus*, orangeband surgeonfish) and *'ālo'ilo'i* (14.9%, *Dascyllus albisella*, Hawaiian dascyllus). In June, the key contributors to biomass were *mā'i'i'i* (25.3%, *A. nigrofuscus*, brown surgeonfish), *humuhumulei* (18.8%, *Sufflamen bursa*, lei triggerfish), and *hīnālea lauwili* (12.0%, *T. duperrey*, saddle wrasse). The biomass in August was dominated by *humuhumulei* (19.3%, *Sufflamen bursa*, lei triggerfish), followed by *kihikihi* (11.4%, *Zanclus cornutus*, moorish idol) and *mā'i'i'i* (11.3%, *A. nigrofuscus*, brown surgeonfish). October's survey biomass was dominated by four speices of fishes: *hīnālea lauwili* (15.8%, *T. duperrey*, saddle wrasse), *moano* (15.4%, *P. multifasciatus*, manybar goatfish), *humuhumulei* (11.9%, *S. bursa*, lei triggerfish), and *mā'i'i'i* (10.4%, *A. nigrofuscus*, brown surgeonfish). The two most abundant fish species within all quarterly surveys at 7B in years 2019 through 2022, excluding the large school of *opelu* (*D. macarellus*, mackerel scad), were the blackfin chromis (*C. vanderbilti*) and *mā'i'i'i* (*A. nigrofuscus*, brown surgeonfish).

Kahe 7E: Kahe 7E was highly variable in the number of individuals throughout the four surveys, this trend was similar to 2020 and 2021's surveys. In 2022, Kahe 7E had the lowest fish abundance and species richness of all Kahe stations. Kahe 7E also had significantly less herbivore ($p = 0.029$) and zooplanktivore ($p = 0.029$) biomass when compared to 2021. June had the lowest biomass, total number of fishes, and species richness (22.9 g/m^2, 23 individuals, 10 species) present along transects when compared to other survey dates. The biomass was dominated by four species of fishes: *manini* (28.6%, *A. triostegus*, convict tang), *na'ena'e* (16.7%, *A. olivaceus*, orangeband surgeonfish) and *humuhumulei* (16.5%, *S. bursa*, lei triggerfish), and *umaumalei* (11.3%, *N. lituratus*, orangspine unicornfish). The biomass, number of fishes, and species richness in June was slightly higher than May (28.0 g/m^2, 89 individuals, 15 species). The biomass was dominated by three species of triggerfish: *humuhumu'ele'ele* (31.5%, *M. niger*, black durgon), *humuhumulei* (13.5%, *S. bursa*, lei triggerfish), and *humuhumuuhi'ukole* (12.1%, *M. vidua*, pinktail durgon). August's survey had the greatest number of individual fishes of all timepoints (32.4 g/m^2, 317 individuals, 19 species). The majority of these fishes (77.3%) were the small schooling Blackfin Chromis (*C. vanderbiliti*). The biomass was dominated by five species of fish: *humuhumulei* (31.6%, *S. bursa*, lei triggerfish), *na'ena'e* (15.2%, *A. olivaceus*, orangeband surgeonfish), *hīnālea lauwili* (12.0%, *T. duperrey*, saddle wrasse), *humuhumuuhi'ukole* (11.6%, *M. vidua*, pinktail durgon), and *moano* (10.6%, *P. multifasciatus*, manybar goatfish). The greatest biomass and species richness occurred in October's survey (66.9 g/m^2, 102 individuals, 21 species). The biomass was dominated by 10 individuals of *humuhumu'ele'ele* (38.8%, *M. niger*, black durgon). Similar to 2021's surveys, the Blackfin Chromis (*C. vanderbiliti*) was the overwhelmingly most abundance species along 7E transect.



Field Photo 19. Kahe 7E showing the ledges that provide hiding areas from predators (June 2022).

NANAKULI (Control Stations)
Two fish transects are included in the Nanakuli group: NANA 1 and NANA 2. These survey sites are the control stations for all other stations for this project. No significant differences were found in biomass, abundance, or number of species between 2021 and 2022. The biomass at Nanakuli stations in 2021 (117.2 ± 53.4 g/m^2) and 2022 (50.4 ± 41.7 g/m^2) were highly variable between timepoints. The average abundance of fishes (2021: 0.9 ± 0.3, 2022: 1.1 ± 0.2), and average number of species (2021: 14.1 ± 2.7, 2022: 18.8 ± 4.0) also remained similar (Figure 6). The most abundant fish along Nanakuli stations was the Blackfin Chromis (*C. vanderbiliti*) Similar to that of 2020 and 2021 surveys, the second most abundant fishes at Nanakuli group in 2022 were *māʻi'i'i* (*A. nigrofuscus*, brown surgeonfish) and *māikoiko (A. leucopareius*, whitebar surgeonfish) (Figure 10), while *māikoiko (A. leucopareius*, whitebar surgeonfish) alone dominated the biomass (Figure 10).

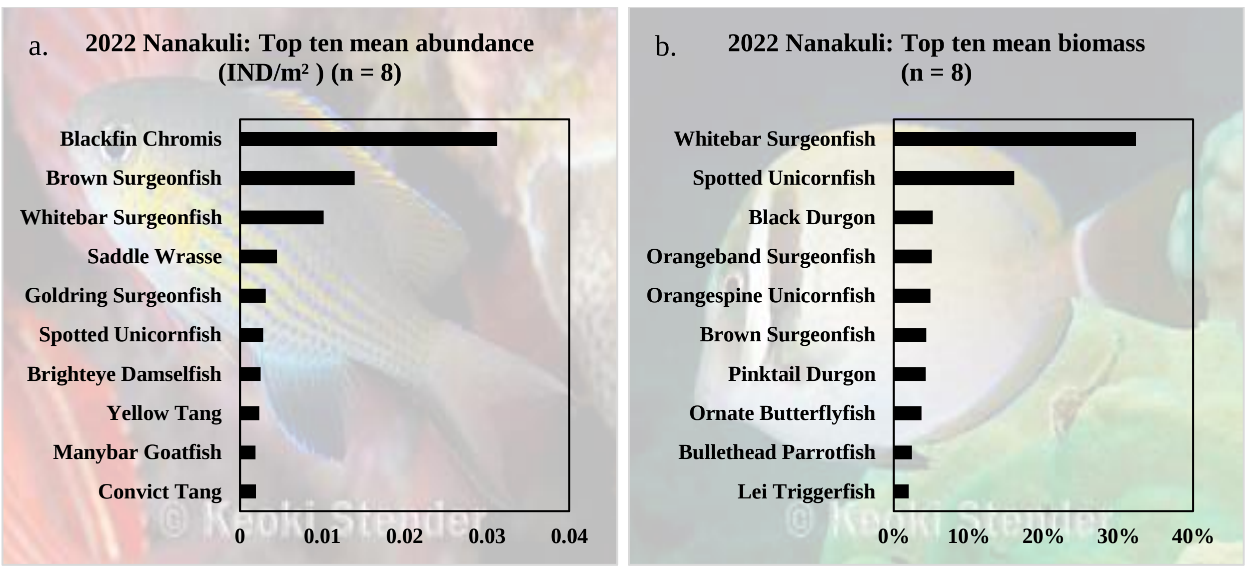
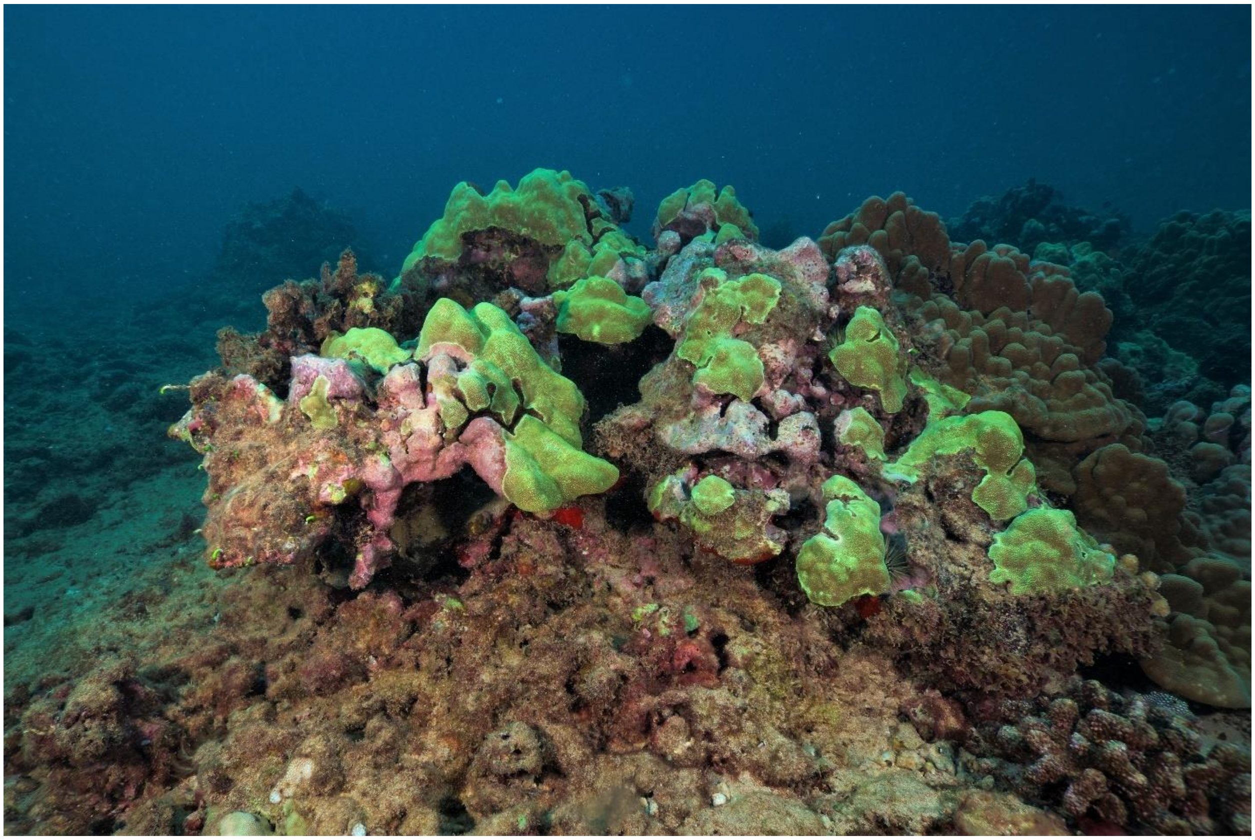


Figure 10. Top ten fishes contributing to mean abundance and biomass at Nanakuli transect grouping in 2022 surveys.

NANA 1: Biomass and number of species was lowest at NANA 1 transect when compared to all other transects surveyed. Despite having the lowest species richness of all transects, the number of species was significantly ($p = 0.029$) greater than the previous year. During the May survey at NANA 1 (5.3 g/m^2, 154 individuals, 14 species), two species dominated the biomass: the wrasse *hīnālea lauwili* (26.9%, *T. duperrey*, saddlewrasse), and the eel *puhi o niʻo* (25.3%, *Gymnothorax meleagris*, whitemouth moray). In June, biomass (8.7 g/m^2, 143 individuals, 19 species) was composed of *āwela* (18.3%, *Thalassoma trilobatum*, Christmas wrasse), *maiko* (14.8%, *Acanthurus nigroris*, bluelined surgeonfish), *humuhumunukunukuapua'a* (14.5%, *Rhinecanthus rectangulus*, reef triggerfish), *hīnālea lau wili* (12.6%, *T. duperrey*, saddle wrasse), and *manini* (11.0%, *A. triostegus*, convict tang). The *āwela* (50.8%, *T. trilobatum*, Christmas wrasse) also dominated the biomass in August's survey (14.4 g/m^2, 74 individuals, 14 species), followed by *moano* (21.1%, *P. multifasciatus*, manybar goatfish). October's survey was dominated by two species of triggerfish making up a total of 69% of the biomass (6.0 g/m^2, 66

individuals, 12 species). These triggerfish were *humuhumulei* (47.6%, *Sufflamen bursa*, lei triggerfish) and *humuhumunukunukuapua'a* (21.4%, *R. rectangulus*, reef triggerfish). Similar to 2021, the blackfin chromis (*C. vanderbilti*), *hīnālea lauwili* (*T. duperrey*, saddlewrasse), and bright-eye damselfish (*P. imparipennis*) were the most common fishes along transects for all timepoints in 2022.

NANA 2: Despite their geographic similarity, the Nana 2 transect is consistently greater in all fish community factors (May: 24.9 g/m^2, 107 individuals, 20 species, June: 100.1 g/m^2, 153 individuals, 19 species, August: 128.5 g/m^2, 178 individuals, 26 species, October: 114.9 g/m^2, 220 individuals, 26 species). NANA 2 transect did not differ in fish biomass, abundance or species diversity between survey years 2021 and 2022. The biomass in May was dominated by *mā‘i‘i‘i* (33.2%, *A. nigrofuscus*, brown surgeonfish) and *humuhumuhi‘ukole* (13.6%, *M. vidua*, pinktail durgon). All other quarterly surveys were dominated by *māikoiko* (June: 35.0%, August: 52.5%, October: 36.2%, *A. leucopareius*, whitebar surgeonfish). In June, *umaumalei* (12.4%, *Naso lituratus*, orangespine unicornfish), *hīnālea lauwili* (11.8%, *T. duperrey*, saddlewrasse), and *na'ena'e* (10.6%, *A. olivaceus*, orangeband surgeonfish) also significantly contributed to the biomass at NANA 2. Another large contributor to the biomass in October was *kala lōlō*, (20.7%, *N. brevirostris*, spotted unicornfish). Similar to 2021's surveys, the most abundant fishes along all transects were *mā‘i'i'i* (*A. nigrofuscus*, brown surgeonfish) and *māikoiko* (*A. leucopareius*, whitebar surgeonfish). Other significant contributors to fish abundance were *kole* (*C. strigosus*, goldring surgeonfish), *hīnālea lauwili*, and the blackfin chromis (*C. vanderbilti*).



Field Photo 20. The Nanakuli group serves as the reference site for the other monitoring stations. (Nanakuli 2, October 2022).

PIPELINE

The KGS Pipe station is the only transect in this study that is located on an artificial surface. The fish biomass, number of fish individuals and number of species present along the Pipe is consistently greater than the East, Ko‘Olina, Kahe, and Nanakuli groups (Figure 6). The fish biomass in 2020 (362.0 ± 10.4 g/m^2) was significantly lower than the biomass in 2021 (991.8 ± 123.5 g/m^2) (p = 0.029) (Figure 6). Similarly, the fish biomass in 2022 (620.2 ± 94.2 g/m^2) was also significantly (p = 0.029) less than 2021. Therefore, it is likely that the biomass in 2021 may have been the anoamoly. The biomass of zooplanktivorous fishes was also significantly (p = 0.029) less in 2022 when compared to 2021. Fish abundance, although not statistically significant, was also greater in 2021 when compared to 2020 and 2022, and the species diversity along Pipe transect was similar between survey years (2022: 9.8 ± 1.0 #/m^2, 52.5 ± 3.7 fish species; 2021: 11.9 ± 1.7 #/m^2, 47.0 ± 3.2 fish species; 2020: 5.3 ± 0.4 #/m^2, 51.3 ± 2.1 fish species). Throughout the four 2022 surveys, Pipe transect fluctuated in biomass, number of fish individuals, and number of species present: May: 377.6 g/m^2, 1058 individuals, 44 species, June: 674.9 g/m^2, 1133 individuals, 52 species, August: 702.1 g/m^2, 1535 individuals, 55 species, and October: 726.4 g/m^2, 1187 individuals, 59 species.

During the May survey, the biomass was not dominated by a single species, but comprised of five top species, many of which were prominent along 2021’s surveys: *mamo* (22.5%, *A. vaigiensis*, Indo-Pacific sergeant), *mā‘i'i'i* (14.6%, *A. nigrofuscus*, brown surgeonfish), the invasive *ta‘ape* (14.4%, *L. kasmira*, bluestripe snapper), *mamo* (11.4%, *Abudefduf abdominalis*, sargent major), and *hīnālea lauwili* (11.1%, *T. duperrey*, saddlewrasse). In June, the biomass was dominated by the invasive *ta‘ape* (38.7%, *L. kasmira*, bluestripe snapper), *weke* (12.2%, *Mulloidichthys flavolineatus*, yellowstripe goatfish). Although August’s survey had the second highest species richness, the biomass was primarily dominated by *ta‘ape* (Aug: 42.0%); all other contributors made up less than 10% individually of the biomass. October’s survey had the highest species riches and biomass of all timepoints. The biomass was dominated by the invasive *ta‘ape* (28.7%, *L. kasmira*, bluestripe snapper), *moano* (16.0%, *P. multifasciatus*, manybar goatfish), and *mamo* (10.3%, *A. vaigiensis*, Indo-Pacific sergeant). Combining all four survey timepoints, the most abundant fish species in number and biomass at Pipe transect was the *ta'ape* (*L. kasmira*, bluestripe snapper, invasive) (Figure 11). This is similar to surveys in previous years. Large resident schools of *ta‘ape*, *mā‘i'i'i*, *mamo*, and *weke* are consistently found throughout surveys.

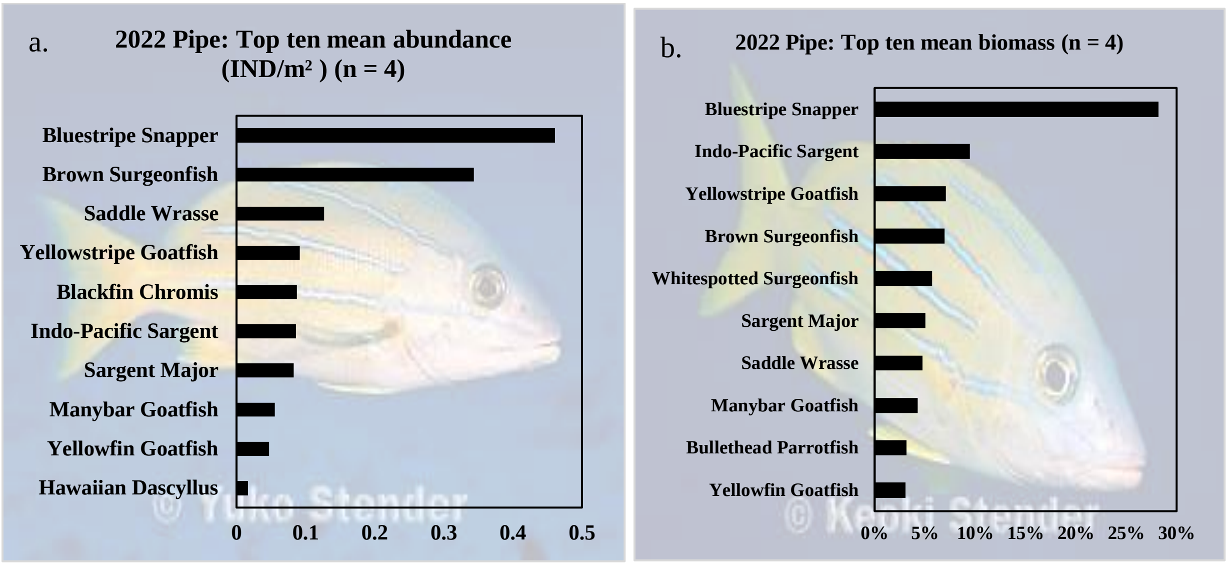
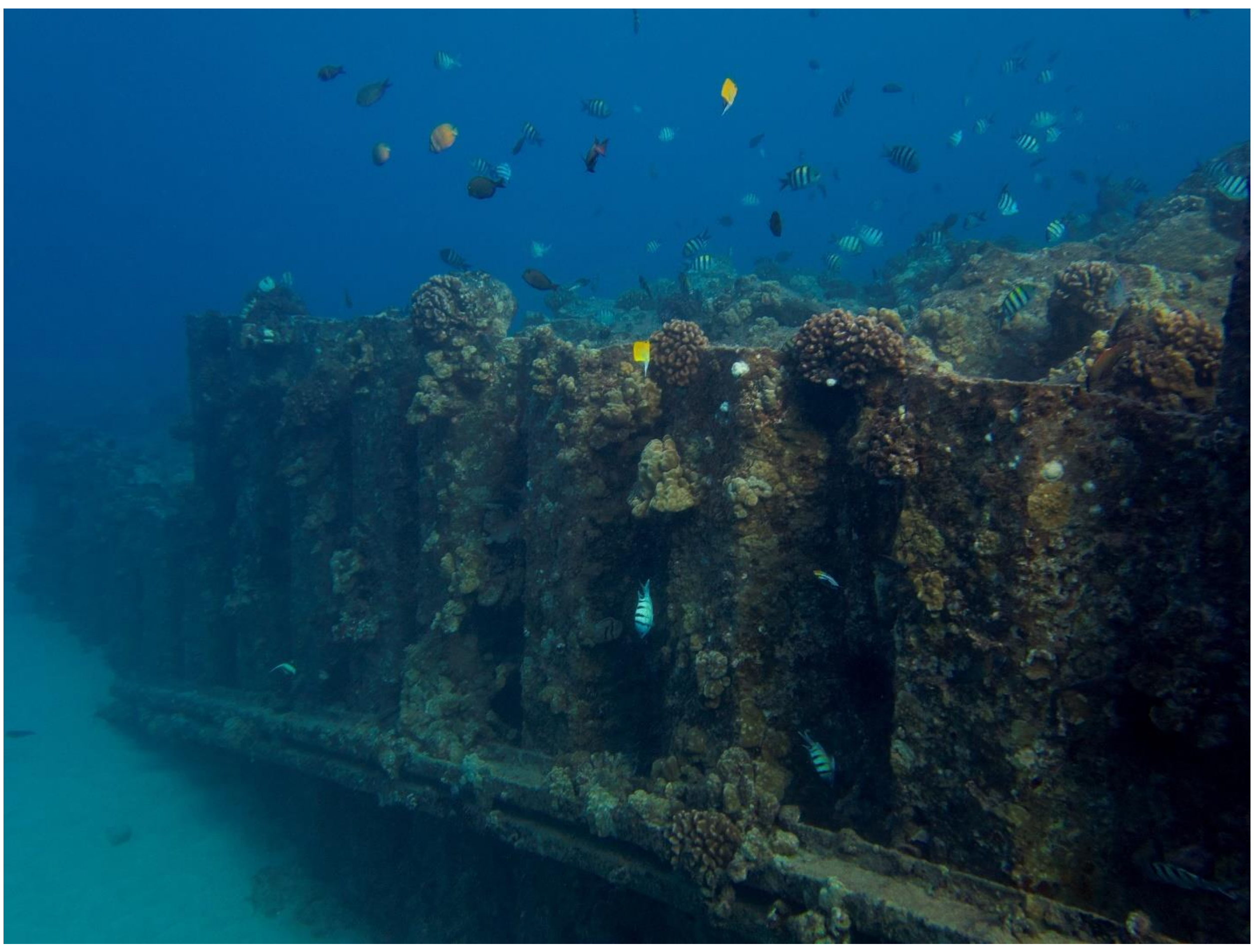


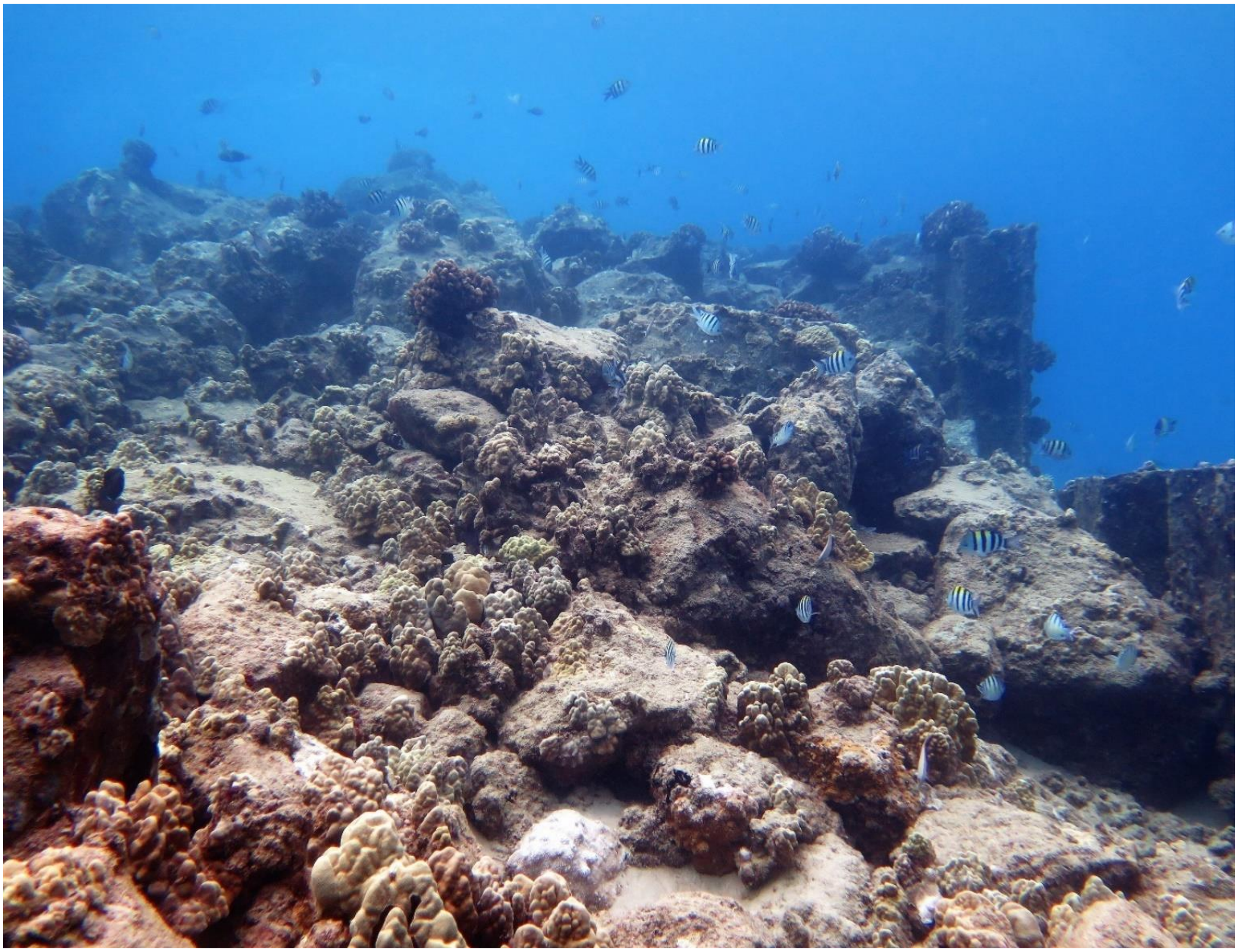
Figure 11. Top ten fishes contributing to mean abundance and biomass at the Pipe transect in 2022.



Field Photo 21. The Pipeline serves as an artificial reef that contains the highest abundance, biomass and species of fishes of all sites surveyed due to its high spatial complexity (October 2022).

Field Photo 22. Chelonia mydas, the Green turtle is listed as threatened under the Endangered Species Act and is found throughout the main Hawaiian Islands (Kahe Pipe, October 2022).

Field Photo 23. The structural formation at the Kahe Pipeline provides support for corals and maintains productive assemblages of various fishes (October 2022)



Field Photo 24. The structural relief and magnitude of cavities on the Kahe Pipe provides the shelter and food resources to support an unusually large and diverse number of fishes and coral species (October 2022).

FOOD FISHES

Twenty-one common species of targeted fishes (Table 4) for hook line and spearfishing as resources of food for the community were assessed for their change in number of fishes and biomass of fishes from 2018 (Brock's survey) through the present 2022 survey.

Table 4. Fishes considered food fishes in analyses.

Scientific Name	Common Name	Hawaiian Name
Acanthurus blochii	Ringtail Surgeonfish	*pualu*
Acanthurus dussumieri	Eye-stripe Surgeonfish	*palani*
Acanthurus nigroris	Bluelined Surgeonfish	*maiko*
Acanthurus triostegus	Convict Tang	*manini*
Aprion virescens	Green Jobfish	*uku*
Calotomus carolinus	Stareye Parrotfish	
Caranx melampygus	Blue Trevally	*omilu*
Cephalopholis argus	Blue-spotted Grouper	
Kyphosus bigibbus	Brown Chub	*nenue*
Kyphosus cinerascens	Highfin Chub	*nenue*
Kyphosus species	Lowfin Chub	*nenue*
Lutjanus fulvus	Blacktail Snapper	*to'au*
Lutjanus kasmira	Bluestripe Snapper	*ta'ape*
Monotaxis grandoculis	Bigeye Emperor	*mu*
Mulloidichthys flavolineatus	Yellowstripe Goatfish	*weke*
Mulloidichthys vanicolensis	Yellowfin Goatfish	*weke 'ula*
Naso lituratus	Orangespine Unicornfish	*umaumalei*
Naso unicornis	Bluespine Unicornfish	*kala*
Parupeneus cyclostomus	Blue Goatfish	*moano kea*
Scarus psittacus	Palenose Parrotfish	*uhu*
Scarus rubroviolaceus	Redlip Parrotfish	*pālukaluka*

In 2018, the percent abundance and biomass of food fishes compared to species of fishes not usually targeted as food was highest at Pipe, followed by East and Ko'Olina, Nanakuli, and Kahe (Figure 12). Throughout 2018 to 2021 survey years, the percentages of food fishes varied, with an overall trend of decreasing within East, Ko'Olina, Nanakuli, and Kahe, while increasing at Pipe. In 2022, all sites increased, not significantly, in biomass of food fish. Despite increases in biomass of food fish, the abundance of food fish remained relatively stable, suggesting there was a similar number of food fishes along transects that were larger in size, when compared to previous years. The increase in food fishes at Pipe, is likely the result of increases in the number of invasive *ta'ape* (*Lutjanus kasmira*, bluestriped snapper) along the transect in more recent years. Some spikes in certain species can be linked to seasonal and annual variability determined by high recruitment. Abundance and biomass of fishes is extremely variable, and therefore, this project will continue to monitor the percentage of food fishes at each transect in future years to determine if there is a pattern of fishing pressure at any particular site. Overall, the only significant difference observed in the ratio of food fish to non-food fish was seen at East 1 transect ($p = 0.029$), with significantly great biomass of food fishes to non-food fishes ratio in 2022 surveys when compared to 2019 surveys. No significant shifts in food fish to non-food fish

rations were noted between surveys during 2022 and 2021. Continuous monitoring of the ratio over time will allow us to monitor for unsustainable fishing practices.

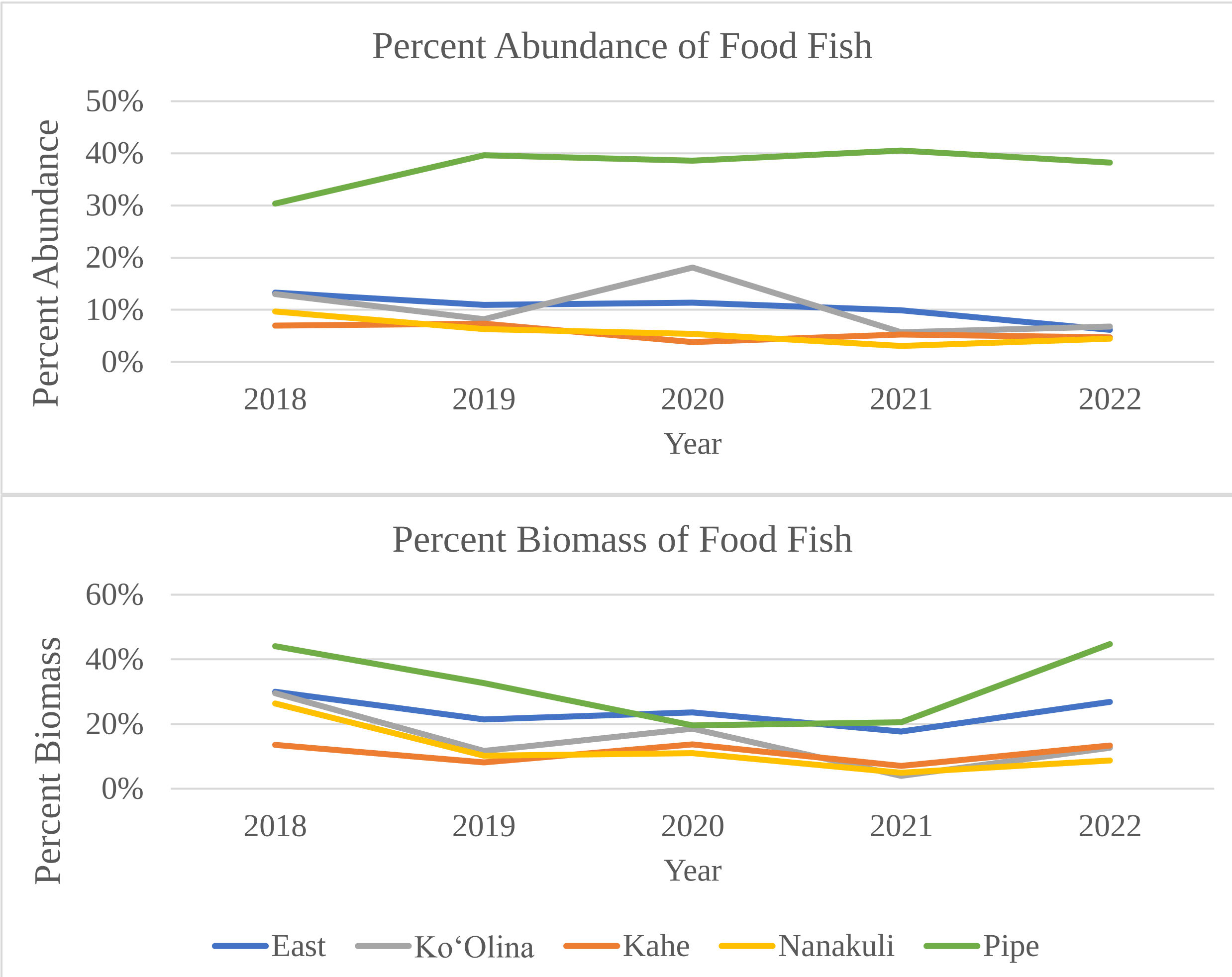


Figure 12. Percent abundance and biomass of food fishes from 2018 through 2022.

SUMMARY

Fish communities surveyed in 2022 remain similar to 2021. The total number of fish species recorded in 2022 surveys (113 species) was similar to that of 2021(101 species) and 2020 surveys (118 species). The dominant species observed in 2022 were similar to those reported in 2021 and 2020: *mā'i'i'i* (*A. nigrofuscus,* brown surgeonfish), blackfin chromis (*C. vanderbilti*), *hīnālea lauwili* (*T. duperrey*, saddle wrasse), and the invasive *ta'ape* (*L. kasmira*, bluestribe snapper). Biomass was dominated by the invasive *ta'ape* (*L. kasmira*, bluestripe snapper), *mā'i'i'i* (*A. nigrofuscus,* brown surgeonfish), *hīnālea lauwili* (*T. duperrey,* saddle wrasse), and *na'ena'e* (*A. olivaceus*, orangeband surgeonfish. In 2021, the biomass was largely made up of the *humuhumuhi'ukole* (*M. vidua*, pinktail durgon), invasive *ta'ape* (*L. kasmira*, bluestripe snapper), *na'ena'e* (*A. olivaceus*, orangeband surgeonfish), *humuhumu'ele'ele* (*M. niger*, black durgon), *mamo* (*A. vaigiensis*, Indo-Pacific sergeant), and *māikoiko* (*A. leucopareius,* whitebar surgeonfish. The only significant shifts in trophic feeding guilds between 2021 and 2020 surveys was at the Pipe transect where zooplanktivorous fishes increased significantly in biomass in 2021 surveys ($p = 0.029$), a subequent significant ($p = 0.029$) decrease in zooplanktivorous fishes at Pipe was observed in 2022. The significant decrease in biomass of herbivorous fishes were detected at Ko'Olina 2, Kahe 7B and Kahe 7E transects ($p = 0.029$), which likely corresponds to the overall decreases in biomass of herbivorous fishes from 49% (2021) dominance to 41% (2022). Of the twelve transects, only East 1 experienced a significant decline in fish individuals since 2021 ($p = 0.039$). Excluding Pipe, which has the highest fish abundance and biomass, East and Ko 'Olina groups have more developed fish communities than the other groups (Kahe and Nanakuli), although not statistically significant. At Ko'Olina, this can be attributed to high spatial relief associated with well-developed fish communities. East, Kahe, and Nanakuli naturally have flatter reef that make the environment less favorable to well-developed fish communities. The 2022 surveys found no significant changes in fish communities that can be attributed to the Hawaiian Electric's KGS or CIP Generating Station facilities.

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APPENDICES

A. Summary of the fish censuses conducted at twelve locations on eight surveys over the 2021-2022 period. Previous survey data can be obtained from past reports (2007-2018 from Brock (2019) (2019-2020 Rodgers et.al.)

Appendix A (2021)

Sample Date	Transect No.	No. Species	No. Individuals	Biomass (g/m2)
10-Jun-21	1	20	246.00	221.5
	3	30	318.00	576.4
	4	21	172.00	42.1
	5	21	240.00	170.5
	6	23	273.00	139.5
	7	21	338.00	141.2
	8	21	260.00	69.4
	9	14	68.00	36.2
	12	20	107.00	90.8
	14	6	48.00	0.3
	15	21	116.00	278.1
	16	54	2082.00	947.9
27-Jul-21	1	18	214.00	430.5
	3	17	142.00	47.5
	4	21	246.00	72.6
	5	12	122.00	112.2
	6	26	250.00	361.1
	7	15	155.00	65.0
	8	18	131.00	32.9
	9	19	97.00	40.0
	12	5	38.00	20.4
	14	7	21.00	3.8
	15	23	364.00	156.4
	16	39	1537.00	1345.8
9-Sep-21	1	11	113.00	38.7
	3	21	172.00	28.0
	4	14	207.00	113.8
	5	15	221.00	84.4
	6	30	210.00	114.6
	7	22	258.00	68.3
	8	25	227.00	45.3
	9	19	287.00	245.0
	12	25	68.00	64.0
	14	6	67.00	2.3
	15	17	111.00	88.6
	16	50	1148.00	898.2
22-Nov-21	1	23	226.00	202.1
	3	24	134.00	152.1
	4	22	347.00	114.0
	5	23	123.00	160.0
	6	27	141.00	170.4
	7	21	193.00	273.8
	8	22	221.00	51.9
	9	19	230.00	85.4
	12	21	340.00	96.1
	14	10	44.00	7.9
	15	23	141.00	399.8
	16	45	1183.00	775.1

Appendix A cont. (2022)

Sample Date	Transect No.	No. Species	No. Individuals	Biomass (g/m^2)
13-May-22	1	17	100.00	32.2
	3	18	84.00	14.2
	4	15	159.00	84.9
	5	19	194.00	46.2
	6	25	220.00	237.4
	7	16	215.00	77.9
	8	32	280.00	53.7
	9	26	122.00	18.3
	12	10	23.00	22.8
	14	14	154.00	5.3
	15	20	107.00	24.8
	16	44	1058.00	377.5
8-Jun-22	1	20	109.00	35.4
	3	19	199.00	44.8
	4	18	275.00	53.8
	5	15	223.00	67.9
	6	23	248.00	153.6
	7	20	223.00	48.8
	8	21	238.00	38.3
	9	24	174.00	20.0
	12	15	89.00	27.9
	14	19	143.00	8.6
	15	19	153.00	100.1
	16	52	1133.00	674.9
19-Aug-22	1	26	107.00	79.6
	3	16	170.00	53.8
	4	18	88.00	38.9
	5	30	318.00	209.0
	6	30	297.00	169.2
	7	21	211.00	100.8
	8	34	360.00	41.1
	9	25	243.00	30.9
	12	19	317.00	32.4
	14	14	74.00	14.4
	15	26	178.00	128.5
	16	55	1535.00	702.0
31-Oct-22	1	21	93.00	42.9
	3	18	186.00	38.3
	4	25	248.00	93.7
	5	16	150.00	96.2
	6	21	155.00	49.1
	7	17	176.00	71.0
	8	23	325.00	41.8
	9	38	224.00	42.3
	12	21	102.00	66.9
	14	12	66.00	6.0
	15	26	220.00	114.9
	16	59	1187.00	726.3

B. Results of fish censuses carried out each of the four 2022 surveys. Trophic categories include Herbivore (H), Corallivore (C), Detritivore (D), Mixed (MI), Piscivore (P), Sessile Invertebrate feeder (SI) and Zooplanktivore (Z). Endemism categories include Endemic (E), Indigenous (I) and Introduced (X).

Date	Transect Name	Species	Number	Average Length (cm)	Biomass (g/m2)	Trophic	Endemism
5/13/22	PIPE	*Acanthurus nigrofuscus*	300	10	34.39	H	I
5/13/22	PIPE	*Abudefduf vaigiensis*	85	13	53.16	Z	I
5/13/22	PIPE	*Abudefduf abdominalis*	85	13	26.87	Z	E
5/13/22	PIPE	*Dascyllus albisella*	15	10	2.54	Z	E
5/13/22	PIPE	*Chromis vanderbilti*	100	4	0.69	Z	I
5/13/22	PIPE	*Parupeneus multifasciatus*	3	15	0.80	MI	I
5/13/22	PIPE	*Parupeneus multifasciatus*	1	10	0.08	MI	I
5/13/22	PIPE	*Chaetodon kleinii*	4	10	0.54	Z	I
5/13/22	PIPE	*Parupeneus pleurostigma*	1	15	0.31	MI	I
5/13/22	PIPE	*Forcipiger flavissimus*	2	13	0.30	SI	I
5/13/22	PIPE	*Sufflamen bursa*	3	18	2.36	MI	I
5/13/22	PIPE	*Myripristis berndti*	1	15	0.36	Z	I
5/13/22	PIPE	*Cantherhines sandwichiensis*	1	13	0.28	H	E
5/13/22	PIPE	*Stegastes fasciolatus*	5	10	0.75	H	I
5/13/22	PIPE	*Gomphosus varius*	4	13	0.52	MI	I
5/13/22	PIPE	*Gomphosus varius*	2	18	0.58	MI	I
5/13/22	PIPE	*Gomphosus varius*	2	10	0.13	MI	I
5/13/22	PIPE	*Stethojulis balteata*	3	13	0.64	MI	E
5/13/22	PIPE	*Stethojulis balteata*	2	10	0.19	MI	E
5/13/22	PIPE	*Myripristis kuntee*	2	13	0.47	Z	I
5/13/22	PIPE	*Zanclus cornutus*	4	18	3.54	SI	I
5/13/22	PIPE	*Parupeneus bifasciatus*	3	15	1.24	MI	I
5/13/22	PIPE	*Parupeneus bifasciatus*	1	10	0.12	MI	I
5/13/22	PIPE	*Halichoeres ornatissimus*	3	13	0.30	MI	I
5/13/22	PIPE	*Chaetodon multicinctus*	5	10	0.73	C	E
5/13/22	PIPE	*Thalassoma trilobatum*	1	23	1.03	MI	I
5/13/22	PIPE	*Thalassoma trilobatum*	1	28	1.85	MI	I
5/13/22	PIPE	*Aulostomus chinensis*	1	46	0.90	P	I
5/13/22	PIPE	*Aulostomus chinensis*	1	30	0.21	P	I
5/13/22	PIPE	*Zebrasoma veliferum*	1	25	2.00	H	I
5/13/22	PIPE	*Pervagor aspricaudus*	9	8	0.48	H	I
5/13/22	PIPE	*Pseudocheilinus tetrataenia*	1	5	0.01	MI	I
5/13/22	PIPE	*Labroides phthirophagus*	2	8	0.03	P	E

5/13/22	PIPE	*Parupeneus multifasciatus*	1	20	0.66	MI	I
5/13/22	PIPE	*Canthigaster jactator*	6	4	0.08	H	E
5/13/22	PIPE	*Ctenochaetus strigosus*	1	10	0.16	D	I
5/13/22	PIPE	*Ctenochaetus strigosus*	1	15	0.55	D	I
5/13/22	PIPE	*Chromis agilis*	1	8	0.06	Z	I
5/13/22	PIPE	*Ostracion meleagris*	1	3	0.00	SI	I
5/13/22	PIPE	*Ostracion meleagris*	1	8	0.08	SI	I
5/13/22	PIPE	*Thalassoma lutenscens*	2	13	3.83	MI	I
5/13/22	PIPE	*Canthigaster amboinensis*	1	5	0.05	H	I
5/13/22	PIPE	*Thalassoma duperrey*	5	10	0.35	MI	E
5/13/22	PIPE	*Thalassoma duperrey*	15	15	3.73	MI	E
5/13/22	PIPE	*Thalassoma duperrey*	25	18	10.98	MI	E
5/13/22	PIPE	*Thalassoma duperrey*	70	13	11.14	MI	E
5/13/22	PIPE	*Thalassoma purpureum*	1	30	2.37	MI	I
5/13/22	PIPE	*Thalassoma purpureum*	2	18	0.91	MI	I
5/13/22	PIPE	*Chromis hanui*	1	5	0.01	Z	E
5/13/22	PIPE	*Lutjanus kasmira*	200	13	34.02	MI	X
5/13/22	PIPE	*Mulloidichthys vanicolensis*	50	18	23.02	MI	I
5/13/22	PIPE	*Macropharyngodon geoffroyi*	1	10	0.12	MI	E
5/13/22	PIPE	*Chlorurus sordidus*	1	28	3.50	H	I
5/13/22	PIPE	*Plectroglyphidodon johnstonianus*	3	5	0.05	C	I
5/13/22	PIPE	*Plectroglyphidodon johnstonianus*	4	8	0.30	C	I
5/13/22	PIPE	*Paracirrhites arcatus*	4	8	0.23	MI	I
5/13/22	PIPE	*Paracirrhites arcatus*	2	10	0.27	MI	I
5/13/22	PIPE	*Thalassoma quinquevittatum*	1	13	0.16	MI	I
5/13/22	PIPE	*Thalassoma quinquevittatum*	1	15	0.25	MI	I
5/13/22	PIPE	*Cirrhitops fasciatus*	1	8	0.05	MI	I
5/13/22	PIPE	*Naso annulatus*	2	30	4.47	Z	I
5/13/22	1D	*Acanthurus nigrofuscus*	70	10	8.02	H	I
5/13/22	1D	*Thalassoma duperrey*	40	10	2.81	MI	E
5/13/22	1D	*Thalassoma duperrey*	10	15	2.49	MI	E
5/13/22	1D	*Thalassoma duperrey*	30	13	4.77	MI	E
5/13/22	1D	*Ctenochaetus strigosus*	25	10	3.90	D	I
5/13/22	1D	*Ctenochaetus strigosus*	10	15	5.52	D	I
5/13/22	1D	*Ctenochaetus strigosus*	1	5	0.02	D	I
5/13/22	1D	*Forcipiger flavissimus*	1	13	0.15	SI	I
5/13/22	1D	*Melichthys niger*	7	23	12.83	H	I
5/13/22	1D	*Canthigaster jactator*	2	5	0.05	H	E
5/13/22	1D	*Canthigaster jactator*	2	3	0.01	H	E
5/13/22	1D	*Sufflamen bursa*	3	18	2.36	MI	I
5/13/22	1D	*Acanthurus olivaceus*	2	13	0.42	H	I

5/13/22	1D	*Parupeneus multifasciatus*	2	15	0.54	MI	I
5/13/22	1D	*Parupeneus multifasciatus*	1	8	0.04	MI	I
5/13/22	1D	*Parupeneus cyclostomus*	1	18	0.94	P	I
5/13/22	1D	*Parupeneus bifasciatus*	1	10	0.12	MI	I
5/13/22	1D	*Chlorurus sordidus*	1	28	3.50	H	I
5/13/22	1D	*Chlorurus sordidus*	1	15	0.43	H	I
5/13/22	1D	*Stegastes fasciolatus*	1	8	0.08	H	I
5/13/22	1D	*Stethojulis balteata*	2	8	0.09	MI	E
5/13/22	1D	*Acanthurus nigroris*	1	13	0.24	H	I
5/13/22	1D	*Ostracion meleagris*	1	5	0.02	SI	I
5/13/22	7E	*Sufflamen bursa*	3	18	2.36	MI	I
5/13/22	7E	*Canthigaster jactator*	1	5	0.02	H	E
5/13/22	7E	*Acanthurus triostegus*	10	15	4.10	H	I
5/13/22	7E	*Acanthurus olivaceus*	2	23	2.39	H	I
5/13/22	7E	*Naso lituratus*	2	20	1.62	H	I
5/13/22	7E	*Parupeneus multifasciatus*	1	18	0.47	MI	I
5/13/22	7E	*Cantherhines sandwichiensis*	1	13	0.28	H	E
5/13/22	7E	*Acanthurus nigroris*	1	15	0.36	H	I
5/13/22	7E	*Melichthys vidua*	1	18	1.12	H	I
5/13/22	7E	*Sufflamen fraenatus*	1	23	1.58	MI	I
5/13/22	NANA1	*Chromis vanderbilti*	110	3	0.32	Z	I
5/13/22	NANA1	*Canthigaster jactator*	3	5	0.07	H	E
5/13/22	NANA1	*Ctenochaetus strigosus*	1	3	0.00	D	I
5/13/22	NANA1	*Plectroglyphidodon imparipennis*	7	3	0.03	MI	I
5/13/22	NANA1	*Thalassoma duperrey*	10	13	1.59	MI	E
5/13/22	NANA1	*Thalassoma duperrey*	3	5	0.02	MI	E
5/13/22	NANA1	*Thalassoma duperrey*	2	3	0.00	MI	E
5/13/22	NANA1	*Thalassoma trilobatum*	1	10	0.09	MI	I
5/13/22	NANA1	*Thalassoma trilobatum*	1	13	0.19	MI	I
5/13/22	NANA1	*Stegastes fasciolatus*	1	3	0.00	H	I
5/13/22	NANA1	*Cirrhitops fasciatus*	2	8	0.10	MI	I
5/13/22	NANA1	*Stethojulis balteata*	2	8	0.09	MI	E
5/13/22	NANA1	*Plagiotremus goslinei*	4	5	0.01	P	E
5/13/22	NANA1	*Plectroglyphidodon johnstonianus*	2	3	0.01	C	I
5/13/22	NANA1	*Stethojulis balteata*	2	8	0.09	MI	E
5/13/22	NANA1	*Cirripectes vanderbilti*	1	5	0.01	H	E
5/13/22	NANA1	*Acanthurus nigroris*	1	5	0.02	H	I
5/13/22	NANA1	*Gymnothorax meleagris*	1	51	0.70	P	I
5/13/22	NANA2	*Rhinecanthus rectangulus*	1	18	0.79	MI	I
5/13/22	NANA2	*Sufflamen bursa*	1	18	0.79	MI	I
5/13/22	NANA2	*Acanthurus nigrofuscus*	45	10	5.16	H	I

5/13/22	NANA2	*Zebrasoma flavescens*	1	8	0.12	H	I
5/13/22	NANA2	*Zebrasoma flavescens*	2	5	0.07	H	I
5/13/22	NANA2	*Zebrasoma flavescens*	2	15	1.12	H	I
5/13/22	NANA2	*Gymnothorax meleagris*	1	51	0.70	P	I
5/13/22	NANA2	*Gomphosus varius*	2	15	0.37	MI	I
5/13/22	NANA2	*Forcipiger flavissimus*	1	13	0.15	SI	I
5/13/22	NANA2	*Melichthys vidua*	1	23	2.11	H	I
5/13/22	NANA2	*Canthigaster jactator*	5	6	0.18	H	E
5/13/22	NANA2	*Plectroglyphidodon johnstonianus*	3	5	0.05	C	I
5/13/22	NANA2	*Chromis vanderbilti*	20	3	0.06	Z	I
5/13/22	NANA2	*Parupeneus cyclostomus*	1	10	0.10	P	I
5/13/22	NANA2	*Lutjanus fulvus*	3	20	1.26	MI	X
5/13/22	NANA2	*Paracirrhites forsteri*	1	15	0.34	P	I
5/13/22	NANA2	*Thalassoma duperrey*	5	13	0.80	MI	E
5/13/22	NANA2	*Thalassoma duperrey*	5	10	0.35	MI	E
5/13/22	NANA2	*Labroides phthirophagus*	1	8	0.02	P	E
5/13/22	NANA2	*Chaetodon quadrimaculatus*	1	10	0.17	C	I
5/13/22	NANA2	*Stethojulis balteata*	1	10	0.09	MI	E
5/13/22	NANA2	*Ctenochaetus strigosus*	1	13	0.35	D	I
5/13/22	NANA2	*Ctenochaetus strigosus*	1	10	0.16	D	I
5/13/22	NANA2	*Ctenochaetus strigosus*	1	8	0.08	D	I
5/13/22	NANA2	*Monotaxis grandoculis*	1	13	0.22	MI	I
5/13/22	E1	*Canthigaster jactator*	2	3	0.01	H	E
5/13/22	E1	*Thalassoma duperrey*	2	5	0.02	MI	E
5/13/22	E1	*Thalassoma duperrey*	4	10	0.28	MI	E
5/13/22	E1	*Plectroglyphidodon imparipennis*	4	3	0.01	MI	I
5/13/22	E1	*Plectroglyphidodon johnstonianus*	3	5	0.05	C	I
5/13/22	E1	*Acanthurus dussumieri*	8	25	6.16	H	I
5/13/22	E1	*Acanthurus dussumieri*	4	30	5.32	H	I
5/13/22	E1	*Acanthurus olivaceus*	5	20	3.90	H	I
5/13/22	E1	*Paracirrhites forsteri*	1	10	0.10	P	I
5/13/22	E1	*Lutjanus fulvus*	1	18	0.31	MI	X
5/13/22	E1	*Acanthurus triostegus*	5	15	2.05	H	I
5/13/22	E1	*Acanthurus triostegus*	2	13	0.50	H	I
5/13/22	E1	*Parupeneus multifasciatus*	1	18	0.47	MI	I
5/13/22	E1	*Acanthurus nigrofuscus*	20	0	0.00	H	I
5/13/22	E1	*Acanthurus nigrofuscus*	5	8	0.30	H	I
5/13/22	E1	*Acanthurus nigroris*	1	8	0.06	H	I
5/13/22	E1	*Chromis vanderbilti*	25	3	0.07	Z	I
5/13/22	E1	*Rhinecanthus rectangulus*	1	15	0.47	MI	I

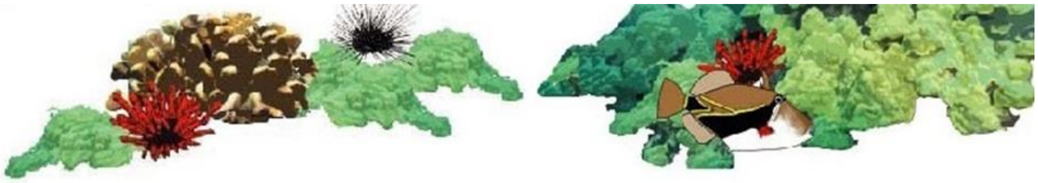
5/13/22	E1	*Halichoeres ornatissimus*	1	8	0.04	MI	I
5/13/22	E1	*Labroides phthirophagus*	2	8	0.03	P	E
5/13/22	E1	*Labroides phthirophagus*	1	3	0.00	P	E
5/13/22	E1	*Plagiotremus goslinei*	2	5	0.00	P	E
5/13/22	E3	*Bodianus bilunulatus*	1	15	0.32	MI	I
5/13/22	E3	*Canthigaster jactator*	1	5	0.02	H	E
5/13/22	E3	*Thalassoma duperrey*	5	13	0.80	MI	E
5/13/22	E3	*Thalassoma duperrey*	1	8	0.03	MI	E
5/13/22	E3	*Thalassoma duperrey*	15	10	1.05	MI	E
5/13/22	E3	*Acanthurus nigrofuscus*	25	10	2.87	H	I
5/13/22	E3	*Ctenochaetus strigosus*	3	10	0.47	D	I
5/13/22	E3	*Acanthurus nigroris*	1	8	0.06	H	I
5/13/22	E3	*Plectroglyphidodon johnstonianus*	4	5	0.07	C	I
5/13/22	E3	*Plectroglyphidodon johnstonianus*	1	8	0.08	C	I
5/13/22	E3	*Chromis vanderbilti*	15	3	0.04	Z	I
5/13/22	E3	*Halichoeres ornatissimus*	2	10	0.12	MI	I
5/13/22	E3	*Parupeneus bifasciatus*	1	10	0.12	MI	I
5/13/22	E3	*Gomphosus varius*	1	10	0.07	MI	I
5/13/22	E3	*Stethojulis balteata*	1	8	0.05	MI	E
5/13/22	E3	*Paracirrhites arcatus*	2	8	0.12	MI	I
5/13/22	E3	*Stegastes fasciolatus*	1	8	0.08	H	I
5/13/22	E3	*Sufflamen bursa*	1	18	0.79	MI	I
5/13/22	E3	*Scarus rubroviolaceus*	1	10	0.15	H	I
5/13/22	E3	*Macropharyngodon geoffroyi*	1	10	0.12	MI	E
5/13/22	E3	*Scarus psittacus*	1	23	1.65	H	I
5/13/22	E4	*Acanthurus olivaceus*	15	28	32.67	H	I
5/13/22	E4	*Bodianus bilunulatus*	1	36	4.84	MI	I
5/13/22	E4	*Acanthurus nigrofuscus*	35	10	4.01	H	I
5/13/22	E4	*Plectroglyphidodon johnstonianus*	2	5	0.04	C	I
5/13/22	E4	*Paracirrhites arcatus*	4	8	0.23	MI	I
5/13/22	E4	*Canthigaster jactator*	6	5	0.14	H	E
5/13/22	E4	*Synodus binotatus*	1	8	0.02	P	I
5/13/22	E4	*Synodus binotatus*	1	13	0.09	P	I
5/13/22	E4	*Stethojulis balteata*	1	10	0.09	MI	E
5/13/22	E4	*Chromis vanderbilti*	50	4	0.34	Z	I
5/13/22	E4	*Halichoeres ornatissimus*	2	10	0.12	MI	I
5/13/22	E4	*Thalassoma duperrey*	15	8	0.52	MI	E
5/13/22	E4	*Thalassoma duperrey*	5	13	0.80	MI	E
5/13/22	E4	*Thalassoma duperrey*	15	10	1.05	MI	E
5/13/22	E4	*Parupeneus multifasciatus*	1	13	0.17	MI	I

5/13/22	E4	*Acanthurus nigroris*	1	8	0.06	H	I
5/13/22	E4	*Coris gaimard*	1	25	1.30	MI	I
5/13/22	E4	*Coris gaimard*	1	30	2.36	MI	I
5/13/22	E4	*Melichthys vidua*	2	23	4.22	H	I
5/13/22	KO1	*Chaetodon multicinctus*	4	10	0.59	C	E
5/13/22	KO1	*Plectroglyphidodon johnstonianus*	5	5	0.09	C	I
5/13/22	KO1	*Ctenochaetus strigosus*	35	10	5.46	D	I
5/13/22	KO1	*Ctenochaetus strigosus*	30	13	10.61	D	I
5/13/22	KO1	*Stegastes fasciolatus*	1	8	0.08	H	I
5/13/22	KO1	*Acanthurus nigrofuscus*	30	10	3.44	H	I
5/13/22	KO1	*Thalassoma duperrey*	20	13	3.18	MI	E
5/13/22	KO1	*Thalassoma duperrey*	35	10	2.46	MI	E
5/13/22	KO1	*Thalassoma duperrey*	1	15	0.25	MI	E
5/13/22	KO1	*Canthigaster jactator*	5	3	0.03	H	E
5/13/22	KO1	*Canthigaster jactator*	1	5	0.02	H	E
5/13/22	KO1	*Chromis vanderbilti*	10	3	0.03	Z	I
5/13/22	KO1	*Labroides phthirophagus*	2	8	0.03	P	E
5/13/22	KO1	*Stethojulis balteata*	2	10	0.19	MI	E
5/13/22	KO1	*Cirripectes vanderbilti*	2	5	0.01	H	E
5/13/22	KO1	*Sufflamen bursa*	1	18	0.79	MI	I
5/13/22	KO1	*Chaetodon quadrimaculatus*	1	13	0.39	C	I
5/13/22	KO1	*Gomphosus varius*	1	8	0.04	MI	I
5/13/22	KO1	*Lutjanus fulvus*	1	15	0.18	MI	X
5/13/22	KO1	*Thalassoma ballieui*	1	15	0.27	MI	E
5/13/22	KO1	*Parupeneus multifasciatus*	4	13	0.69	MI	I
5/13/22	KO1	*Canthigaster amboinensis*	1	5	0.05	H	I
5/13/22	KO1	*Paracirrhites arcatus*	1	8	0.06	MI	I
5/13/22	KO2	*Plectroglyphidodon imparipennis*	1	3	0.00	MI	I
5/13/22	KO2	*Plectroglyphidodon johnstonianus*	4	5	0.07	C	I
5/13/22	KO2	*Acanthurus nigrofuscus*	1	8	0.06	H	I
5/13/22	KO2	*Acanthurus nigrofuscus*	20	10	2.29	H	I
5/13/22	KO2	*Chaetodon ephippium*	1	20	1.04	MI	I
5/13/22	KO2	*Ctenochaetus strigosus*	15	15	8.29	D	I
5/13/22	KO2	*Ctenochaetus strigosus*	15	13	5.30	D	I
5/13/22	KO2	*Acanthurus leucopareius*	10	23	21.61	H	I
5/13/22	KO2	*Thalassoma duperrey*	15	10	1.05	MI	E
5/13/22	KO2	*Thalassoma duperrey*	15	13	2.39	MI	E
5/13/22	KO2	*Thalassoma duperrey*	15	8	0.52	MI	E
5/13/22	KO2	*Chaetodon unimaculatus*	2	13	0.74	C	I
5/13/22	KO2	*Chaetodon multicinctus*	4	10	0.59	C	E

5/13/22	KO2	*Melichthys niger*	5	23	9.16	H	I
5/13/22	KO2	*Cephalopholis argus*	1	33	3.14	P	X
5/13/22	KO2	*Labroides phthirophagus*	1	8	0.02	P	E
5/13/22	KO2	*Naso lituratus*	1	18	0.58	H	I
5/13/22	KO2	*Canthigaster jactator*	3	5	0.07	H	E
5/13/22	KO2	*Canthigaster jactator*	1	3	0.01	H	E
5/13/22	KO2	*Sufflamen bursa*	1	18	0.79	MI	I
5/13/22	KO2	*Acanthurus leucopareius*	12	25	33.53	H	I
5/13/22	KO2	*Thalassoma lutenscens*	1	13	1.91	MI	I
5/13/22	KO2	*Acanthurus triostegus*	45	15	18.44	H	I
5/13/22	KO2	*Gomphosus varius*	2	10	0.13	MI	I
5/13/22	KO2	*Zebrasoma flavescens*	1	13	0.39	H	I
5/13/22	KO2	*Zebrasoma flavescens*	2	10	0.41	H	I
5/13/22	KO2	*Zebrasoma flavescens*	1	5	0.04	H	I
5/13/22	KO2	*Zebrasoma flavescens*	2	8	0.23	H	I
5/13/22	KO2	*Acanthurus nigricans*	2	15	0.65	H	I
5/13/22	KO2	*Chaetodon ornatissimus*	2	20	3.03	C	I
5/13/22	KO2	*Scarus rubroviolaceus*	1	33	5.20	H	I
5/13/22	KO2	*Scarus rubroviolaceus*	1	28	3.19	H	I
5/13/22	KO2	*Acanthurus olivaceus*	15	28	32.67	H	I
5/13/22	KO2	*Stegastes fasciolatus*	1	8	0.08	H	I
5/13/22	KO2	*Ostracion meleagris*	1	8	0.08	SI	I
5/13/22	5B	*Acanthurus nigrofuscus*	60	10	6.88	H	I
5/13/22	5B	*Acanthurus nigrofuscus*	20	8	1.21	H	I
5/13/22	5B	*Sufflamen bursa*	2	18	1.57	MI	I
5/13/22	5B	*Chaetodon multicinctus*	1	8	0.07	C	E
5/13/22	5B	*Chlorurus sordidus*	1	20	1.13	H	I
5/13/22	5B	*Thalassoma duperrey*	15	10	1.05	MI	E
5/13/22	5B	*Thalassoma duperrey*	5	13	0.80	MI	E
5/13/22	5B	*Thalassoma duperrey*	2	15	0.50	MI	E
5/13/22	5B	*Gomphosus varius*	2	18	0.58	MI	I
5/13/22	5B	*Gomphosus varius*	2	13	0.26	MI	I
5/13/22	5B	*Gomphosus varius*	1	15	0.18	MI	I
5/13/22	5B	*Canthigaster jactator*	3	5	0.07	H	E
5/13/22	5B	*Canthigaster jactator*	2	3	0.01	H	E
5/13/22	5B	*Thalassoma lutenscens*	1	13	1.91	MI	I
5/13/22	5B	*Pervagor aspricaudus*	3	8	0.16	H	I
5/13/22	5B	*Parupeneus bifasciatus*	1	15	0.41	MI	I
5/13/22	5B	*Coris venusta*	1	13	0.16	MI	E
5/13/22	5B	*Paracirrhites arcatus*	3	5	0.03	MI	I
5/13/22	5B	*Fistularia commersonii*	1	38	0.14	P	I

5/13/22	5B	*Scarus psittacus*	1	13	0.25	H	I
5/13/22	5B	*Mulloidichthys flavolineatus*	15	18	6.33	MI	I
5/13/22	5B	*Abudefduf vaigiensis*	5	13	3.13	Z	I
5/13/22	5B	*Chaetodon multicinctus*	2	10	0.29	C	E
5/13/22	5B	*Canthigaster amboinensis*	1	5	0.05	H	I
5/13/22	5B	*Abudefduf abdominalis*	5	13	1.58	Z	E
5/13/22	5B	*Plectroglyphidodon imparipennis*	5	3	0.02	MI	I
5/13/22	5B	*Naso lituratus*	1	13	0.21	H	I
5/13/22	5B	*Naso lituratus*	1	10	0.09	H	I
5/13/22	5B	*Cantherhines sandwichiensis*	1	10	0.14	H	E
5/13/22	5B	*Cantherhines sandwichiensis*	1	13	0.28	H	E
5/13/22	5B	*Ostracion meleagris*	1	8	0.08	SI	I
5/13/22	5B	*Rhinecanthus rectangulus*	2	18	1.57	MI	I
5/13/22	5B	*Chromis vanderbilti*	90	4	0.62	Z	I
5/13/22	5B	*Acanthurus olivaceus*	2	18	1.13	H	I
5/13/22	5B	*Acanthurus olivaceus*	2	15	0.65	H	I
5/13/22	5B	*Cirrhitops fasciatus*	1	8	0.05	MI	I
5/13/22	5B	*Parupeneus multifasciatus*	2	13	0.34	MI	I
5/13/22	5B	*Parupeneus multifasciatus*	1	10	0.08	MI	I
5/13/22	5B	*Plectroglyphidodon johnstonianus*	4	5	0.07	C	I
5/13/22	5B	*Dascyllus albisella*	1	10	0.17	Z	E
5/13/22	5B	*Halichoeres ornatissimus*	3	8	0.12	MI	I
5/13/22	5B	*Chaetodon quadrimaculatus*	1	8	0.08	C	I
5/13/22	5B	*Chaetodon quadrimaculatus*	2	10	0.34	C	I
5/13/22	5B	*Plectroglyphidodon johnstonianus*	2	8	0.15	C	I
5/13/22	5B	*Paracirrhites forsteri*	1	10	0.10	P	I
5/13/22	5B	*Paracirrhites forsteri*	1	15	0.34	P	I
5/13/22	7B	*Chromis vanderbilti*	70	4	0.48	Z	I
5/13/22	7B	*Dascyllus albisella*	10	10	1.70	Z	E
5/13/22	7B	*Dascyllus albisella*	1	3	0.00	Z	E
5/13/22	7B	*Acanthurus nigrofuscus*	5	10	0.57	H	I
5/13/22	7B	*Aulostomus chinensis*	1	23	0.08	P	I
5/13/22	7B	*Abudefduf abdominalis*	2	13	0.63	Z	E
5/13/22	7B	*Halichoeres ornatissimus*	1	10	0.06	MI	I
5/13/22	7B	*Halichoeres ornatissimus*	1	8	0.04	MI	I
5/13/22	7B	*Lutjanus kasmira*	1	13	0.17	MI	X
5/13/22	7B	*Mulloidichthys flavolineatus*	1	18	0.42	MI	I
5/13/22	7B	*Canthigaster jactator*	2	5	0.05	H	E
5/13/22	7B	*Gymnothorax meleagris*	1	36	0.23	P	I
5/13/22	7B	*Acanthurus olivaceus*	2	23	2.39	H	I

5/13/22	7B	*Calotomus carolinus*	1	18	0.55	H	I
5/13/22	7B	*Gomphosus varius*	2	15	0.37	MI	I
5/13/22	7B	*Ctenochaetus strigosus*	2	3	0.01	D	I
5/13/22	7B	*Zebrasoma flavescens*	1	5	0.04	H	I
5/13/22	7B	*Plectroglyphidodon imparipennis*	1	3	0.00	MI	I
5/13/22	7B	*Cirrhitops fasciatus*	1	8	0.05	MI	I
5/13/22	7B	*Cantherhines sandwichiensis*	1	13	0.28	H	E
5/13/22	7B	*Labroides phthirophagus*	1	5	0.00	P	E
5/13/22	7B	*Naso lituratus*	1	18	0.58	H	I
5/13/22	7B	*Melichthys vidua*	1	18	1.12	H	I
5/13/22	7B	*Acanthurus nigroris*	2	13	0.48	H	I
5/13/22	7B	*Acanthurus nigroris*	1	3	0.00	H	I
5/13/22	7B	*Parupeneus multifasciatus*	1	13	0.17	MI	I
5/13/22	7B	*Parupeneus multifasciatus*	1	15	0.27	MI	I
5/13/22	7B	*Thalassoma duperrey*	1	13	0.16	MI	E
5/13/22	7B	*Thalassoma duperrey*	1	15	0.25	MI	E
5/13/22	7B	*Thalassoma duperrey*	1	5	0.01	MI	E
5/13/22	7B	*Plectroglyphidodon johnstonianus*	3	5	0.05	C	I
5/13/22	7B	*Monotaxis grandoculis*	1	13	0.22	MI	I
6/8/22	E1	*Canthigaster jactator*	3	3	0.02	H	E
6/8/22	E1	*Canthigaster jactator*	2	5	0.05	H	E
6/8/22	E1	*Caranx melampygus*	3	23	3.34	P	I
6/8/22	E1	*Parupeneus multifasciatus*	1	18	0.47	MI	I
6/8/22	E1	*Plectroglyphidodon johnstonianus*	1	5	0.02	C	I
6/8/22	E1	*Plectroglyphidodon imparipennis*	4	3	0.01	MI	I
6/8/22	E1	*Acanthurus nigrofuscus*	2	8	0.12	H	I
6/8/22	E1	*Acanthurus nigrofuscus*	25	10	2.87	H	I
6/8/22	E1	*Acanthurus blochii*	6	28	6.49	H	I
6/8/22	E1	*Chaetodon lunula*	1	20	0.81	SI	I
6/8/22	E1	*Acanthurus dussumieri*	1	28	1.08	H	I
6/8/22	E1	*Plagiotremus goslinei*	2	5	0.00	P	E
6/8/22	E1	*Lutjanus fulvus*	2	20	0.84	MI	X
6/8/22	E1	*Labroides phthirophagus*	5	8	0.08	P	E
6/8/22	E1	*Labroides phthirophagus*	1	3	0.00	P	E
6/8/22	E1	*Naso annulatus*	1	25	1.33	Z	I
6/8/22	E1	*Halichoeres ornatissimus*	1	8	0.04	MI	I
6/8/22	E1	*Halichoeres ornatissimus*	3	1	0.00	MI	I
6/8/22	E1	*Thalassoma duperrey*	10	10	0.70	MI	E
6/8/22	E1	*Thalassoma duperrey*	2	13	0.32	MI	E
6/8/22	E1	*Thalassoma duperrey*	1	15	0.25	MI	E



6/8/22	E1	*Chromis vanderbilti*	25	3	0.07	Z	I
6/8/22	E1	*Acanthurus triostegus*	3	15	1.23	H	I
6/8/22	E1	*Acanthurus triostegus*	1	3	0.00	H	I
6/8/22	E1	*Naso lituratus*	1	23	1.25	H	I
6/8/22	E1	*Rhinecanthus rectangulus*	1	18	0.79	MI	I
6/8/22	E1	*Coris flavovittata*	1	3	0.00	MI	E
6/8/22	E3	*Plectroglyphidodon johnstonianus*	5	5	0.09	C	I
6/8/22	E3	*Plectroglyphidodon johnstonianus*	2	8	0.15	C	I
6/8/22	E3	*Paracirrhites arcatus*	3	8	0.17	MI	I
6/8/22	E3	*Acanthurus nigrofuscus*	45	10	5.16	H	I
6/8/22	E3	*Acanthurus nigrofuscus*	45	8	2.73	H	I
6/8/22	E3	*Thalassoma duperrey*	35	13	5.57	MI	E
6/8/22	E3	*Thalassoma duperrey*	35	10	2.46	MI	E
6/8/22	E3	*Sufflamen bursa*	1	18	0.79	MI	I
6/8/22	E3	*Chaetodon ornatissimus*	2	18	2.19	C	I
6/8/22	E3	*Canthigaster jactator*	3	5	0.07	H	E
6/8/22	E3	*Stegastes fasciolatus*	2	8	0.15	H	I
6/8/22	E3	*Melichthys vidua*	1	23	2.11	H	I
6/8/22	E3	*Chaetodon multicinctus*	2	10	0.29	C	E
6/8/22	E3	*Stethojulis balteata*	4	10	0.37	MI	E
6/8/22	E3	*Bodianus bilunulatus*	1	28	2.22	MI	I
6/8/22	E3	*Ctenochaetus strigosus*	6	8	0.47	D	I
6/8/22	E3	*Ctenochaetus strigosus*	1	10	0.16	D	I
6/8/22	E3	*Macropharyngodon geoffroyi*	1	8	0.06	MI	E
6/8/22	E3	*Parupeneus bifasciatus*	1	10	0.12	MI	I
6/8/22	E3	*Canthigaster amboinensis*	1	8	0.14	H	I
6/8/22	E3	*Halichoeres ornatissimus*	1	13	0.10	MI	I
6/8/22	E3	*Gymnothorax meleagris*	1	75	2.44	P	I
6/8/22	E3	*Pseudocheilinus octotaenia*	1	10	0.09	MI	I
6/8/22	E4	*Stethojulis balteata*	2	10	0.19	MI	E
6/8/22	E4	*Melichthys vidua*	1	23	2.11	H	I
6/8/22	E4	*Chaetodon multicinctus*	1	8	0.07	C	E
6/8/22	E4	*Rhinecanthus rectangulus*	1	18	0.79	MI	I
6/8/22	E4	*Pseudocheilinus tetrataenia*	1	5	0.01	MI	I
6/8/22	E4	*Chromis vanderbilti*	60	3	0.18	Z	I
6/8/22	E4	*Plectroglyphidodon imparipennis*	1	3	0.00	MI	I
6/8/22	E4	*Canthigaster jactator*	6	5	0.14	H	E
6/8/22	E4	*Ctenochaetus strigosus*	1	10	0.16	D	I
6/8/22	E4	*Ctenochaetus strigosus*	2	5	0.04	D	I
6/8/22	E4	*Acanthurus nigrofuscus*	45	10	5.16	H	I

6/8/22	E4	*Acanthurus nigrofuscus*	45	8	2.73	H	I
6/8/22	E4	*Gomphosus varius*	1	15	0.18	MI	I
6/8/22	E4	*Acanthurus olivaceus*	4	28	8.71	H	I
6/8/22	E4	*Halichoeres ornatissimus*	2	10	0.12	MI	I
6/8/22	E4	*Paracirrhites arcatus*	5	8	0.29	MI	I
6/8/22	E4	*Melichthys niger*	1	23	1.83	H	I
6/8/22	E4	*Plectroglyphidodon johnstonianus*	3	5	0.05	C	I
6/8/22	E4	*Parupeneus multifasciatus*	2	15	0.54	MI	I
6/8/22	E4	*Parupeneus multifasciatus*	1	10	0.08	MI	I
6/8/22	E4	*Thalassoma duperrey*	45	13	7.16	MI	E
6/8/22	E4	*Thalassoma duperrey*	45	10	3.16	MI	E
6/8/22	KO1	*Ctenochaetus strigosus*	35	13	12.37	D	I
6/8/22	KO1	*Ctenochaetus strigosus*	35	10	5.46	D	I
6/8/22	KO1	*Ctenochaetus strigosus*	5	15	2.76	D	I
6/8/22	KO1	*Thalassoma duperrey*	35	13	5.57	MI	E
6/8/22	KO1	*Thalassoma duperrey*	35	10	2.46	MI	E
6/8/22	KO1	*Thalassoma duperrey*	1	5	0.01	MI	E
6/8/22	KO1	*Chaetodon multicinctus*	4	10	0.59	C	E
6/8/22	KO1	*Melichthys niger*	3	23	5.50	H	I
6/8/22	KO1	*Pseudocheilinus tetrataenia*	1	3	0.00	MI	I
6/8/22	KO1	*Acanthurus nigrofuscus*	35	10	4.01	H	I
6/8/22	KO1	*Acanthurus nigrofuscus*	20	8	1.21	H	I
6/8/22	KO1	*Thalassoma ballieui*	1	20	0.66	MI	E
6/8/22	KO1	*Cirrhitops fasciatus*	1	8	0.05	MI	I
6/8/22	KO1	*Chaetodon quadrimaculatus*	2	13	0.77	C	I
6/8/22	KO1	*Plectroglyphidodon johnstonianus*	4	5	0.07	C	I
6/8/22	KO1	*Chaetodon unimaculatus*	2	13	0.74	C	I
6/8/22	KO1	*Stegastes fasciolatus*	1	8	0.08	H	I
6/8/22	KO1	*Canthigaster jactator*	1	5	0.02	H	E
6/8/22	KO1	*Gomphosus varius*	1	13	0.13	MI	I
6/8/22	KO1	*Zebrasoma flavescens*	1	5	0.04	H	I
6/8/22	KO2	*Sufflamen bursa*	5	18	3.93	MI	I
6/8/22	KO2	*Chromis vanderbilti*	5	3	0.01	Z	I
6/8/22	KO2	*Thalassoma duperrey*	15	13	2.39	MI	E
6/8/22	KO2	*Thalassoma duperrey*	25	10	1.75	MI	E
6/8/22	KO2	*Thalassoma duperrey*	2	15	0.50	MI	E
6/8/22	KO2	*Acanthurus nigrofuscus*	55	10	6.30	H	I
6/8/22	KO2	*Plectroglyphidodon imparipennis*	2	3	0.01	MI	I
6/8/22	KO2	*Plectroglyphidodon johnstonianus*	4	5	0.07	C	I
6/8/22	KO2	*Parupeneus bifasciatus*	1	18	0.72	MI	I

6/8/22	KO2	*Chaetodon multicinctus*	5	10	0.73	C	E
6/8/22	KO2	*Stegastes fasciolatus*	2	8	0.15	H	I
6/8/22	KO2	*Ctenochaetus strigosus*	15	15	8.29	D	I
6/8/22	KO2	*Ctenochaetus strigosus*	25	13	8.84	D	I
6/8/22	KO2	*Ctenochaetus strigosus*	3	8	0.23	D	I
6/8/22	KO2	*Ctenochaetus strigosus*	1	5	0.02	D	I
6/8/22	KO2	*Ctenochaetus strigosus*	10	10	1.56	D	I
6/8/22	KO2	*Paracirrhites forsteri*	1	10	0.10	P	I
6/8/22	KO2	*Labroides phthirophagus*	2	8	0.03	P	E
6/8/22	KO2	*Forcipiger flavissimus*	2	15	0.47	SI	I
6/8/22	KO2	*Zebrasoma flavescens*	2	13	0.78	H	I
6/8/22	KO2	*Zebrasoma flavescens*	2	5	0.07	H	I
6/8/22	KO2	*Zebrasoma flavescens*	1	8	0.12	H	I
6/8/22	KO2	*Canthigaster jactator*	2	5	0.05	H	E
6/8/22	KO2	*Canthigaster jactator*	3	3	0.02	H	E
6/8/22	KO2	*Cantherhines sandwichiensis*	1	13	0.28	H	E
6/8/22	KO2	*Scarus psittacus*	1	23	1.65	H	I
6/8/22	KO2	*Parupeneus multifasciatus*	1	13	0.17	MI	I
6/8/22	KO2	*Melichthys niger*	3	23	5.50	H	I
6/8/22	KO2	*Acanthurus olivaceus*	15	28	32.67	H	I
6/8/22	KO2	*Acanthurus nigroris*	6	20	4.96	H	I
6/8/22	KO2	*Acanthurus triostegus*	30	15	12.29	H	I
6/8/22	KO2	*Chaetodon ornatissimus*	1	20	1.51	C	I
6/8/22	5B	*Acanthurus nigrofuscus*	60	10	6.88	H	I
6/8/22	5B	*Acanthurus nigrofuscus*	20	8	1.21	H	I
6/8/22	5B	*Forcipiger flavissimus*	1	15	0.23	SI	I
6/8/22	5B	*Exallias brevis*	1	10	0.09	C	I
6/8/22	5B	*Chaetodon multicinctus*	3	10	0.44	C	E
6/8/22	5B	*Gomphosus varius*	1	10	0.07	MI	I
6/8/22	5B	*Thalassoma duperrey*	30	13	4.77	MI	E
6/8/22	5B	*Thalassoma duperrey*	15	15	3.73	MI	E
6/8/22	5B	*Thalassoma duperrey*	20	10	1.40	MI	E
6/8/22	5B	*Rhinecanthus rectangulus*	1	18	0.79	MI	I
6/8/22	5B	*Chromis vanderbilti*	55	3	0.16	Z	I
6/8/22	5B	*Plectroglyphidodon imparipennis*	4	3	0.01	MI	I
6/8/22	5B	*Plectroglyphidodon imparipennis*	2	5	0.04	MI	I
6/8/22	5B	*Acanthurus nigroris*	1	8	0.06	H	I
6/8/22	5B	*Sufflamen bursa*	3	18	2.36	MI	I
6/8/22	5B	*Stegastes fasciolatus*	2	8	0.15	H	I
6/8/22	5B	*Gomphosus varius*	1	13	0.13	MI	I
6/8/22	5B	*Paracirrhites arcatus*	4	8	0.23	MI	I

6/8/22	5B	*Plectroglyphidodon johnstonianus*	4	8	0.30	C	I
6/8/22	5B	*Canthigaster jactator*	2	3	0.01	H	E
6/8/22	5B	*Canthigaster jactator*	1	5	0.02	H	E
6/8/22	5B	*Cirrhitops fasciatus*	2	8	0.10	MI	I
6/8/22	5B	*Parupeneus multifasciatus*	1	15	0.27	MI	I
6/8/22	5B	*Dascyllus albisella*	1	10	0.17	Z	E
6/8/22	5B	*Paracirrhites forsteri*	1	13	0.22	P	I
6/8/22	5B	*Pervagor aspricaudus*	1	8	0.05	H	I
6/8/22	5B	*Ostracion meleagris*	1	8	0.08	SI	I
6/8/22	1D	*Acanthurus nigrofuscus*	40	10	4.59	H	I
6/8/22	1D	*Acanthurus nigrofuscus*	20	8	1.21	H	I
6/8/22	1D	*Stethojulis balteata*	3	10	0.28	MI	E
6/8/22	1D	*Thalassoma duperrey*	20	13	3.18	MI	E
6/8/22	1D	*Thalassoma duperrey*	40	10	2.81	MI	E
6/8/22	1D	*Thalassoma duperrey*	10	15	2.49	MI	E
6/8/22	1D	*Canthigaster jactator*	1	5	0.02	H	E
6/8/22	1D	*Pervagor aspricaudus*	2	8	0.11	H	I
6/8/22	1D	*Thalassoma ballieui*	1	18	0.47	MI	E
6/8/22	1D	*Canthigaster amboinensis*	1	5	0.05	H	I
6/8/22	1D	*Plectroglyphidodon johnstonianus*	2	8	0.15	C	I
6/8/22	1D	*Ctenochaetus strigosus*	15	10	2.34	D	I
6/8/22	1D	*Ctenochaetus strigosus*	10	13	3.54	D	I
6/8/22	1D	*Ctenochaetus strigosus*	1	5	0.02	D	I
6/8/22	1D	*Stegastes fasciolatus*	4	8	0.30	H	I
6/8/22	1D	*Gomphosus varius*	1	10	0.07	MI	I
6/8/22	1D	*Gomphosus varius*	1	15	0.18	MI	I
6/8/22	1D	*Parupeneus multifasciatus*	2	18	0.95	MI	I
6/8/22	1D	*Parupeneus multifasciatus*	3	15	0.80	MI	I
6/8/22	1D	*Parupeneus multifasciatus*	1	13	0.17	MI	I
6/8/22	1D	*Plectroglyphidodon imparipennis*	1	3	0.00	MI	I
6/8/22	1D	*Coris gaimard*	1	18	0.44	MI	I
6/8/22	1D	*Scarus psittacus*	25	10	2.62	H	I
6/8/22	1D	*Acanthurus olivaceus*	5	15	1.62	H	I
6/8/22	1D	*Acanthurus olivaceus*	3	10	0.28	H	I
6/8/22	1D	*Acanthurus nigroris*	3	10	0.34	H	I
6/8/22	1D	*Acanthurus triostegus*	5	10	0.51	H	I
6/8/22	1D	*Paracirrhites forsteri*	1	13	0.22	P	I
6/8/22	1D	*Sufflamen bursa*	1	18	0.79	MI	I
6/8/22	PIPE	*Chaetodon multicinctus*	10	10	1.46	C	E
6/8/22	PIPE	*Parupeneus pleurostigma*	2	15	0.62	MI	I

6/8/22	PIPE	*Parupeneus pleurostigma*	1	13	0.21	MI	I
6/8/22	PIPE	*Dascyllus albisella*	11	10	1.87	Z	E
6/8/22	PIPE	*Chlorurus sordidus*	10	25	23.91	H	I
6/8/22	PIPE	*Chlorurus sordidus*	1	30	4.40	H	I
6/8/22	PIPE	*Gomphosus varius*	1	18	0.29	MI	I
6/8/22	PIPE	*Gomphosus varius*	5	13	0.64	MI	I
6/8/22	PIPE	*Coris gaimard*	1	25	1.30	MI	I
6/8/22	PIPE	*Coris gaimard*	1	30	2.36	MI	I
6/8/22	PIPE	*Thalassoma purpureum*	1	23	1.00	MI	I
6/8/22	PIPE	*Thalassoma purpureum*	1	25	1.31	MI	I
6/8/22	PIPE	*Thalassoma purpureum*	1	30	2.37	MI	I
6/8/22	PIPE	*Sufflamen bursa*	4	18	3.14	MI	I
6/8/22	PIPE	*Cantherhines sandwichiensis*	1	10	0.14	H	E
6/8/22	PIPE	*Forcipiger flavissimus*	4	15	0.94	SI	I
6/8/22	PIPE	*Chaetodon fremblii*	2	13	0.56	SI	E
6/8/22	PIPE	*Stegastes fasciolatus*	3	8	0.23	H	I
6/8/22	PIPE	*Plectroglyphidodon johnstonianus*	2	8	0.15	C	I
6/8/22	PIPE	*Halichoeres ornatissimus*	1	13	0.10	MI	I
6/8/22	PIPE	*Aulostomus chinensis*	2	30	0.41	P	I
6/8/22	PIPE	*Aulostomus chinensis*	2	25	0.22	P	I
6/8/22	PIPE	*Cantherhines dumerilii*	1	20	0.84	C	I
6/8/22	PIPE	*Parupeneus multifasciatus*	4	15	1.07	MI	I
6/8/22	PIPE	*Melichthys niger*	1	23	1.83	H	I
6/8/22	PIPE	*Exallias brevis*	1	10	0.09	C	I
6/8/22	PIPE	*Thalassoma trilobatum*	2	23	2.06	MI	I
6/8/22	PIPE	*Canthigaster jactator*	3	5	0.07	H	E
6/8/22	PIPE	*Stethojulis balteata*	2	10	0.19	MI	E
6/8/22	PIPE	*Stethojulis balteata*	1	13	0.21	MI	E
6/8/22	PIPE	*Pervagor aspricaudus*	5	10	0.50	H	I
6/8/22	PIPE	*Heteropriacanthus cruentatus*	1	18	0.51	Z	I
6/8/22	PIPE	*Lutjanus kasmira*	300	18	163.07	MI	X
6/8/22	PIPE	*Chaetodon quadrimaculatus*	2	13	0.77	C	I
6/8/22	PIPE	*Gymnothorax meleagris*	1	51	0.70	P	I
6/8/22	PIPE	*Naso annulatus*	3	30	6.71	Z	I
6/8/22	PIPE	*Parupeneus bifasciatus*	1	20	1.00	MI	I
6/8/22	PIPE	*Parupeneus bifasciatus*	1	18	0.72	MI	I
6/8/22	PIPE	*Parupeneus bifasciatus*	1	15	0.41	MI	I
6/8/22	PIPE	*Monotaxis grandoculis*	8	23	11.06	MI	I
6/8/22	PIPE	*Mulloidichthys vanicolensis*	15	18	6.91	MI	I
6/8/22	PIPE	*Mulloidichthys flavolineatus*	90	20	51.52	MI	I
6/8/22	PIPE	*Chromis vanderbilti*	50	3	0.15	Z	I

6/8/22	PIPE	*Macropharyngodon geoffroyi*	1	10	0.12	MI	E
6/8/22	PIPE	*Chaetodon kleinii*	3	13	0.87	Z	I
6/8/22	PIPE	*Chaetodon ornatissimus*	1	20	1.51	C	I
6/8/22	PIPE	*Zanclus cornutus*	4	15	2.10	SI	I
6/8/22	PIPE	*Zanclus cornutus*	1	13	0.35	SI	I
6/8/22	PIPE	*Paracirrhites forsteri*	3	13	0.66	P	I
6/8/22	PIPE	*Chaetodon miliaris*	1	13	0.30	Z	E
6/8/22	PIPE	*Myripristis kuntee*	1	13	0.24	Z	I
6/8/22	PIPE	*Chaetodon lunula*	2	18	1.18	SI	I
6/8/22	PIPE	*Paracirrhites arcatus*	3	8	0.17	MI	I
6/8/22	PIPE	*Thalassoma quinquevittatum*	3	8	0.10	MI	I
6/8/22	PIPE	*Calotomus carolinus*	1	30	2.95	H	I
6/8/22	PIPE	*Cephalopholis argus*	1	28	1.91	P	X
6/8/22	PIPE	*Scarus rubroviolaceus*	1	30	3.91	H	I
6/8/22	PIPE	*Labroides phthirophagus*	2	8	0.03	P	E
6/8/22	PIPE	*Acanthurus xanthopterus*	5	28	6.23	H	I
6/8/22	PIPE	*Abudefduf abdominalis*	50	13	15.81	Z	E
6/8/22	PIPE	*Abudefduf vaigiensis*	50	13	31.27	Z	I
6/8/22	PIPE	*Acanthurus nigrofuscus*	350	10	40.12	H	I
6/8/22	PIPE	*Thalassoma duperrey*	40	15	9.95	MI	E
6/8/22	PIPE	*Thalassoma duperrey*	50	13	7.95	MI	E
6/8/22	7B	*Chromis vanderbilti*	90	3	0.26	Z	I
6/8/22	7B	*Plectroglyphidodon johnstonianus*	1	3	0.00	C	I
6/8/22	7B	*Plectroglyphidodon johnstonianus*	1	5	0.02	C	I
6/8/22	7B	*Gymnothorax meleagris*	1	25	0.07	P	I
6/8/22	7B	*Forcipiger flavissimus*	1	10	0.06	SI	I
6/8/22	7B	*Mulloidichthys vanicolensis*	1	13	0.16	MI	I
6/8/22	7B	*Myripristis kuntee*	2	10	0.22	Z	I
6/8/22	7B	*Canthigaster jactator*	1	3	0.01	H	E
6/8/22	7B	*Zebrasoma flavescens*	1	3	0.01	H	I
6/8/22	7B	*Zebrasoma flavescens*	1	8	0.12	H	I
6/8/22	7B	*Cirrhitops fasciatus*	1	8	0.05	MI	I
6/8/22	7B	*Pervagor aspricaudus*	1	8	0.05	H	I
6/8/22	7B	*Acanthurus nigrofuscus*	25	10	2.87	H	I
6/8/22	7B	*Acanthurus nigrofuscus*	5	8	0.30	H	I
6/8/22	7B	*Dascyllus albisella*	1	3	0.00	Z	E
6/8/22	7B	*Dascyllus albisella*	6	10	1.02	Z	E
6/8/22	7B	*Halichoeres ornatissimus*	1	10	0.06	MI	I
6/8/22	7B	*Aulostomus chinensis*	1	18	0.04	P	I
6/8/22	7B	*Aulostomus chinensis*	1	28	0.16	P	I
6/8/22	7B	*Parupeneus multifasciatus*	1	18	0.47	MI	I

6/8/22	7B	*Parupeneus multifasciatus*	1	8	0.04	MI	I
6/8/22	7B	*Parupeneus multifasciatus*	1	15	0.27	MI	I
6/8/22	7B	*Parupeneus multifasciatus*	1	13	0.17	MI	I
6/8/22	7B	*Labroides phthirophagus*	1	5	0.00	P	E
6/8/22	7B	*Plectroglyphidodon imparipennis*	2	3	0.01	MI	I
6/8/22	7B	*Ctenochaetus strigosus*	2	3	0.01	D	I
6/8/22	7B	*Ctenochaetus strigosus*	1	5	0.02	D	I
6/8/22	7B	*Stethojulis balteata*	5	13	1.06	MI	E
6/8/22	7B	*Thalassoma duperrey*	5	13	0.80	MI	E
6/8/22	7B	*Thalassoma duperrey*	3	10	0.21	MI	E
6/8/22	7B	*Thalassoma duperrey*	2	15	0.50	MI	E
6/8/22	7B	*Scarus psittacus*	1	13	0.25	H	I
6/8/22	7B	*Coris gaimard*	1	20	0.62	MI	I
6/8/22	7B	*Sufflamen bursa*	3	18	2.36	MI	I
6/8/22	7B	*Chaetodon kleinii*	2	10	0.27	Z	I
6/8/22	7E	*Acanthurus olivaceus*	2	20	1.56	H	I
6/8/22	7E	*Canthigaster jactator*	4	5	0.09	H	E
6/8/22	7E	*Sufflamen bursa*	3	18	2.36	MI	I
6/8/22	7E	*Plectroglyphidodon johnstonianus*	3	5	0.05	C	I
6/8/22	7E	*Paracirrhites arcatus*	5	8	0.29	MI	I
6/8/22	7E	*Parupeneus multifasciatus*	1	13	0.17	MI	I
6/8/22	7E	*Parupeneus multifasciatus*	2	10	0.15	MI	I
6/8/22	7E	*Chaetodon auriga*	2	18	1.77	SI	I
6/8/22	7E	*Thalassoma duperrey*	1	5	0.01	MI	E
6/8/22	7E	*Naso unicornis*	1	25	1.59	H	I
6/8/22	7E	*Chromis vanderbilti*	55	3	0.16	Z	I
6/8/22	7E	*Melichthys vidua*	1	23	2.11	H	I
6/8/22	7E	*Pseudojuloides cerasinus*	4	5	0.03	MI	I
6/8/22	7E	*Melichthys niger*	3	23	5.50	H	I
6/8/22	7E	*Sufflamen fraenatus*	1	23	1.58	MI	I
6/8/22	7E	*Cirrhitops fasciatus*	1	8	0.05	MI	I
6/8/22	NANA1	*Chromis vanderbilti*	80	3	0.23	Z	I
6/8/22	NANA1	*Paracirrhites arcatus*	3	8	0.17	MI	I
6/8/22	NANA1	*Stethojulis balteata*	3	8	0.14	MI	E
6/8/22	NANA1	*Cirrhitops fasciatus*	1	8	0.05	MI	I
6/8/22	NANA1	*Thalassoma duperrey*	5	8	0.17	MI	E
6/8/22	NANA1	*Thalassoma duperrey*	5	10	0.35	MI	E
6/8/22	NANA1	*Thalassoma duperrey*	1	13	0.16	MI	E
6/8/22	NANA1	*Plectroglyphidodon imparipennis*	15	3	0.05	MI	I
6/8/22	NANA1	*Macropharyngodon geoffroyi*	1	5	0.02	MI	E

6/8/22	NANA1	*Stegastes fasciolatus*	1	5	0.02	H	I
6/8/22	NANA1	*Plagiotremus goslinei*	2	5	0.00	P	E
6/8/22	NANA1	*Parupeneus multifasciatus*	1	8	0.04	MI	I
6/8/22	NANA1	*Parupeneus multifasciatus*	1	13	0.17	MI	I
6/8/22	NANA1	*Halichoeres ornatissimus*	1	8	0.04	MI	I
6/8/22	NANA1	*Canthigaster jactator*	4	5	0.09	H	E
6/8/22	NANA1	*Acanthurus triostegus*	1	3	0.00	H	I
6/8/22	NANA1	*Acanthurus triostegus*	2	13	0.50	H	I
6/8/22	NANA1	*Cirripectes vanderbilti*	1	5	0.01	H	E
6/8/22	NANA1	*Acanthurus olivaceus*	1	15	0.32	H	I
6/8/22	NANA1	*Acanthurus olivaceus*	1	13	0.21	H	I
6/8/22	NANA1	*Acanthurus nigroris*	7	10	0.80	H	I
6/8/22	NANA1	*Rhinecanthus rectangulus*	1	18	0.79	MI	I
6/8/22	NANA1	*Acanthurus triostegus*	2	8	0.09	H	I
6/8/22	NANA1	*Thalassoma trilobatum*	2	18	1.00	MI	I
6/8/22	NANA1	*Plectroglyphidodon johnstonianus*	1	3	0.00	C	I
6/8/22	NANA2	*Sufflamen bursa*	2	18	1.57	MI	I
6/8/22	NANA2	*Canthigaster jactator*	4	5	0.09	H	E
6/8/22	NANA2	*Plectroglyphidodon johnstonianus*	1	5	0.02	C	I
6/8/22	NANA2	*Cirripectes vanderbilti*	1	5	0.01	H	E
6/8/22	NANA2	*Thalassoma duperrey*	10	15	2.49	MI	E
6/8/22	NANA2	*Thalassoma duperrey*	30	13	4.77	MI	E
6/8/22	NANA2	*Zebrasoma flavescens*	1	18	0.88	H	I
6/8/22	NANA2	*Acanthurus nigrofuscus*	20	8	1.21	H	I
6/8/22	NANA2	*Acanthurus nigrofuscus*	40	10	4.59	H	I
6/8/22	NANA2	*Ctenochaetus strigosus*	5	5	0.09	D	I
6/8/22	NANA2	*Ctenochaetus strigosus*	5	10	0.78	D	I
6/8/22	NANA2	*Gomphosus varius*	2	15	0.37	MI	I
6/8/22	NANA2	*Monotaxis grandoculis*	4	15	1.39	MI	I
6/8/22	NANA2	*Stegastes fasciolatus*	1	8	0.08	H	I
6/8/22	NANA2	*Naso lituratus*	2	18	1.17	H	I
6/8/22	NANA2	*Naso lituratus*	4	25	6.45	H	I
6/8/22	NANA2	*Acanthurus leucopareius*	10	23	21.61	H	I
6/8/22	NANA2	*Acanthurus olivaceus*	3	28	6.53	H	I
6/8/22	NANA2	*Acanthurus dussumieri*	1	20	0.39	H	I
6/8/22	NANA2	*Lutjanus fulvus*	1	18	0.31	MI	X
6/8/22	NANA2	*Labroides phthirophagus*	1	8	0.02	P	E
6/8/22	NANA2	*Chlorurus sordidus*	2	20	2.26	H	I
6/8/22	NANA2	*Melichthys niger*	3	23	5.50	H	I
8/19/22	E1	*Paracirrhites arcatus*	3	8	0.17	MI	I
8/19/22	E1	*Sufflamen fraenatus*	1	25	2.01	MI	I

8/19/22	E1	*Rhinecanthus rectangulus*	2	18	1.57	MI	I
8/19/22	E1	*Plectroglyphidodon imparipennis*	3	3	0.01	MI	I
8/19/22	E1	*Chromis vanderbilti*	20	3	0.06	Z	I
8/19/22	E1	*Caranx melampygus*	2	28	4.01	P	I
8/19/22	E1	*Acanthurus dussumieri*	8	28	8.66	H	I
8/19/22	E1	*Acanthurus dussumieri*	3	20	1.18	H	I
8/19/22	E1	*Acanthurus triostegus*	10	15	4.10	H	I
8/19/22	E1	*Naso lituratus*	1	23	1.25	H	I
8/19/22	E1	*Cantherhines dumerilii*	1	23	1.33	C	I
8/19/22	E1	*Chaetodon ornatissimus*	2	20	3.03	C	I
8/19/22	E1	*Plectroglyphidodon johnstonianus*	1	8	0.08	C	I
8/19/22	E1	*Chaetodon auriga*	1	20	1.23	SI	I
8/19/22	E1	*Chaetodon quadrimaculatus*	2	13	0.77	C	I
8/19/22	E1	*Chaetodon lunula*	1	20	0.81	SI	I
8/19/22	E1	*Acanthurus olivaceus*	2	25	3.08	H	I
8/19/22	E1	*Canthigaster jactator*	5	5	0.11	H	E
8/19/22	E1	*Acanthurus blochii*	5	30	6.66	H	I
8/19/22	E1	*Acanthurus leucopareius*	2	23	4.32	H	I
8/19/22	E1	*Lutjanus fulvus*	1	20	0.42	MI	X
8/19/22	E1	*Acanthurus nigrofuscus*	20	10	2.29	H	I
8/19/22	E1	*Scarus rubroviolaceus*	1	51	19.03	H	I
8/19/22	E1	*Thalassoma duperrey*	4	10	0.28	MI	E
8/19/22	E1	*Thalassoma duperrey*	2	13	0.32	MI	E
8/19/22	E1	*Stethojulis balteata*	1	10	0.09	MI	E
8/19/22	E1	*Labroides phthirophagus*	1	8	0.02	P	E
8/19/22	E1	*Halichoeres ornatissimus*	1	10	0.06	MI	I
8/19/22	E1	*Halichoeres ornatissimus*	1	3	0.01	MI	I
8/19/22	E3	*Canthigaster jactator*	8	5	0.18	H	E
8/19/22	E3	*Chaetodon multicinctus*	2	10	0.29	C	E
8/19/22	E3	*Stethojulis balteata*	1	10	0.09	MI	E
8/19/22	E3	*Sufflamen bursa*	2	18	1.57	MI	I
8/19/22	E3	*Thalassoma duperrey*	2	15	0.50	MI	E
8/19/22	E3	*Thalassoma duperrey*	30	10	2.11	MI	E
8/19/22	E3	*Thalassoma duperrey*	25	13	3.98	MI	E
8/19/22	E3	*Plectroglyphidodon imparipennis*	1	5	0.02	MI	I
8/19/22	E3	*Parupeneus multifasciatus*	2	13	0.34	MI	I
8/19/22	E3	*Plectroglyphidodon johnstonianus*	7	8	0.53	C	I
8/19/22	E3	*Acanthurus nigrofuscus*	10	8	0.61	H	I
8/19/22	E3	*Acanthurus nigrofuscus*	20	10	2.29	H	I
8/19/22	E3	*Acanthurus nigrofuscus*	1	5	0.02	H	I

8/19/22	E3	*Ctenochaetus strigosus*	25	8	1.94	D	I
8/19/22	E3	*Ctenochaetus strigosus*	20	10	3.12	D	I
8/19/22	E3	*Halichoeres ornatissimus*	2	10	0.12	MI	I
8/19/22	E3	*Acanthurus blochii*	3	30	3.99	H	I
8/19/22	E3	*Stegastes fasciolatus*	2	8	0.15	H	I
8/19/22	E3	*Chaetodon ornatissimus*	2	20	3.03	C	I
8/19/22	E3	*Pseudocheilinus octotaenia*	1	10	0.09	MI	I
8/19/22	E3	*Acanthurus olivaceus*	4	28	8.71	H	I
8/19/22	E4	*Plectroglyphidodon imparipennis*	2	5	0.04	MI	I
8/19/22	E4	*Melichthys vidua*	1	23	2.11	H	I
8/19/22	E4	*Plectroglyphidodon johnstonianus*	4	8	0.30	C	I
8/19/22	E4	*Rhinecanthus rectangulus*	3	18	2.36	MI	I
8/19/22	E4	*Pseudocheilinus tetrataenia*	3	5	0.03	MI	I
8/19/22	E4	*Zebrasoma flavescens*	2	18	1.76	H	I
8/19/22	E4	*Zebrasoma flavescens*	1	5	0.04	H	I
8/19/22	E4	*Acanthurus nigrofuscus*	5	10	0.57	H	I
8/19/22	E4	*Acanthurus nigrofuscus*	5	8	0.30	H	I
8/19/22	E4	*Chromis vanderbilti*	40	3	0.12	Z	I
8/19/22	E4	*Naso lituratus*	2	25	3.23	H	I
8/19/22	E4	*Paracirrhites arcatus*	5	8	0.29	MI	I
8/19/22	E4	*Acanthurus olivaceus*	4	28	8.71	H	I
8/19/22	E4	*Acanthurus nigroris*	1	10	0.11	H	I
8/19/22	E4	*Sufflamen fraenatus*	1	23	1.58	MI	I
8/19/22	E4	*Thalassoma duperrey*	2	15	0.50	MI	E
8/19/22	E4	*Thalassoma duperrey*	2	10	0.14	MI	E
8/19/22	E4	*Melichthys niger*	1	23	1.83	H	I
8/19/22	E4	*Canthigaster jactator*	1	3	0.01	H	E
8/19/22	E4	*Canthigaster jactator*	1	5	0.02	H	E
8/19/22	E4	*Parupeneus multifasciatus*	1	13	0.17	MI	I
8/19/22	E4	*Stethojulis balteata*	1	10	0.09	MI	E
8/19/22	1D	*Melichthys niger*	5	23	9.16	H	I
8/19/22	1D	*Acanthurus triostegus*	10	13	2.50	H	I
8/19/22	1D	*Acanthurus triostegus*	1	10	0.10	H	I
8/19/22	1D	*Acanthurus nigroris*	1	13	0.24	H	I
8/19/22	1D	*Acanthurus nigroris*	2	18	1.22	H	I
8/19/22	1D	*Thalassoma duperrey*	30	15	7.46	MI	E
8/19/22	1D	*Thalassoma duperrey*	35	13	5.57	MI	E
8/19/22	1D	*Monotaxis grandoculis*	10	25	18.10	MI	I
8/19/22	1D	*Parupeneus bifasciatus*	1	13	0.26	MI	I
8/19/22	1D	*Stegastes fasciolatus*	2	8	0.15	H	I
8/19/22	1D	*Acanthurus nigrofuscus*	40	10	4.59	H	I

8/19/22	1D	*Parupeneus multifasciatus*	3	13	0.51	MI	I
8/19/22	1D	*Parupeneus multifasciatus*	1	10	0.08	MI	I
8/19/22	1D	*Gomphosus varius*	2	10	0.13	MI	I
8/19/22	1D	*Gomphosus varius*	1	8	0.04	MI	I
8/19/22	1D	*Abudefduf vaigiensis*	13	5	0.67	Z	I
8/19/22	1D	*Chaetodon quadrimaculatus*	3	13	1.16	C	I
8/19/22	1D	*Canthigaster jactator*	5	5	0.11	H	E
8/19/22	1D	*Ctenochaetus strigosus*	15	10	2.34	D	I
8/19/22	1D	*Ctenochaetus strigosus*	20	13	7.07	D	I
8/19/22	1D	*Plectroglyphidodon imparipennis*	1	3	0.00	MI	I
8/19/22	1D	*Paracirrhites forsteri*	1	13	0.22	P	I
8/19/22	1D	*Stethojulis balteata*	2	10	0.19	MI	E
8/19/22	1D	*Cirripectes vanderbilti*	1	8	0.02	H	E
8/19/22	1D	*Plectroglyphidodon johnstonianus*	1	5	0.02	C	I
8/19/22	1D	*Abudefduf abdominalis*	1	13	0.32	Z	E
8/19/22	1D	*Acanthurus olivaceus*	4	13	0.84	H	I
8/19/22	5B	*Acanthurus nigrofuscus*	50	10	5.73	H	I
8/19/22	5B	*Acanthurus nigrofuscus*	1	8	0.06	H	I
8/19/22	5B	*Chlorurus sordidus*	1	30	4.40	H	I
8/19/22	5B	*Coris venusta*	1	13	0.16	MI	E
8/19/22	5B	*Labroides phthirophagus*	1	8	0.02	P	E
8/19/22	5B	*Chromis vanderbilti*	180	3	0.53	Z	I
8/19/22	5B	*Thalassoma duperrey*	25	10	1.75	MI	E
8/19/22	5B	*Thalassoma duperrey*	10	15	2.49	MI	E
8/19/22	5B	*Thalassoma duperrey*	10	13	1.59	MI	E
8/19/22	5B	*Cantherhines sandwichiensis*	1	13	0.28	H	E
8/19/22	5B	*Pervagor aspricaudus*	2	8	0.11	H	I
8/19/22	5B	*Parupeneus multifasciatus*	2	13	0.34	MI	I
8/19/22	5B	*Parupeneus multifasciatus*	2	15	0.54	MI	I
8/19/22	5B	*Naso lituratus*	1	13	0.21	H	I
8/19/22	5B	*Chaetodon multicinctus*	2	10	0.29	C	E
8/19/22	5B	*Naso unicornis*	1	13	0.25	H	I
8/19/22	5B	*Cirrhitops fasciatus*	1	8	0.05	MI	I
8/19/22	5B	*Abudefduf abdominalis*	1	13	0.32	Z	E
8/19/22	5B	*Paracirrhites arcatus*	3	8	0.17	MI	I
8/19/22	5B	*Rhinecanthus rectangulus*	3	18	2.36	MI	I
8/19/22	5B	*Zanclus cornutus*	1	18	0.88	SI	I
8/19/22	5B	*Acanthurus nigroris*	1	10	0.11	H	I
8/19/22	5B	*Sufflamen bursa*	1	18	0.79	MI	I
8/19/22	5B	*Plectroglyphidodon johnstonianus*	7	5	0.12	C	I

8/19/22	5B	*Plectroglyphidodon johnstonianus*	5	8	0.38	C	I
8/19/22	5B	*Plectroglyphidodon imparipennis*	10	3	0.04	MI	I
8/19/22	5B	*Plectroglyphidodon imparipennis*	10	5	0.18	MI	I
8/19/22	5B	*Canthigaster amboinensis*	1	5	0.05	H	I
8/19/22	5B	*Canthigaster amboinensis*	1	8	0.14	H	I
8/19/22	5B	*Canthigaster amboinensis*	1	10	0.23	H	I
8/19/22	5B	*Stethojulis balteata*	1	8	0.05	MI	E
8/19/22	5B	*Paracirrhites forsteri*	1	10	0.10	P	I
8/19/22	5B	*Stegastes fasciolatus*	1	5	0.02	H	I
8/19/22	5B	*Aulostomus chinensis*	1	15	0.02	P	I
8/19/22	5B	*Cirripectes vanderbilti*	1	8	0.02	H	E
8/19/22	5B	*Canthigaster jactator*	6	5	0.14	H	E
8/19/22	5B	*Halichoeres ornatissimus*	1	13	0.10	MI	I
8/19/22	5B	*Halichoeres ornatissimus*	3	8	0.12	MI	I
8/19/22	5B	*Exallias brevis*	1	10	0.09	C	I
8/19/22	5B	*Parupeneus pleurostigma*	1	13	0.21	MI	I
8/19/22	5B	*Ostracion meleagris*	1	8	0.08	SI	I
8/19/22	5B	*Ostracion meleagris*	2	5	0.03	SI	I
8/19/22	5B	*Synodus binotatus*	1	10	0.04	P	I
8/19/22	5B	*Scarus psittacus*	3	8	0.15	H	I
8/19/22	PIPE	*Acanthurus nigrofuscus*	350	10	40.12	H	I
8/19/22	PIPE	*Zebrasoma flavescens*	2	10	0.41	H	I
8/19/22	PIPE	*Thalassoma duperrey*	10	10	0.70	MI	E
8/19/22	PIPE	*Thalassoma duperrey*	40	13	6.36	MI	E
8/19/22	PIPE	*Thalassoma duperrey*	60	15	14.92	MI	E
8/19/22	PIPE	*Scarus psittacus*	1	10	0.10	H	I
8/19/22	PIPE	*Dascyllus albisella*	15	10	2.54	Z	E
8/19/22	PIPE	*Thalassoma trilobatum*	4	20	2.73	MI	I
8/19/22	PIPE	*Thalassoma trilobatum*	2	25	2.64	MI	I
8/19/22	PIPE	*Chromis agilis*	1	8	0.06	Z	I
8/19/22	PIPE	*Melichthys vidua*	1	23	2.11	H	I
8/19/22	PIPE	*Coris gaimard*	1	30	2.36	MI	I
8/19/22	PIPE	*Acanthurus guttatus*	12	23	25.93	H	I
8/19/22	PIPE	*Aulostomus chinensis*	1	36	0.39	P	I
8/19/22	PIPE	*Chromis vanderbilti*	60	3	0.18	Z	I
8/19/22	PIPE	*Cephalopholis argus*	1	28	1.91	P	X
8/19/22	PIPE	*Gomphosus varius*	8	10	0.54	MI	I
8/19/22	PIPE	*Gomphosus varius*	3	15	0.55	MI	I
8/19/22	PIPE	*Pervagor aspricaudus*	5	8	0.27	H	I
8/19/22	PIPE	*Lutjanus kasmira*	650	15	184.28	MI	X

8/19/22	PIPE	*Parupeneus multifasciatus*	5	13	0.86	MI	I
8/19/22	PIPE	*Parupeneus multifasciatus*	5	15	1.34	MI	I
8/19/22	PIPE	*Parupeneus bifasciatus*	1	15	0.41	MI	I
8/19/22	PIPE	*Parupeneus bifasciatus*	4	13	1.06	MI	I
8/19/22	PIPE	*Ctenochaetus strigosus*	3	10	0.47	D	I
8/19/22	PIPE	*Ctenochaetus strigosus*	1	15	0.55	D	I
8/19/22	PIPE	*Plectroglyphidodon johnstonianus*	7	8	0.53	C	I
8/19/22	PIPE	*Plectroglyphidodon johnstonianus*	3	5	0.05	C	I
8/19/22	PIPE	*Forcipiger flavissimus*	3	13	0.45	SI	I
8/19/22	PIPE	*Chaetodon quadrimaculatus*	1	13	0.39	C	I
8/19/22	PIPE	*Cirrhitops fasciatus*	1	10	0.11	MI	I
8/19/22	PIPE	*Stegastes fasciolatus*	4	8	0.30	H	I
8/19/22	PIPE	*Parupeneus pleurostigma*	6	13	1.24	MI	I
8/19/22	PIPE	*Chaetodon fremblii*	1	13	0.28	SI	E
8/19/22	PIPE	*Chaetodon miliaris*	1	13	0.30	Z	E
8/19/22	PIPE	*Stethojulis balteata*	2	10	0.19	MI	E
8/19/22	PIPE	*Stethojulis balteata*	2	13	0.43	MI	E
8/19/22	PIPE	*Abudefduf vaigiensis*	65	13	40.65	Z	I
8/19/22	PIPE	*Naso annulatus*	3	33	8.79	Z	I
8/19/22	PIPE	*Naso annulatus*	1	38	4.37	Z	I
8/19/22	PIPE	*Canthigaster amboinensis*	1	8	0.14	H	I
8/19/22	PIPE	*Abudefduf abdominalis*	55	15	25.26	Z	E
8/19/22	PIPE	*Naso brevirostris*	1	33	4.09	Z	I
8/19/22	PIPE	*Melichthys niger*	4	23	7.33	H	I
8/19/22	PIPE	*Canthigaster jactator*	16	5	0.36	H	E
8/19/22	PIPE	*Thalassoma purpureum*	2	28	3.79	MI	I
8/19/22	PIPE	*Thalassoma purpureum*	2	23	2.01	MI	I
8/19/22	PIPE	*Chaetodon lunula*	1	18	0.59	SI	I
8/19/22	PIPE	*Naso hexacanthus*	1	15	0.40	Z	I
8/19/22	PIPE	*Chaetodon multicinctus*	8	10	1.17	C	E
8/19/22	PIPE	*Chaetodon kleinii*	4	10	0.54	Z	I
8/19/22	PIPE	*Chromis ovalis*	10	13	2.08	Z	E
8/19/22	PIPE	*Chaetodon ornatissimus*	2	20	3.03	C	I
8/19/22	PIPE	*Halichoeres ornatissimus*	1	13	0.10	MI	I
8/19/22	PIPE	*Halichoeres ornatissimus*	1	10	0.06	MI	I
8/19/22	PIPE	*Cirrhitus pinnulatus*	1	13	0.29	MI	I
8/19/22	PIPE	*Cirrhitus pinnulatus*	1	15	0.45	MI	I
8/19/22	PIPE	*Ostracion meleagris*	1	5	0.02	SI	I
8/19/22	PIPE	*Thalassoma quinquevittatum*	1	10	0.07	MI	I
8/19/22	PIPE	*Thalassoma quinquevittatum*	3	13	0.48	MI	I
8/19/22	PIPE	*Thalassoma quinquevittatum*	1	15	0.25	MI	I

8/19/22	PIPE	*Chlorurus sordidus*	2	30	8.81	H	I
8/19/22	PIPE	*Chlorurus sordidus*	1	25	2.39	H	I
8/19/22	PIPE	*Paracirrhites arcatus*	5	8	0.29	MI	I
8/19/22	PIPE	*Acanthurus leucopareius*	1	20	1.41	H	I
8/19/22	PIPE	*Sufflamen bursa*	4	18	3.14	MI	I
8/19/22	PIPE	*Zanclus cornutus*	6	18	5.31	SI	I
8/19/22	PIPE	*Exallias brevis*	1	10	0.09	C	I
8/19/22	PIPE	*Mulloidichthys vanicolensis*	25	15	6.42	MI	I
8/19/22	PIPE	*Mulloidichthys vanicolensis*	10	20	6.45	MI	I
8/19/22	PIPE	*Mulloidichthys flavolineatus*	15	5	0.16	MI	I
8/19/22	PIPE	*Synodus dermatogenys*	2	15	0.30	P	I
8/19/22	KO1	*Acanthurus nigrofuscus*	7	8	0.42	H	I
8/19/22	KO1	*Acanthurus nigrofuscus*	26	10	2.98	H	I
8/19/22	KO1	*Acanthurus nigrofuscus*	6	12	1.16	H	I
8/19/22	KO1	*Acanthurus nigrofuscus*	3	7	0.12	H	I
8/19/22	KO1	*Ctenochaetus strigosus*	58	12	15.97	D	I
8/19/22	KO1	*Ctenochaetus strigosus*	8	7	0.41	D	I
8/19/22	KO1	*Ctenochaetus strigosus*	17	15	9.39	D	I
8/19/22	KO1	*Ctenochaetus strigosus*	13	10	2.03	D	I
8/19/22	KO1	*Ctenochaetus strigosus*	1	5	0.02	D	I
8/19/22	KO1	*Ctenochaetus strigosus*	2	20	2.71	D	I
8/19/22	KO1	*Thalassoma duperrey*	4	15	0.99	MI	E
8/19/22	KO1	*Thalassoma duperrey*	5	12	0.62	MI	E
8/19/22	KO1	*Thalassoma duperrey*	5	8	0.17	MI	E
8/19/22	KO1	*Thalassoma duperrey*	4	6	0.06	MI	E
8/19/22	KO1	*Thalassoma duperrey*	6	10	0.42	MI	E
8/19/22	KO1	*Plectroglyphidodon johnstonianus*	2	6	0.06	C	I
8/19/22	KO1	*Plectroglyphidodon johnstonianus*	5	8	0.38	C	I
8/19/22	KO1	*Plectroglyphidodon johnstonianus*	6	10	0.90	C	I
8/19/22	KO1	*Melichthys vidua*	1	20	1.47	H	I
8/19/22	KO1	*Melichthys vidua*	1	22	1.88	H	I
8/19/22	KO1	*Sufflamen bursa*	9	15	4.20	MI	I
8/19/22	KO1	*Canthigaster jactator*	6	4	0.08	H	E
8/19/22	KO1	*Canthigaster jactator*	2	5	0.05	H	E
8/19/22	KO1	*Canthigaster jactator*	1	3	0.01	H	E
8/19/22	KO1	*Stegastes fasciolatus*	1	8	0.08	H	I
8/19/22	KO1	*Stethojulis balteata*	1	10	0.09	MI	E
8/19/22	KO1	*Stethojulis balteata*	1	20	0.83	MI	E
8/19/22	KO1	*Chaetodon multicinctus*	6	10	0.88	C	E
8/19/22	KO1	*Paracirrhites forsteri*	1	22	1.11	P	I

8/19/22	KO1	*Melichthys niger*	8	23	14.66	H	I
8/19/22	KO1	*Chaetodon ornatissimus*	2	20	3.03	C	I
8/19/22	KO1	*Gomphosus varius*	1	12	0.11	MI	I
8/19/22	KO1	*Thalassoma ballieui*	1	22	0.90	MI	E
8/19/22	KO1	*Zebrasoma flavescens*	9	4	0.19	H	I
8/19/22	KO1	*Zebrasoma flavescens*	5	6	0.29	H	I
8/19/22	KO1	*Zebrasoma flavescens*	4	20	4.58	H	I
8/19/22	KO1	*Zebrasoma flavescens*	5	5	0.18	H	I
8/19/22	KO1	*Zebrasoma flavescens*	2	12	0.64	H	I
8/19/22	KO1	*Labroides phthirophagus*	2	8	0.03	P	E
8/19/22	KO1	*Labroides phthirophagus*	1	7	0.01	P	E
8/19/22	KO1	*Lutjanus kasmira*	46	20	36.42	MI	X
8/19/22	KO1	*Chromis vanderbilti*	4	4	0.03	Z	I
8/19/22	KO1	*Aulostomus chinensis*	1	33	0.29	P	I
8/19/22	KO1	*Aulostomus chinensis*	1	30	0.21	P	I
8/19/22	KO1	*Naso lituratus*	1	24	1.42	H	I
8/19/22	KO1	*Monotaxis grandoculis*	2	23	2.77	MI	I
8/19/22	KO1	*Monotaxis grandoculis*	6	20	5.28	MI	I
8/19/22	KO1	*Parupeneus cyclostomus*	1	21	1.70	P	I
8/19/22	KO1	*Parupeneus multifasciatus*	1	15	0.27	MI	I
8/19/22	KO1	*Sargocentron spiniferum*	1	35	4.32	MI	I
8/19/22	KO1	*Sargocentron spiniferum*	1	30	2.95	MI	I
8/19/22	KO1	*Chaetodon quadrimaculatus*	1	15	0.61	C	I
8/19/22	KO1	*Cirrhitus pinnulatus*	1	12	0.22	MI	I
8/19/22	KO1	*Acanthurus nigricans*	1	15	0.32	H	I
8/19/22	KO1	*Lutjanus fulvus*	1	24	0.72	MI	X
8/19/22	KO1	*Forcipiger flavissimus*	1	12	0.12	SI	I
8/19/22	KO2	*Acanthurus nigrofuscus*	40	10	4.59	H	I
8/19/22	KO2	*Acanthurus nigrofuscus*	22	8	1.34	H	I
8/19/22	KO2	*Acanthurus nigrofuscus*	3	12	0.58	H	I
8/19/22	KO2	*Ctenochaetus strigosus*	7	10	1.09	D	I
8/19/22	KO2	*Ctenochaetus strigosus*	10	6	0.32	D	I
8/19/22	KO2	*Ctenochaetus strigosus*	5	12	1.38	D	I
8/19/22	KO2	*Ctenochaetus strigosus*	6	20	8.13	D	I
8/19/22	KO2	*Ctenochaetus strigosus*	15	16	10.14	D	I
8/19/22	KO2	*Ctenochaetus strigosus*	5	4	0.04	D	I
8/19/22	KO2	*Ctenochaetus strigosus*	1	3	0.00	D	I
8/19/22	KO2	*Plectroglyphidodon imparipennis*	10	4	0.09	MI	I
8/19/22	KO2	*Plectroglyphidodon imparipennis*	4	6	0.12	MI	I

8/19/22	KO2	*Canthigaster jactator*	5	4	0.06	H	E
8/19/22	KO2	*Canthigaster jactator*	1	6	0.04	H	E
8/19/22	KO2	*Zebrasoma flavescens*	9	5	0.33	H	I
8/19/22	KO2	*Zebrasoma flavescens*	1	10	0.20	H	I
8/19/22	KO2	*Zebrasoma flavescens*	4	15	2.24	H	I
8/19/22	KO2	*Chaetodon unimaculatus*	3	15	1.75	C	I
8/19/22	KO2	*Thalassoma duperrey*	7	8	0.24	MI	E
8/19/22	KO2	*Thalassoma duperrey*	8	10	0.56	MI	E
8/19/22	KO2	*Thalassoma duperrey*	4	15	0.99	MI	E
8/19/22	KO2	*Thalassoma duperrey*	5	6	0.07	MI	E
8/19/22	KO2	*Thalassoma duperrey*	3	12	0.37	MI	E
8/19/22	KO2	*Chaetodon multicinctus*	5	10	0.73	C	E
8/19/22	KO2	*Chaetodon multicinctus*	4	12	1.01	C	E
8/19/22	KO2	*Melichthys niger*	4	22	6.50	H	I
8/19/22	KO2	*Melichthys niger*	13	24	26.74	H	I
8/19/22	KO2	*Melichthys vidua*	4	26	11.58	H	I
8/19/22	KO2	*Plectroglyphidodon johnstonianus*	6	6	0.19	C	I
8/19/22	KO2	*Plectroglyphidodon johnstonianus*	2	8	0.15	C	I
8/19/22	KO2	*Stethojulis balteata*	1	6	0.02	MI	E
8/19/22	KO2	*Stethojulis balteata*	1	10	0.09	MI	E
8/19/22	KO2	*Cephalopholis argus*	1	24	1.20	P	X
8/19/22	KO2	*Labroides phthirophagus*	2	8	0.03	P	E
8/19/22	KO2	*Acanthurus nigricans*	1	18	0.55	H	I
8/19/22	KO2	*Acanthurus nigricans*	1	16	0.39	H	I
8/19/22	KO2	*Acanthurus nigricans*	1	8	0.05	H	I
8/19/22	KO2	*Gomphosus varius*	1	12	0.11	MI	I
8/19/22	KO2	*Acanthurus triostegus*	1	10	0.10	H	I
8/19/22	KO2	*Scarus psittacus*	2	20	2.08	H	I
8/19/22	KO2	*Scarus psittacus*	1	25	2.17	H	I
8/19/22	KO2	*Zanclus cornutus*	2	16	1.26	SI	I
8/19/22	KO2	*Parupeneus multifasciatus*	3	10	0.23	MI	I
8/19/22	KO2	*Parupeneus multifasciatus*	1	12	0.13	MI	I
8/19/22	KO2	*Sufflamen bursa*	4	15	1.87	MI	I
8/19/22	KO2	*Parupeneus bifasciatus*	1	20	1.00	MI	I
8/19/22	KO2	*Stegastes fasciolatus*	1	9	0.11	H	I
8/19/22	KO2	*Chromis vanderbilti*	35	4	0.24	Z	I
8/19/22	KO2	*Forcipiger flavissimus*	2	17	0.70	SI	I
8/19/22	KO2	*Paracirrhites arcatus*	1	8	0.06	MI	I

8/19/22	KO2	*Paracirrhites arcatus*	1	4	0.00	MI	I
8/19/22	KO2	*Acanthurus triostegus*	2	15	0.82	H	I
8/19/22	KO2	*Chaetodon ornatissimus*	3	16	2.29	C	I
8/19/22	KO2	*Chaetodon ornatissimus*	1	20	1.51	C	I
8/19/22	KO2	*Chaetodon ephippium*	2	20	2.07	MI	I
8/19/22	KO2	*Sufflamen fraenatus*	2	24	3.58	MI	I
8/19/22	KO2	*Monotaxis grandoculis*	1	22	1.20	MI	I
8/19/22	KO2	*Gomphosus varius*	2	12	0.21	MI	I
8/19/22	KO2	*Gomphosus varius*	1	15	0.18	MI	I
8/19/22	KO2	*Gomphosus varius*	2	10	0.13	MI	I
8/19/22	KO2	*Gomphosus varius*	1	6	0.02	MI	I
8/19/22	7B	*Chromis vanderbilti*	103	4	0.71	Z	I
8/19/22	7B	*Chromis vanderbilti*	20	3	0.06	Z	I
8/19/22	7B	*Chromis vanderbilti*	40	2	0.03	Z	I
8/19/22	7B	*Thalassoma duperrey*	1	15	0.25	MI	E
8/19/22	7B	*Thalassoma duperrey*	2	10	0.14	MI	E
8/19/22	7B	*Thalassoma duperrey*	1	20	0.61	MI	E
8/19/22	7B	*Sargocentron xantherythrum*	1	12	0.17	MI	
8/19/22	7B	*Stethojulis balteata*	1	12	0.17	MI	E
8/19/22	7B	*Stethojulis balteata*	2	10	0.19	MI	E
8/19/22	7B	*Parupeneus multifasciatus*	4	15	1.07	MI	I
8/19/22	7B	*Parupeneus multifasciatus*	1	20	0.66	MI	I
8/19/22	7B	*Lutjanus kasmira*	1	20	0.79	MI	X
8/19/22	7B	*Zanclus cornutus*	3	15	1.57	SI	I
8/19/22	7B	*Zanclus cornutus*	1	16	0.63	SI	I
8/19/22	7B	*Apogon menesemus*	1	14	0.26	MI	E
8/19/22	7B	*Apogon kallopterus*	1	12	0.18	MI	I
8/19/22	7B	*Naso lituratus*	2	8	0.09	H	I
8/19/22	7B	*Plectroglyphidodon johnstonianus*	2	8	0.15	C	I
8/19/22	7B	*Plectroglyphidodon johnstonianus*	2	4	0.02	C	I
8/19/22	7B	*Dascyllus albisella*	6	12	1.86	Z	E
8/19/22	7B	*Dascyllus albisella*	2	6	0.06	Z	E
8/19/22	7B	*Ctenochaetus strigosus*	1	8	0.08	D	I
8/19/22	7B	*Ctenochaetus strigosus*	3	6	0.10	D	I
8/19/22	7B	*Chaetodon multicinctus*	2	8	0.15	C	E
8/19/22	7B	*Oxycheilinus bimaculatus*	1	5	0.00	MI	I
8/19/22	7B	*Parupeneus pleurostigma*	2	10	0.19	MI	I
8/19/22	7B	*Canthigaster jactator*	3	4	0.04	H	E

8/19/22	7B	*Acanthurus nigrofuscus*	5	8	0.30	H	I
8/19/22	7B	*Acanthurus nigrofuscus*	8	12	1.54	H	I
8/19/22	7B	*Acanthurus nigrofuscus*	3	10	0.34	H	I
8/19/22	7B	*Sufflamen bursa*	8	15	3.73	MI	I
8/19/22	7B	*Acanthurus olivaceus*	1	22	1.04	H	I
8/19/22	7B	*Acanthurus olivaceus*	3	12	0.49	H	I
8/19/22	7B	*Plectroglyphidodon imparipennis*	1	4	0.01	MI	I
8/19/22	7B	*Parupeneus cyclostomus*	1	20	1.41	P	I
8/19/22	7B	*Paracirrhites arcatus*	1	5	0.01	MI	I
8/19/22	7B	*Gomphosus varius*	1	22	0.48	MI	I
8/19/22	7B	*Canthigaster jactator*	1	6	0.04	H	E
8/19/22	7B	*Naso unicornis*	1	18	0.62	H	I
8/19/22	7E	*Thalassoma duperrey*	5	12	0.62	MI	E
8/19/22	7E	*Thalassoma duperrey*	1	20	0.61	MI	E
8/19/22	7E	*Thalassoma duperrey*	2	5	0.02	MI	E
8/19/22	7E	*Thalassoma duperrey*	3	18	1.32	MI	E
8/19/22	7E	*Thalassoma duperrey*	1	10	0.07	MI	E
8/19/22	7E	*Sufflamen bursa*	7	15	3.26	MI	I
8/19/22	7E	*Sufflamen bursa*	4	18	3.14	MI	I
8/19/22	7E	*Chaetodon miliaris*	4	10	0.56	Z	E
8/19/22	7E	*Chaetodon miliaris*	1	6	0.03	Z	E
8/19/22	7E	*Chaetodon miliaris*	2	5	0.04	Z	E
8/19/22	7E	*Parupeneus multifasciatus*	4	12	0.53	MI	I
8/19/22	7E	*Parupeneus multifasciatus*	1	21	0.77	MI	I
8/19/22	7E	*Parupeneus multifasciatus*	2	15	0.54	MI	I
8/19/22	7E	*Parupeneus multifasciatus*	3	10	0.23	MI	I
8/19/22	7E	*Paracirrhites arcatus*	4	6	0.08	MI	I
8/19/22	7E	*Canthigaster jactator*	1	5	0.02	H	E
8/19/22	7E	*Canthigaster jactator*	3	4	0.04	H	E
8/19/22	7E	*Chromis vanderbilti*	20	3	0.06	Z	I
8/19/22	7E	*Chromis vanderbilti*	10	2	0.01	Z	I
8/19/22	7E	*Chromis vanderbilti*	10	4	0.07	Z	I
8/19/22	7E	*Parupeneus cyclostomus*	2	15	0.94	P	I
8/19/22	7E	*Plagiotremus goslinei*	1	7	0.01	P	E
8/19/22	7E	*Ostracion meleagris*	1	8	0.08	SI	I
8/19/22	7E	*Xyrichtys umbrilatus*	1	6	0.01	MI	E
8/19/22	7E	*Pseudojuloides cerasinus*	5	6	0.07	MI	I
8/19/22	7E	*Oxycheilinus bimaculatus*	3	5	0.01	MI	I

8/19/22	7E	*Melichthys vidua*	1	24	2.36	H	I
8/19/22	7E	*Acanthurus olivaceus*	2	25	3.08	H	I
8/19/22	7E	*Chromis vanderbilti*	110	4	0.76	Z	I
8/19/22	7E	*Chromis vanderbilti*	65	5	0.87	Z	I
8/19/22	7E	*Chromis vanderbilti*	30	2	0.03	Z	I
8/19/22	7E	*Acanthurus nigrofuscus*	1	10	0.11	H	I
8/19/22	7E	*Acanthurus nigrofuscus*	1	5	0.02	H	I
8/19/22	7E	*Parupeneus multifasciatus*	2	8	0.08	MI	I
8/19/22	7E	*Canthigaster coronata*	1	7	0.05	SI	I
8/19/22	7E	*Canthigaster coronata*	1	9	0.11	SI	I
8/19/22	7E	*Halichoeres ornatissimus*	1	12	0.08	MI	I
8/19/22	7E	*Centropyge potteri*	1	8	0.11	H	E
8/19/22	NANA1	*Chromis vanderbilti*	1	5	0.01	Z	I
8/19/22	NANA1	*Chromis vanderbilti*	4	4	0.03	Z	I
8/19/22	NANA1	*Chromis vanderbilti*	5	2	0.00	Z	I
8/19/22	NANA1	*Chromis vanderbilti*	12	3	0.04	Z	I
8/19/22	NANA1	*Cirripectes vanderbilti*	1	8	0.02	H	E
8/19/22	NANA1	*Ctenochaetus strigosus*	1	3	0.00	D	I
8/19/22	NANA1	*Parupeneus bifasciatus*	1	4	0.01	MI	I
8/19/22	NANA1	*Plectroglyphidodon imparipennis*	6	4	0.05	MI	I
8/19/22	NANA1	*Parupeneus multifasciatus*	4	8	0.15	MI	I
8/19/22	NANA1	*Parupeneus multifasciatus*	5	14	1.08	MI	I
8/19/22	NANA1	*Parupeneus multifasciatus*	2	16	0.66	MI	I
8/19/22	NANA1	*Parupeneus multifasciatus*	1	6	0.02	MI	I
8/19/22	NANA1	*Thalassoma duperrey*	4	6	0.06	MI	E
8/19/22	NANA1	*Thalassoma duperrey*	10	3	0.02	MI	E
8/19/22	NANA1	*Rhinecanthus rectangulus*	3	20	3.19	MI	I
8/19/22	NANA1	*Rhinecanthus rectangulus*	1	22	1.39	MI	I
8/19/22	NANA1	*Thalassoma ballieui*	1	18	0.47	MI	E
8/19/22	NANA1	*Thalassoma ballieui*	1	14	0.21	MI	E
8/19/22	NANA1	*Canthigaster jactator*	1	6	0.04	H	E
8/19/22	NANA1	*Canthigaster jactator*	1	4	0.01	H	E
8/19/22	NANA1	*Chaetodon quadrimaculatus*	2	10	0.34	C	I
8/19/22	NANA1	*Stethojulis balteata*	2	10	0.19	MI	E
8/19/22	NANA1	*Ostracion meleagris*	1	12	0.28	SI	I
8/19/22	NANA1	*Thalassoma trilobatum*	2	15	0.58	MI	I
8/19/22	NANA1	*Thalassoma trilobatum*	2	10	0.17	MI	I
8/19/22	NANA2	*Parupeneus multifasciatus*	5	15	1.34	MI	I

8/19/22	NANA2	*Thalassoma duperrey*	3	12	0.37	MI	E
8/19/22	NANA2	*Thalassoma duperrey*	7	10	0.49	MI	E
8/19/22	NANA2	*Thalassoma duperrey*	2	15	0.50	MI	E
8/19/22	NANA2	*Acanthurus nigrofuscus*	9	12	1.73	H	I
8/19/22	NANA2	*Acanthurus nigrofuscus*	7	8	0.42	H	I
8/19/22	NANA2	*Acanthurus nigrofuscus*	1	14	0.30	H	I
8/19/22	NANA2	*Acanthurus nigrofuscus*	2	6	0.05	H	I
8/19/22	NANA2	*Acanthurus nigrofuscus*	5	8	0.30	H	I
8/19/22	NANA2	*Acanthurus nigrofuscus*	1	4	0.01	H	I
8/19/22	NANA2	*Canthigaster jactator*	3	6	0.11	H	E
8/19/22	NANA2	*Canthigaster jactator*	1	3	0.01	H	E
8/19/22	NANA2	*Plectroglyphidodon imparipennis*	1	4	0.01	MI	I
8/19/22	NANA2	*Chaetodon ornatissimus*	2	20	3.03	C	I
8/19/22	NANA2	*Chaetodon ornatissimus*	3	16	2.29	C	I
8/19/22	NANA2	*Chaetodon ornatissimus*	1	5	0.02	C	I
8/19/22	NANA2	*Stethojulis balteata*	7	8	0.32	MI	E
8/19/22	NANA2	*Parupeneus cyclostomus*	1	8	0.04	P	I
8/19/22	NANA2	*Stegastes fasciolatus*	1	8	0.08	H	I
8/19/22	NANA2	*Acanthurus triostegus*	4	16	2.05	H	I
8/19/22	NANA2	*Acanthurus olivaceus*	2	23	2.39	H	I
8/19/22	NANA2	*Acanthurus olivaceus*	3	25	4.62	H	I
8/19/22	NANA2	*Acanthurus olivaceus*	1	8	0.05	H	I
8/19/22	NANA2	*Acanthurus leucopareius*	30	20	42.16	H	I
8/19/22	NANA2	*Naso lituratus*	1	24	1.42	H	I
8/19/22	NANA2	*Melichthys vidua*	1	25	2.62	H	I
8/19/22	NANA2	*Zebrasoma flavescens*	2	15	1.12	H	I
8/19/22	NANA2	*Zebrasoma flavescens*	3	6	0.17	H	I
8/19/22	NANA2	*Zebrasoma flavescens*	2	4	0.04	H	I
8/19/22	NANA2	*Sufflamen bursa*	4	16	2.24	MI	I
8/19/22	NANA2	*Lutjanus fulvus*	4	22	2.23	MI	X
8/19/22	NANA2	*Chaetodon quadrimaculatus*	1	14	0.49	C	I
8/19/22	NANA2	*Melichthys niger*	2	24	4.11	H	I
8/19/22	NANA2	*Chaetodon multicinctus*	2	10	0.29	C	E
8/19/22	NANA2	*Gomphosus varius*	1	22	0.48	MI	I
8/19/22	NANA2	*Gomphosus varius*	1	10	0.07	MI	I
8/19/22	NANA2	*Ctenochaetus strigosus*	8	6	0.25	D	I
8/19/22	NANA2	*Ctenochaetus strigosus*	2	10	0.31	D	I
8/19/22	NANA2	*Ctenochaetus strigosus*	8	8	0.62	D	I

8/19/22	NANA2	*Ctenochaetus strigosus*	2	4	0.02	D	I
8/19/22	NANA2	*Chromis hanui*	3	6	0.05	Z	E
8/19/22	NANA2	*Chromis vanderbilti*	25	5	0.34	Z	I
8/19/22	NANA2	*Stegastes fasciolatus*	1	8	0.08	H	I
8/19/22	NANA2	*Lutjanus fulvus*	1	20	0.42	MI	X
8/19/22	NANA2	*Cirrhitus pinnulatus*	1	12	0.22	MI	I
8/19/22	NANA2	*Macropharyngodon geoffroyi*	1	8	0.06	MI	E
10/31/22	KO1	*Acanthurus nigrofuscus*	5	8	0.30	H	I
10/31/22	KO1	*Acanthurus nigrofuscus*	10	12	1.93	H	I
10/31/22	KO1	*Acanthurus nigrofuscus*	5	10	0.57	H	I
10/31/22	KO1	*Thalassoma duperrey*	5	15	1.24	MI	E
10/31/22	KO1	*Thalassoma duperrey*	5	10	0.35	MI	E
10/31/22	KO1	*Thalassoma duperrey*	5	4	0.02	MI	E
10/31/22	KO1	*Thalassoma duperrey*	8	7	0.18	MI	E
10/31/22	KO1	*Thalassoma duperrey*	11	18	4.83	MI	E
10/31/22	KO1	*Ctenochaetus strigosus*	18	15	9.94	D	I
10/31/22	KO1	*Ctenochaetus strigosus*	23	12	6.33	D	I
10/31/22	KO1	*Ctenochaetus strigosus*	6	10	0.94	D	I
10/31/22	KO1	*Ctenochaetus strigosus*	2	8	0.16	D	I
10/31/22	KO1	*Ctenochaetus strigosus*	5	5	0.09	D	I
10/31/22	KO1	*Ctenochaetus strigosus*	1	15	0.55	D	I
10/31/22	KO1	*Canthigaster jactator*	1	4	0.01	H	E
10/31/22	KO1	*Canthigaster jactator*	2	3	0.01	H	E
10/31/22	KO1	*Melichthys niger*	9	24	18.51	H	I
10/31/22	KO1	*Chaetodon ornatissimus*	1	16	0.76	C	I
10/31/22	KO1	*Cirripectes vanderbilti*	1	8	0.02	H	E
10/31/22	KO1	*Plectroglyphidodon johnstonianus*	1	5	0.02	C	I
10/31/22	KO1	*Plectroglyphidodon johnstonianus*	2	7	0.10	C	I
10/31/22	KO1	*Stethojulis balteata*	1	10	0.09	MI	E
10/31/22	KO1	*Stethojulis balteata*	1	8	0.05	MI	E
10/31/22	KO1	*Stethojulis balteata*	1	15	0.33	MI	E
10/31/22	KO1	*Lutjanus kasmira*	5	22	5.56	MI	X
10/31/22	KO1	*Sufflamen bursa*	2	20	2.12	MI	I
10/31/22	KO1	*Sufflamen bursa*	1	18	0.79	MI	I
10/31/22	KO1	*Chaetodon multicinctus*	6	12	1.52	C	E
10/31/22	KO1	*Monotaxis grandoculis*	3	15	1.04	MI	I
10/31/22	KO1	*Lutjanus fulvus*	2	24	1.45	MI	X
10/31/22	KO1	*Labroides phthirophagus*	1	8	0.02	P	E

10/31/22	KO1	*Chaetodon quadrimaculatus*	1	12	0.30	C	I
10/31/22	KO2	*Thalassoma duperrey*	6	15	1.49	MI	E
10/31/22	KO2	*Thalassoma duperrey*	8	5	0.06	MI	E
10/31/22	KO2	*Thalassoma duperrey*	14	12	1.74	MI	E
10/31/22	KO2	*Thalassoma duperrey*	1	20	0.61	MI	E
10/31/22	KO2	*Ctenochaetus strigosus*	13	6	0.41	D	I
10/31/22	KO2	*Ctenochaetus strigosus*	2	18	1.95	D	I
10/31/22	KO2	*Ctenochaetus strigosus*	2	14	0.89	D	I
10/31/22	KO2	*Ctenochaetus strigosus*	4	12	1.10	D	I
10/31/22	KO2	*Ctenochaetus strigosus*	3	8	0.23	D	I
10/31/22	KO2	*Ctenochaetus strigosus*	3	5	0.05	D	I
10/31/22	KO2	*Sufflamen bursa*	1	18	0.79	MI	I
10/31/22	KO2	*Canthigaster jactator*	2	4	0.03	H	E
10/31/22	KO2	*Plectroglyphidodon imparipennis*	9	4	0.08	MI	I
10/31/22	KO2	*Plectroglyphidodon imparipennis*	3	5	0.05	MI	I
10/31/22	KO2	*Forcipiger flavissimus*	1	16	0.29	SI	I
10/31/22	KO2	*Acanthurus nigrofuscus*	9	12	1.73	H	I
10/31/22	KO2	*Acanthurus nigrofuscus*	12	10	1.38	H	I
10/31/22	KO2	*Acanthurus nigrofuscus*	1	6	0.03	H	I
10/31/22	KO2	*Acanthurus nigrofuscus*	1	15	0.36	H	I
10/31/22	KO2	*Plectroglyphidodon johnstonianus*	1	4	0.01	C	I
10/31/22	KO2	*Plectroglyphidodon johnstonianus*	4	7	0.20	C	I
10/31/22	KO2	*Plectroglyphidodon johnstonianus*	2	5	0.04	C	I
10/31/22	KO2	*Zebrasoma flavescens*	2	10	0.41	H	I
10/31/22	KO2	*Zebrasoma flavescens*	5	6	0.29	H	I
10/31/22	KO2	*Zebrasoma flavescens*	2	15	1.12	H	I
10/31/22	KO2	*Zebrasoma flavescens*	3	12	0.96	H	I
10/31/22	KO2	*Acanthurus nigroris*	1	18	0.61	H	I
10/31/22	KO2	*Acanthurus blochii*	1	18	0.29	H	I
10/31/22	KO2	*Acanthurus blochii*	1	15	0.17	H	I
10/31/22	KO2	*Acanthurus leucopareius*	1	16	0.71	H	I
10/31/22	KO2	*Chaetodon unimaculatus*	2	15	1.17	C	I
10/31/22	KO2	*Melichthys vidua*	1	25	2.62	H	I
10/31/22	KO2	*Stethojulis balteata*	2	7	0.06	MI	E
10/31/22	KO2	*Stethojulis balteata*	1	10	0.09	MI	E
10/31/22	KO2	*Acanthurus olivaceus*	2	24	2.72	H	I
10/31/22	KO2	*Gomphosus varius*	1	8	0.04	MI	I
10/31/22	KO2	*Chaetodon multicinctus*	4	12	1.01	C	E

10/31/22	KO2	*Zanclus cornutus*	2	18	1.77	SI	I
10/31/22	KO2	*Chromis vanderbilti*	20	4	0.14	Z	I
10/31/22	KO2	*Chaetodon ornatissimus*	2	20	3.03	C	I
10/31/22	5D	*Exallias brevis*	1	8	0.04	C	I
10/31/22	5D	*Thalassoma duperrey*	11	12	1.36	MI	E
10/31/22	5D	*Thalassoma duperrey*	4	10	0.28	MI	E
10/31/22	5D	*Thalassoma duperrey*	5	15	1.24	MI	E
10/31/22	5D	*Thalassoma duperrey*	2	20	1.22	MI	E
10/31/22	5D	*Thalassoma duperrey*	3	7	0.07	MI	E
10/31/22	5D	*Acanthurus nigrofuscus*	16	12	3.08	H	I
10/31/22	5D	*Acanthurus nigrofuscus*	63	11	9.48	H	I
10/31/22	5D	*Acanthurus nigrofuscus*	2	5	0.03	H	I
10/31/22	5D	*Acanthurus nigrofuscus*	3	7	0.12	H	I
10/31/22	5D	*Acanthurus nigrofuscus*	12	10	1.38	H	I
10/31/22	5D	*Parupeneus multifasciatus*	2	10	0.15	MI	I
10/31/22	5D	*Parupeneus multifasciatus*	1	8	0.04	MI	I
10/31/22	5D	*Parupeneus multifasciatus*	4	14	0.86	MI	I
10/31/22	5D	*Parupeneus multifasciatus*	2	20	1.32	MI	I
10/31/22	5D	*Plectroglyphidodon johnstonianus*	2	4	0.02	C	I
10/31/22	5D	*Plectroglyphidodon johnstonianus*	2	5	0.04	C	I
10/31/22	5D	*Plectroglyphidodon johnstonianus*	1	7	0.05	C	I
10/31/22	5D	*Acanthurus blochii*	1	10	0.05	H	I
10/31/22	5D	*Acanthurus olivaceus*	2	8	0.10	H	I
10/31/22	5D	*Chromis vanderbilti*	111	3	0.32	Z	I
10/31/22	5D	*Chromis vanderbilti*	21	4	0.14	Z	I
10/31/22	5D	*Stegastes fasciolatus*	1	7	0.05	H	I
10/31/22	5D	*Pervagor spilosoma*	3	10	0.30	H	E
10/31/22	5D	*Halichoeres ornatissimus*	1	10	0.06	MI	I
10/31/22	5D	*Canthigaster jactator*	3	4	0.04	H	E
10/31/22	5D	*Forcipiger flavissimus*	1	15	0.23	SI	I
10/31/22	5D	*Forcipiger flavissimus*	1	13	0.15	SI	I
10/31/22	5D	*Cantherhines sandwichiensis*	2	10	0.29	H	E
10/31/22	5D	*Plectroglyphidodon imparipennis*	10	4	0.09	MI	I
10/31/22	5D	*Plectroglyphidodon imparipennis*	3	5	0.05	MI	I
10/31/22	5D	*Stethojulis balteata*	2	10	0.19	MI	E
10/31/22	5D	*Stethojulis balteata*	1	13	0.21	MI	E
10/31/22	5D	*Paracirrhites arcatus*	1	7	0.03	MI	I
10/31/22	5D	*Paracirrhites arcatus*	1	5	0.01	MI	I

10/31/22	5D	*Canthigaster amboinensis*	2	8	0.28	H	I
10/31/22	5D	*Naso lituratus*	3	6	0.06	H	I
10/31/22	5D	*Naso lituratus*	2	8	0.09	H	I
10/31/22	5D	*Naso lituratus*	10	10	0.94	H	I
10/31/22	5D	*Sufflamen bursa*	1	4	0.01	MI	I
10/31/22	5D	*Zanclus cornutus*	1	15	0.52	SI	I
10/31/22	5D	*Coris gaimard*	3	8	0.09	MI	I
10/31/22	5D	*Rhinecanthus rectangulus*	1	20	1.06	MI	I
10/31/22	5D	*Canthigaster jactator*	1	3	0.01	H	E
10/31/22	NANA2	*Acanthurus nigrofuscus*	3	3	0.01	H	I
10/31/22	NANA2	*Acanthurus nigrofuscus*	38	10	4.36	H	I
10/31/22	NANA2	*Acanthurus nigrofuscus*	30	5	0.48	H	I
10/31/22	NANA2	*Acanthurus nigrofuscus*	7	12	1.35	H	I
10/31/22	NANA2	*Thalassoma duperrey*	6	15	1.49	MI	E
10/31/22	NANA2	*Thalassoma duperrey*	1	12	0.12	MI	E
10/31/22	NANA2	*Acanthurus blochii*	1	10	0.05	H	I
10/31/22	NANA2	*Sufflamen bursa*	1	14	0.38	MI	I
10/31/22	NANA2	*Sufflamen bursa*	3	18	2.36	MI	I
10/31/22	NANA2	*Ctenochaetus strigosus*	10	8	0.78	D	I
10/31/22	NANA2	*Ctenochaetus strigosus*	9	10	1.40	D	I
10/31/22	NANA2	*Ctenochaetus strigosus*	13	6	0.41	D	I
10/31/22	NANA2	*Ctenochaetus strigosus*	4	12	1.10	D	I
10/31/22	NANA2	*Canthigaster jactator*	1	3	0.01	H	E
10/31/22	NANA2	*Paracirrhites arcatus*	1	8	0.06	MI	I
10/31/22	NANA2	*Paracirrhites arcatus*	1	6	0.02	MI	I
10/31/22	NANA2	*Stethojulis balteata*	1	8	0.05	MI	E
10/31/22	NANA2	*Zebrasoma flavescens*	4	8	0.47	H	I
10/31/22	NANA2	*Zebrasoma flavescens*	1	3	0.01	H	I
10/31/22	NANA2	*Zebrasoma flavescens*	5	4	0.10	H	I
10/31/22	NANA2	*Zebrasoma flavescens*	1	20	1.15	H	I
10/31/22	NANA2	*Acanthurus achilles*	1	12	0.30	H	I
10/31/22	NANA2	*Plectroglyphidodon johnstonianus*	2	4	0.02	C	I
10/31/22	NANA2	*Acanthurus leucopareius*	9	18	9.14	H	I
10/31/22	NANA2	*Acanthurus leucopareius*	12	20	16.86	H	I
10/31/22	NANA2	*Chaetodon multicinctus*	3	8	0.22	C	E
10/31/22	NANA2	*Chaetodon multicinctus*	2	5	0.04	C	E
10/31/22	NANA2	*Parupeneus multifasciatus*	2	10	0.15	MI	I
10/31/22	NANA2	*Parupeneus multifasciatus*	2	15	0.54	MI	I

10/31/22	NANA2	*Chaetodon ornatissimus*	2	16	1.53	C	I
10/31/22	NANA2	*Canthigaster jactator*	5	3	0.03	H	E
10/31/22	NANA2	*Canthigaster jactator*	2	4	0.03	H	E
10/31/22	NANA2	*Lutjanus fulvus*	4	22	2.23	MI	X
10/31/22	NANA2	*Melichthys vidua*	3	24	7.07	H	I
10/31/22	NANA2	*Parupeneus cyclostomus*	2	14	0.72	P	I
10/31/22	NANA2	*Parupeneus cyclostomus*	1	10	0.10	P	I
10/31/22	NANA2	*Forcipiger flavissimus*	1	15	0.23	SI	I
10/31/22	NANA2	*Stegastes fasciolatus*	5	8	0.38	H	I
10/31/22	NANA2	*Stegastes fasciolatus*	2	10	0.30	H	I
10/31/22	NANA2	*Stegastes fasciolatus*	1	3	0.00	H	I
10/31/22	NANA2	*Cirripectes vanderbilti*	1	8	0.02	H	E
10/31/22	NANA2	*Chaetodon lunula*	2	15	0.68	SI	I
10/31/22	NANA2	*Halichoeres ornatissimus*	1	12	0.08	MI	I
10/31/22	NANA2	*Chromis vanderbilti*	5	4	0.03	Z	I
10/31/22	NANA2	*Zanclus cornutus*	1	15	0.52	SI	I
10/31/22	NANA2	*Naso brevirostris*	8	25	14.89	Z	I
10/31/22	7B	*Halichoeres ornatissimus*	1	12	0.08	MI	I
10/31/22	7B	*Halichoeres ornatissimus*	1	10	0.06	MI	I
10/31/22	7B	*Acanthurus nigrofuscus*	9	12	1.73	H	I
10/31/22	7B	*Acanthurus nigrofuscus*	7	10	0.80	H	I
10/31/22	7B	*Acanthurus nigrofuscus*	8	6	0.21	H	I
10/31/22	7B	*Myripristis kuntee*	2	12	0.37	Z	I
10/31/22	7B	*Apogon kallopterus*	2	12	0.35	MI	I
10/31/22	7B	*Chromis vanderbilti*	88	3	0.26	Z	I
10/31/22	7B	*Chromis hanui*	2	5	0.02	Z	E
10/31/22	7B	*Mulloidichthys vanicolensis*	4	10	0.28	MI	I
10/31/22	7B	*Mulloidichthys vanicolensis*	1	14	0.21	MI	I
10/31/22	7B	*Plectroglyphidodon imparipennis*	2	4	0.02	MI	I
10/31/22	7B	*Forcipiger flavissimus*	5	15	1.17	SI	I
10/31/22	7B	*Canthigaster jactator*	4	4	0.05	H	E
10/31/22	7B	*Acanthurus blochii*	1	10	0.05	H	I
10/31/22	7B	*Acanthurus blochii*	2	15	0.33	H	I
10/31/22	7B	*Oxycheilinus bimaculatus*	1	6	0.01	MI	I
10/31/22	7B	*Acanthurus triostegus*	3	10	0.30	H	I
10/31/22	7B	*Fistularia commersonii*	1	15	0.01	P	I
10/31/22	7B	*Zanclus cornutus*	2	10	0.33	SI	I
10/31/22	7B	*Ctenochaetus strigosus*	4	6	0.13	D	I

10/31/22	7B	*Cirrhitops fasciatus*	1	8	0.05	MI	I
10/31/22	7B	*Parupeneus bifasciatus*	1	15	0.41	MI	I
10/31/22	7B	*Centropyge potteri*	1	7	0.08	H	E
10/31/22	7B	*Stethojulis balteata*	1	12	0.17	MI	E
10/31/22	7B	*Stethojulis balteata*	1	10	0.09	MI	E
10/31/22	7B	*Stethojulis balteata*	1	15	0.33	MI	E
10/31/22	7B	*Gomphosus varius*	1	20	0.38	MI	I
10/31/22	7B	*Dascyllus albisella*	1	10	0.17	Z	E
10/31/22	7B	*Dascyllus albisella*	2	4	0.02	Z	E
10/31/22	7B	*Thalassoma duperrey*	3	20	1.83	MI	E
10/31/22	7B	*Thalassoma duperrey*	3	12	0.37	MI	E
10/31/22	7B	*Thalassoma duperrey*	6	15	1.49	MI	E
10/31/22	7B	*Thalassoma duperrey*	7	10	0.49	MI	E
10/31/22	7B	*Parupeneus multifasciatus*	6	16	1.97	MI	I
10/31/22	7B	*Parupeneus multifasciatus*	6	12	0.80	MI	I
10/31/22	7B	*Parupeneus multifasciatus*	2	20	1.32	MI	I
10/31/22	7B	*Chaetodon multicinctus*	1	3	0.00	C	E
10/31/22	7B	*Chaetodon multicinctus*	3	5	0.05	C	E
10/31/22	7B	*Chaetodon miliaris*	1	10	0.14	Z	E
10/31/22	7B	*Melichthys vidua*	1	24	2.36	H	I
10/31/22	7B	*Acanthurus olivaceus*	2	12	0.33	H	I
10/31/22	7B	*Acanthurus olivaceus*	2	15	0.65	H	I
10/31/22	7B	*Acanthurus olivaceus*	2	8	0.10	H	I
10/31/22	7B	*Naso lituratus*	1	8	0.05	H	I
10/31/22	7B	*Parupeneus cyclostomus*	2	20	2.82	P	I
10/31/22	7B	*Coris gaimard*	1	20	0.62	MI	I
10/31/22	7B	*Chaetodon kleinii*	2	10	0.27	Z	I
10/31/22	7B	*Parupeneus pleurostigma*	1	16	0.38	MI	I
10/31/22	7B	*Calotomus zonarchus*	1	12	0.18	H	E
10/31/22	7B	*Sufflamen bursa*	4	18	3.14	MI	I
10/31/22	7B	*Paracirrhites arcatus*	4	6	0.08	MI	I
10/31/22	7B	*Gomphosus varius*	1	12	0.11	MI	I
10/31/22	7B	*Naso unicornis*	1	12	0.20	H	I
10/31/22	7B	*Sargocentron diadema*	1	10	0.09	MI	I
10/31/22	7E	*Sufflamen bursa*	4	18	3.14	MI	I
10/31/22	7E	*Sufflamen bursa*	1	16	0.56	MI	I
10/31/22	7E	*Canthigaster jactator*	5	4	0.06	H	E
10/31/22	7E	*Thalassoma duperrey*	3	20	1.83	MI	E
10/31/22	7E	*Thalassoma duperrey*	2	7	0.05	MI	E

10/31/22	7E	*Thalassoma duperrey*	1	5	0.01	MI	E
10/31/22	7E	*Thalassoma duperrey*	5	15	1.24	MI	E
10/31/22	7E	*Acanthurus nigrofuscus*	5	10	0.57	H	I
10/31/22	7E	*Acanthurus nigrofuscus*	9	3	0.03	H	I
10/31/22	7E	*Acanthurus nigrofuscus*	5	8	0.30	H	I
10/31/22	7E	*Acanthurus nigrofuscus*	1	12	0.19	H	I
10/31/22	7E	*Naso unicornis*	1	22	1.10	H	I
10/31/22	7E	*Naso lituratus*	2	22	2.17	H	I
10/31/22	7E	*Paracirrhites arcatus*	5	6	0.10	MI	I
10/31/22	7E	*Paracirrhites arcatus*	1	3	0.00	MI	I
10/31/22	7E	*Paracirrhites arcatus*	2	4	0.01	MI	I
10/31/22	7E	*Parupeneus multifasciatus*	4	12	0.53	MI	I
10/31/22	7E	*Parupeneus multifasciatus*	9	8	0.34	MI	I
10/31/22	7E	*Parupeneus multifasciatus*	1	20	0.66	MI	I
10/31/22	7E	*Parupeneus multifasciatus*	2	16	0.66	MI	I
10/31/22	7E	*Parupeneus pleurostigma*	1	8	0.05	MI	I
10/31/22	7E	*Chromis vanderbilti*	1	3	0.00	Z	I
10/31/22	7E	*Oxycheilinus bimaculatus*	2	4	0.00	MI	I
10/31/22	7E	*Oxycheilinus bimaculatus*	5	6	0.05	MI	I
10/31/22	7E	*Acanthurus olivaceus*	4	22	4.18	H	I
10/31/22	7E	*Canthigaster coronata*	1	8	0.08	SI	I
10/31/22	7E	*Cantherhines dumerilii*	1	32	3.89	C	I
10/31/22	7E	*Zanclus cornutus*	1	18	0.88	SI	I
10/31/22	7E	*Acanthurus blochii*	2	20	0.79	H	I
10/31/22	7E	*Acanthurus blochii*	1	16	0.20	H	I
10/31/22	7E	*Ostracion meleagris*	1	4	0.01	SI	I
10/31/22	7E	*Melichthys vidua*	1	18	1.12	H	I
10/31/22	7E	*Melichthys niger*	10	22	16.25	H	I
10/31/22	7E	*Forcipiger flavissimus*	1	15	0.23	SI	I
10/31/22	7E	*Forcipiger flavissimus*	1	12	0.12	SI	I
10/31/22	7E	*Acanthurus triostegus*	1	15	0.41	H	I
10/31/22	E1	*Paracirrhites arcatus*	4	8	0.23	MI	I
10/31/22	E1	*Gymnothorax meleagris*	1	41	0.34	P	I
10/31/22	E1	*Rhinecanthus rectangulus*	2	18	1.57	MI	I
10/31/22	E1	*Chaetodon ornatissimus*	2	20	3.03	C	I
10/31/22	E1	*Scarus rubroviolaceus*	1	36	6.74	H	I
10/31/22	E1	*Canthigaster jactator*	6	5	0.14	H	E
10/31/22	E1	*Acanthurus triostegus*	15	15	6.15	H	I

10/31/22	E1	*Plectroglyphidodon imparipennis*	4	4	0.04	MI	I
10/31/22	E1	*Plectroglyphidodon johnstonianus*	1	8	0.08	C	I
10/31/22	E1	*Lutjanus fulvus*	2	20	0.84	MI	X
10/31/22	E1	*Acanthurus olivaceus*	2	25	3.08	H	I
10/31/22	E1	*Acanthurus olivaceus*	3	20	2.34	H	I
10/31/22	E1	*Acanthurus dussumieri*	1	25	0.77	H	I
10/31/22	E1	*Acanthurus dussumieri*	1	20	0.39	H	I
10/31/22	E1	*Acanthurus nigroris*	1	18	0.61	H	I
10/31/22	E1	*Acanthurus nigrofuscus*	10	10	1.15	H	I
10/31/22	E1	*Acanthurus blochii*	2	30	2.66	H	I
10/31/22	E1	*Acanthurus blochii*	1	25	0.77	H	I
10/31/22	E1	*Parupeneus multifasciatus*	1	20	0.66	MI	I
10/31/22	E1	*Thalassoma duperrey*	5	10	0.35	MI	E
10/31/22	E1	*Thalassoma duperrey*	5	8	0.17	MI	E
10/31/22	E1	*Thalassoma duperrey*	1	13	0.16	MI	E
10/31/22	E1	*Labroides phthirophagus*	4	8	0.06	P	E
10/31/22	E1	*Halichoeres ornatissimus*	1	10	0.06	MI	I
10/31/22	E1	*Forcipiger flavissimus*	2	15	0.47	SI	I
10/31/22	E1	*Chromis vanderbilti*	15	3	0.04	Z	I
10/31/22	E3	*Acanthurus nigrofuscus*	70	8	4.25	H	I
10/31/22	E3	*Thalassoma duperrey*	15	13	2.39	MI	E
10/31/22	E3	*Thalassoma duperrey*	25	10	1.75	MI	E
10/31/22	E3	*Ctenochaetus strigosus*	45	8	3.50	D	I
10/31/22	E3	*Plectroglyphidodon johnstonianus*	2	5	0.04	C	I
10/31/22	E3	*Plectroglyphidodon johnstonianus*	3	8	0.23	C	I
10/31/22	E3	*Chaetodon multicinctus*	8	10	1.17	C	E
10/31/22	E3	*Sufflamen bursa*	1	18	0.79	MI	I
10/31/22	E3	*Stethojulis balteata*	2	8	0.09	MI	E
10/31/22	E3	*Pseudocheilinus octotaenia*	2	10	0.19	MI	I
10/31/22	E3	*Scarus psittacus*	1	8	0.05	H	I
10/31/22	E3	*Canthigaster jactator*	2	5	0.05	H	E
10/31/22	E3	*Lutjanus fulvus*	1	20	0.42	MI	X
10/31/22	E3	*Halichoeres ornatissimus*	1	10	0.06	MI	I
10/31/22	E3	*Melichthys vidua*	2	23	4.22	H	I
10/31/22	E3	*Stegastes fasciolatus*	1	8	0.08	H	I
10/31/22	E3	*Acanthurus olivaceus*	1	25	1.54	H	I
10/31/22	E3	*Naso lituratus*	1	25	1.61	H	I
10/31/22	E3	*Parupeneus bifasciatus*	1	10	0.12	MI	I

10/31/22	E3	*Caranx melampygus*	2	20	1.47	P	I
10/31/22	E4	*Chromis vanderbilti*	100	3	0.29	Z	I
10/31/22	E4	*Paracirrhites arcatus*	4	8	0.23	MI	I
10/31/22	E4	*Acanthurus nigrofuscus*	65	8	3.94	H	I
10/31/22	E4	*Melichthys vidua*	2	23	4.22	H	I
10/31/22	E4	*Acanthurus olivaceus*	15	28	32.67	H	I
10/31/22	E4	*Acanthurus blochii*	1	25	0.77	H	I
10/31/22	E4	*Acanthurus dussumieri*	1	25	0.77	H	I
10/31/22	E4	*Zebrasoma flavescens*	1	18	0.88	H	I
10/31/22	E4	*Zebrasoma flavescens*	2	8	0.23	H	I
10/31/22	E4	*Bodianus bilunulatus*	1	33	3.70	MI	I
10/31/22	E4	*Bodianus bilunulatus*	1	28	2.22	MI	I
10/31/22	E4	*Labroides phthirophagus*	3	8	0.05	P	E
10/31/22	E4	*Gymnothorax meleagris*	1	33	0.17	P	I
10/31/22	E4	*Stegastes fasciolatus*	1	8	0.08	H	I
10/31/22	E4	*Stegastes fasciolatus*	1	5	0.02	H	I
10/31/22	E4	*Paracirrhites forsteri*	1	13	0.22	P	I
10/31/22	E4	*Cephalopholis argus*	1	25	1.36	P	X
10/31/22	E4	*Pseudocheilinus tetrataenia*	1	4	0.01	MI	I
10/31/22	E4	*Naso lituratus*	1	18	0.58	H	I
10/31/22	E4	*Plectroglyphidodon imparipennis*	1	3	0.00	MI	I
10/31/22	E4	*Halichoeres ornatissimus*	3	10	0.18	MI	I
10/31/22	E4	*Thalassoma duperrey*	5	13	0.80	MI	E
10/31/22	E4	*Canthigaster jactator*	4	5	0.09	H	E
10/31/22	E4	*Stethojulis balteata*	1	8	0.05	MI	E
10/31/22	E4	*Thalassoma duperrey*	25	10	1.75	MI	E
10/31/22	E4	*Coris gaimard*	1	28	1.88	MI	I
10/31/22	E4	*Parupeneus multifasciatus*	2	10	0.15	MI	I
10/31/22	E4	*Parupeneus multifasciatus*	1	18	0.47	MI	I
10/31/22	E4	*Rhinecanthus rectangulus*	1	18	0.79	MI	I
10/31/22	E4	*Plectroglyphidodon johnstonianus*	1	5	0.02	C	I
10/31/22	1D	*Sufflamen bursa*	2	18	1.57	MI	I
10/31/22	1D	*Ctenochaetus strigosus*	5	13	1.77	D	I
10/31/22	1D	*Rhinecanthus rectangulus*	1	18	0.79	MI	I
10/31/22	1D	*Thalassoma duperrey*	25	13	3.98	MI	E
10/31/22	1D	*Thalassoma duperrey*	30	10	2.11	MI	E
10/31/22	1D	*Acanthurus nigrofuscus*	50	10	5.73	H	I
10/31/22	1D	*Melichthys niger*	5	23	9.16	H	I

10/31/22	1D	*Stethojulis balteata*	1	10	0.09	MI	E
10/31/22	1D	*Stethojulis balteata*	1	13	0.21	MI	E
10/31/22	1D	*Zanclus cornutus*	1	18	0.88	SI	I
10/31/22	1D	*Canthigaster jactator*	4	4	0.05	H	E
10/31/22	1D	*Naso lituratus*	1	23	1.25	H	I
10/31/22	1D	*Plectroglyphidodon imparipennis*	2	4	0.02	MI	I
10/31/22	1D	*Gomphosus varius*	2	10	0.13	MI	I
10/31/22	1D	*Cantherhines sandwichiensis*	2	13	0.57	H	E
10/31/22	1D	*Chromis vanderbilti*	30	3	0.09	Z	I
10/31/22	1D	*Acanthurus leucopareius*	10	20	14.05	H	I
10/31/22	1D	*Canthigaster amboinensis*	1	8	0.14	H	I
10/31/22	1D	*Acanthurus nigroris*	3	18	1.84	H	I
10/31/22	NANA1	*Plectroglyphidodon imparipennis*	10	4	0.09	MI	I
10/31/22	NANA1	*Thalassoma duperrey*	2	10	0.14	MI	E
10/31/22	NANA1	*Acanthurus nigrofuscus*	3	8	0.18	H	I
10/31/22	NANA1	*Rhinecanthus rectangulus*	1	18	0.79	MI	I
10/31/22	NANA1	*Rhinecanthus rectangulus*	1	5	0.02	MI	I
10/31/22	NANA1	*Canthigaster jactator*	4	4	0.05	H	E
10/31/22	NANA1	*Parupeneus multifasciatus*	1	13	0.17	MI	I
10/31/22	NANA1	*Chromis vanderbilti*	35	3	0.10	Z	I
10/31/22	NANA1	*Stegastes fasciolatus*	2	8	0.15	H	I
10/31/22	NANA1	*Canthigaster amboinensis*	1	8	0.14	H	I
10/31/22	NANA1	*Stethojulis balteata*	1	8	0.05	MI	E
10/31/22	NANA1	*Paracirrhites forsteri*	1	10	0.10	P	I
10/31/22	NANA1	*Sufflamen bursa*	1	10	0.15	MI	I
10/31/22	NANA1	*Sufflamen bursa*	1	8	0.08	MI	I
10/31/22	NANA1	*Sufflamen bursa*	2	18	1.57	MI	I
10/31/22	PIPE	*Pervagor aspricaudus*	2	8	0.11	H	I
10/31/22	PIPE	*Pervagor aspricaudus*	4	10	0.40	H	I
10/31/22	PIPE	*Halichoeres ornatissimus*	2	13	0.20	MI	I
10/31/22	PIPE	*Halichoeres ornatissimus*	1	15	0.13	MI	I
10/31/22	PIPE	*Abudefduf vaigiensis*	75	13	46.90	Z	I
10/31/22	PIPE	*Abudefduf abdominalis*	75	13	23.71	Z	E
10/31/22	PIPE	*Thalassoma duperrey*	45	13	7.16	MI	E
10/31/22	PIPE	*Thalassoma duperrey*	35	15	8.70	MI	E
10/31/22	PIPE	*Thalassoma duperrey*	10	18	1550.36	MI	E
10/31/22	PIPE	*Canthigaster amboinensis*	1	8	0.14	H	I
10/31/22	PIPE	*Monotaxis grandoculis*	1	10	0.09	MI	I

10/31/22	PIPE	*Monotaxis grandoculis*	5	23	6.91	MI	I
10/31/22	PIPE	*Thalassoma quinquevittatum*	1	13	0.16	MI	I
10/31/22	PIPE	*Thalassoma quinquevittatum*	1	10	0.07	MI	I
10/31/22	PIPE	*Parupeneus multifasciatus*	150	18	71.02	MI	I
10/31/22	PIPE	*Stegastes fasciolatus*	4	8	0.30	H	I
10/31/22	PIPE	*Stegastes fasciolatus*	3	10	0.45	H	I
10/31/22	PIPE	*Plectroglyphidodon johnstonianus*	2	8	0.15	C	I
10/31/22	PIPE	*Synodus dermatogenys*	1	18	0.27	P	I
10/31/22	PIPE	*Mulloidichthys vanicolensis*	50	15	12.84	MI	I
10/31/22	PIPE	*Parupeneus bifasciatus*	4	15	1.65	MI	I
10/31/22	PIPE	*Parupeneus bifasciatus*	1	18	0.72	MI	I
10/31/22	PIPE	*Chaetodon miliaris*	2	10	0.28	Z	E
10/31/22	PIPE	*Chaetodon miliaris*	2	13	0.60	Z	E
10/31/22	PIPE	*Sufflamen fraenatus*	1	25	2.01	MI	I
10/31/22	PIPE	*Lutjanus kasmira*	250	15	70.88	MI	X
10/31/22	PIPE	*Lutjanus kasmira*	75	20	59.38	MI	X
10/31/22	PIPE	*Sufflamen bursa*	5	18	3.93	MI	I
10/31/22	PIPE	*Chaetodon fremblii*	2	13	0.56	SI	E
10/31/22	PIPE	*Chaetodon quadrimaculatus*	2	13	0.77	C	I
10/31/22	PIPE	*Mulloidichthys flavolineatus*	100	18	42.22	MI	I
10/31/22	PIPE	*Mulloidichthys flavolineatus*	15	13	2.47	MI	I
10/31/22	PIPE	*Myripristis kuntee*	5	13	1.18	Z	I
10/31/22	PIPE	*Chaetodon kleinii*	1	13	0.29	Z	I
10/31/22	PIPE	*Chromis ovalis*	3	15	0.96	Z	E
10/31/22	PIPE	*Fistularia commersonii*	1	61	0.53	P	I
10/31/22	PIPE	*Canthigaster jactator*	5	5	0.11	H	E
10/31/22	PIPE	*Stethojulis balteata*	3	13	0.64	MI	E
10/31/22	PIPE	*Stethojulis balteata*	2	10	0.19	MI	E
10/31/22	PIPE	*Novaculichthys taeniourus*	1	18	0.61	MI	I
10/31/22	PIPE	*Paracirrhites arcatus*	5	8	0.29	MI	I
10/31/22	PIPE	*Zebrasoma flavescens*	1	5	0.04	H	I
10/31/22	PIPE	*Acanthurus nigrofuscus*	100	10	11.46	H	I
10/31/22	PIPE	*Dascyllus albisella*	10	10	1.70	Z	E
10/31/22	PIPE	*Thalassoma trilobatum*	5	18	2.49	MI	I
10/31/22	PIPE	*Thalassoma trilobatum*	5	25	6.61	MI	I
10/31/22	PIPE	*Acanthurus olivaceus*	2	20	1.56	H	I
10/31/22	PIPE	*Scarus psittacus*	1	10	0.10	H	I
10/31/22	PIPE	*Scarus psittacus*	4	15	1.60	H	I

10/31/22	PIPE	*Chaetodon multicinctus*	6	10	0.88	C	E
10/31/22	PIPE	*Chaetodon multicinctus*	1	8	0.07	C	E
10/31/22	PIPE	*Melichthys vidua*	1	23	2.11	H	I
10/31/22	PIPE	*Ostracion meleagris*	3	8	0.23	SI	I
10/31/22	PIPE	*Ostracion meleagris*	1	10	0.16	SI	I
10/31/22	PIPE	*Gomphosus varius*	3	10	0.20	MI	I
10/31/22	PIPE	*Gomphosus varius*	7	13	0.90	MI	I
10/31/22	PIPE	*Gomphosus varius*	2	15	0.37	MI	I
10/31/22	PIPE	*Naso lituratus*	2	15	0.66	H	I
10/31/22	PIPE	*Naso lituratus*	1	13	0.21	H	I
10/31/22	PIPE	*Naso lituratus*	1	18	0.58	H	I
10/31/22	PIPE	*Ctenochaetus strigosus*	3	13	1.06	D	I
10/31/22	PIPE	*Ctenochaetus strigosus*	1	10	0.16	D	I
10/31/22	PIPE	*Parupeneus pleurostigma*	10	15	3.12	MI	I
10/31/22	PIPE	*Parupeneus pleurostigma*	2	13	0.41	MI	I
10/31/22	PIPE	*Naso unicornis*	2	15	0.74	H	I
10/31/22	PIPE	*Labroides phthirophagus*	2	8	0.03	P	E
10/31/22	PIPE	*Acanthurus leucopareius*	1	20	1.41	H	I
10/31/22	PIPE	*Acanthurus leucopareius*	1	18	1.02	H	I
10/31/22	PIPE	*Naso hexacanthus*	1	28	2.33	Z	I
10/31/22	PIPE	*Parupeneus cyclostomus*	1	15	0.47	P	I
10/31/22	PIPE	*Aulostomus chinensis*	2	41	1.21	P	I
10/31/22	PIPE	*Thalassoma purpureum*	1	33	3.22	MI	I
10/31/22	PIPE	*Forcipiger flavissimus*	3	15	0.70	SI	I
10/31/22	PIPE	*Forcipiger flavissimus*	5	13	0.74	SI	I
10/31/22	PIPE	*Forcipiger flavissimus*	2	10	0.13	SI	I
10/31/22	PIPE	*Calotomus carolinus*	1	18	0.55	H	I
10/31/22	PIPE	*Chaetodon lunula*	2	18	1.18	SI	I
10/31/22	PIPE	*Parupeneus multifasciatus*	1	18	0.47	MI	I
10/31/22	PIPE	*Parupeneus multifasciatus*	7	13	1.20	MI	I
10/31/22	PIPE	*Chaetodon unimaculatus*	2	13	0.74	C	I
10/31/22	PIPE	*Cantherhines sandwichiensis*	1	10	0.14	H	E
10/31/22	PIPE	*Cantherhines sandwichiensis*	1	13	0.28	H	E
10/31/22	PIPE	*Melichthys niger*	3	23	5.50	H	I
10/31/22	PIPE	*Canthigaster jactator*	1	5	0.02	H	E
10/31/22	PIPE	*Naso annulatus*	3	33	8.79	Z	I
10/31/22	PIPE	*Naso annulatus*	3	28	5.51	Z	I
10/31/22	PIPE	*Zanclus cornutus*	7	13	2.43	SI	I
10/31/22	PIPE	*Zanclus cornutus*	4	18	3.54	SI	I

10/31/22	PIPE	*Chromis agilis*	1	10	0.11	Z	I
10/31/22	PIPE	*Platybelone argalus*	4	30	1.16	P	I