A RAPID BIOLOGICAL ASSESSMENT OF BEQA LAGOON (MARINE)

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A Rapid Biological Assessment of Beqa Lagoon (Marine)

Christopher Henderson
Jesse Mosman

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Abbreviations

DOVS	Diver operated video system
GLMs	Generalised linear models
HD	High-definition video
RUVS	Remote underwater video stations
ICR	Inshore reef
OCR	Offshore reef

Executive summary

Coral reefs are under threat from a wide range of anthropogenic disturbances, including overfishing, habitat degradation and climate change. Beqa lagoon, Fiji, is a coral ecosystem that is currently facing a range of significant threats that will impact the structure and functioning of these coral reef communities. Changes to the catchment, river and lagoon have significantly altered the environment and resilience to further disturbance. Furthermore, decades of land degradation in the Navua Catchment results in excess sediment delivery to the river, which is impacting the coral reefs in the lagoon. Here we assessed fish community structure across inshore and offshore reefs and mangrove forests of Beqa lagoon. We used remote underwater video stations (RUVS) to sample fish communities at 40 sites throughout Beqa lagoon. We identified 270 fish species throughout the region, with fish communities being dominated by Pomacentridae (damselfishes), Scaridae (parrotfishes), Acanthuridae (tangs) and Labridae (wrasses). We identified seven fish functional groups across the 40 sites, with zoobenthivores, herbivores and zooplantivores being the dominant groups, however, we identified a very low abundance of piscivores across Beqa lagoon. We found that sites within the flood plume that extends from the Navua River were significantly correlated with distance to the river. This flood plume effect is likely degrading the coral reef habitat itself, resulting in a lower abundance and diversity of coastal fishes. We recommend that future management of Beqa lagoon focus on catchment remediation to reduce the sediment loads in the river, and on the development of protected areas that are well-enforced and focus on protecting high-order consumers that are crucial to the health of the coral reef ecosystem.

1 Project background

Anthropogenic impacts to natural seascapes are ubiquitous and have resulted in fundamental changes to ecosystem structure and functioning, and the decline of key ecosystem services globally (Halpern et al. 2008, Oliver et al. 2015). The loss of species from ecosystems results in declines in the ecological functions they perform that help to maintain the condition and resilience of many systems (Pace et al. 1999, Cardinale et al. 2012). Coral reefs are regularly impacted by a diversity of disturbances, including floods, coral bleaching events and heavy fishing pressure, and their capacity to cope with perturbation is contingent on the persistence of diverse and intact fish assemblages, which perform a range of ecological functions that help to underpin reef resilience (Olds et al. 2014). Coral reefs are critical habitats for a diversity of reef species, including the juveniles of many taxa that reside on inshore and offshore reefs, and inter-reef gardens as adults (Olds et al. 2014).

Beqa lagoon represents a coral ecosystem that is currently facing significant threats. The lagoon covers 440 km^2 and is protected from ocean swells by a barrier reef and fringing mangroves on the mainland. The lagoon is a premier cultural and environmental asset that has been endorsed as a Particularly Sensitive Sea Area through the International Maritime Organization. An abundance of sea life, including corals, fish, sharks and turtles resides in the lagoon, which underpin its cultural and economic values. Local communities have deep cultural and spiritual connections to the lagoon, and many rely upon it as a traditional fishing ground for subsistence and commercial fishing. The lagoon supports a thriving tourism industry, including shark diving, surfing, scuba diving, snorkelling and resorts located on both mainland Viti Levu and Beqa Island. Changes to the catchment, river and lagoon have reduced the adaptive capacity of the environment to rebound from natural hazards. Additionally, decades of logging has caused land degradation and changes to forest structure, which have probably resulted in excess sediment delivery to the reef via the Navua River. Finally, sand and gravel extraction from the Navua River channel is contributing to stream bed and bank instabilities and extensive erosion. This has a direct impact on infrastructure and houses located near rivers, as well as impacts to the lagoon due to excess sediment and nutrient delivery. Overfishing and pollution are also major threats to the Beqa lagoon. Changes to the coastline such as the removal of mangroves have reduced natural defences to coastal erosion.

Here, this project seeks to address the above-described environmental challenges of Beqa lagoon through halting the decline of biodiversity and strengthening the sustainable management of the coastal and marine ecosystems.

2 Project Objectives

Objective 1- To understand the drivers of fish biodiversity and benthic composition on reefs in Beqa lagoon, Fiji.

Beqa lagoon is a crucial coastal ecosystem for the local communities, with coral reefs in the region providing numerous ecosystem services. This region is facing numerous threats that are modifying fish communities and the structure of coral reefs.

Objective 2- To determine the functional composition of fish biodiversity and benthic composition on reefs in Beqa lagoon, Fiji.

Healthy reefs support a balanced composition of different functional groups. Different threats within the region may be impacting specific species, which then has direct implications for reef health.

3 Methods

3.1 Study site

We sampled 40 sites throughout the Beqa lagoon, including inshore reefs, mangrove forests and offshore reefs (Figure 1). Sites were chosen across a broad spatial scale to capture the variables that are driving fish communities throughout the Beqa lagoon. Sites were initially broken up into a section inside the impacts of the flood plume that extends from the Navua River, and a corresponding number of sites outside the flood plume. Sites were sampled in October 2023 over an eight-day period. All sampling occurred during the day, with mangroves all sampled an hour either side of high tide to maximise inundation and water clarity.

3.2 Fish community sampling

Fish communities throughout Beqa lagoon were surveyed using two complementary methods, the first being a diver operated video system (DOVS) and the second being remote underwater video systems (RUVS). The DOVS is a horizontal bar with two cameras at either side, which record in high-definition video (HD). Three replicate 25 m DOVS were completed at each site, where a snorkeler swims the DOVS along the transect, recording all fish that are present. DOVS are preferred to an underwater visual census as they are quicker, cause less disturbance to fish communities and result in a permanent copy of the transect, assisting with the accurate species identification. The second method, RUVS, uses a camera attached to a weight that is buoyed to the surface. Five replicate RUVS were completed at each site, with cameras recording in HD for 15 minutes. RUVS were spaced 50 m – 100 m apart to ensure that each replicate is independent. RUVS are preferred to other methods as they do not result in any impact to the ecosystem, and they are also ideal for cryptic species.

3.3 Benthic composition

To survey corals and invertebrates, a downward facing camera was included in all DOVS surveys. This allows for measurements of coral (including hard and soft coral and any corals that are bleached), total algae, dead coral and reef base (including substrate), coral rubble and seagrass cover, along with the abundance and diversity of invertebrates throughout the different lagoon habitats (e.g. coral reefs, mangrove forests, seagrass meadows). Due to the low abundance of sites with seagrass and ascidians, we only present information on hard, soft, dead and coral rubble, and total algae.

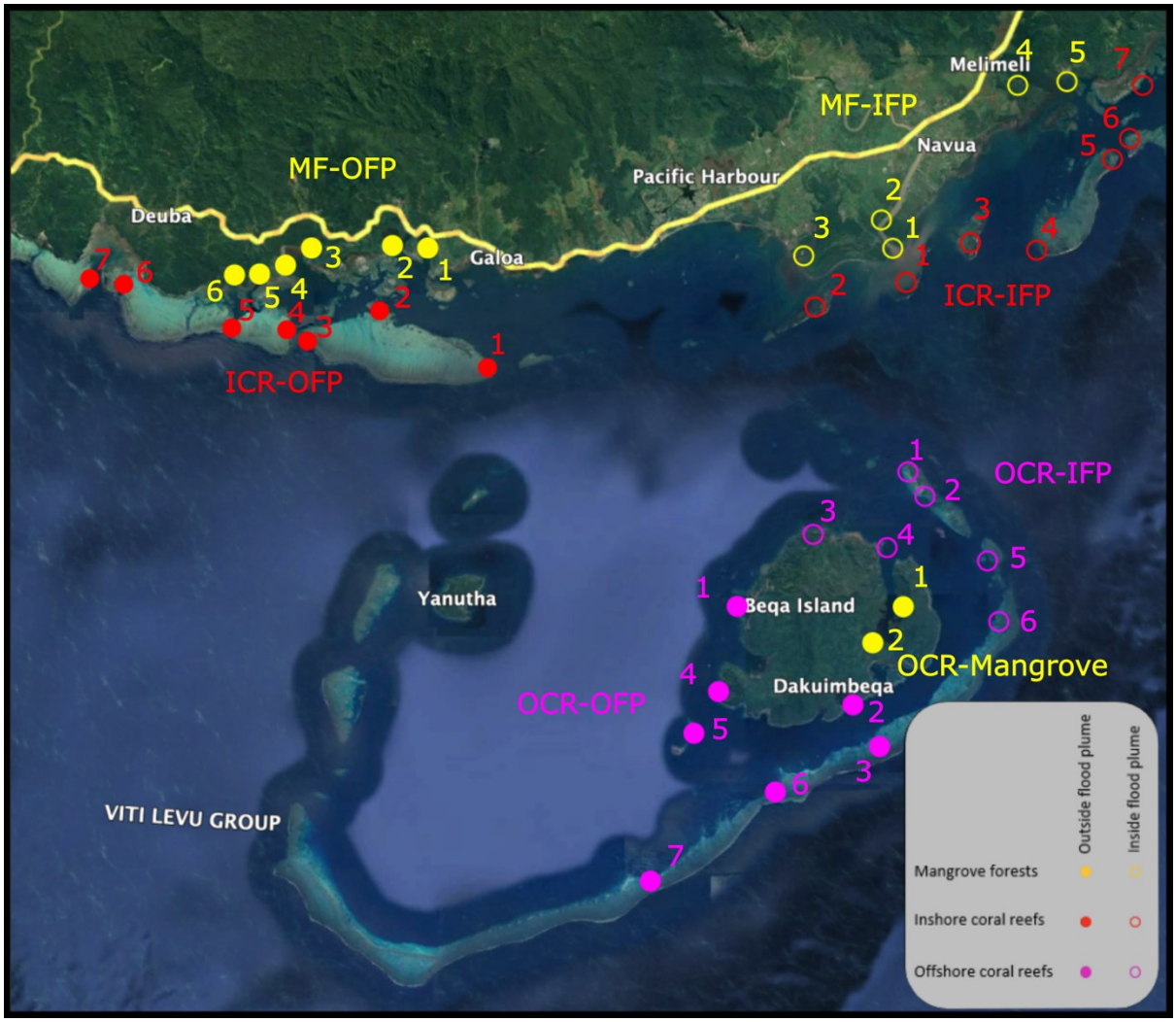

Figure 1. The study map outlining the sites sampled throughout Beqa lagoon, with a series of inshore reefs (coded throughout as ICR), offshore reefs (coded throughout as OCR) and mangrove forests sampled. Sites were chosen in a region close to and further away from the flood plume that extends from the Navua River for the inshore and offshore sections of the Lagoon. The number above each site corresponds to the site number.

3.4 Statistical analysis

We used generalised linear models (GLMs) to test for significant interactions between the habitat sampled, whether the site was inside or outside the flood plume and the distance from the Navua River against different components of the fish community. We fit GLMs with a poisson distribution. We assessed changes in species richness, total fish abundance, harvested fish abundance, and the abundance of fish functional groups (e.g. herbivores, detritivores, omnivores, corallivores, zooplanktivores, zoobenthivores and piscivores). Fish functional group categorisation was based on diets in FishBase.com (Froese and Pauly 2023). We assessed these individual fish functional groups as their abundance is linked to the resilience of coral reefs. For example, abundant corallivores and herbivores are crucial to maintaining reef resilience, while piscivores exert top-down pressure on the fish community. We found that hard coral cover and distance to the Navua River mouth were strongly correlated (Figure 2). Therefore, we only analysed the distance to river mouth relative to the abundance and diversity of fish.

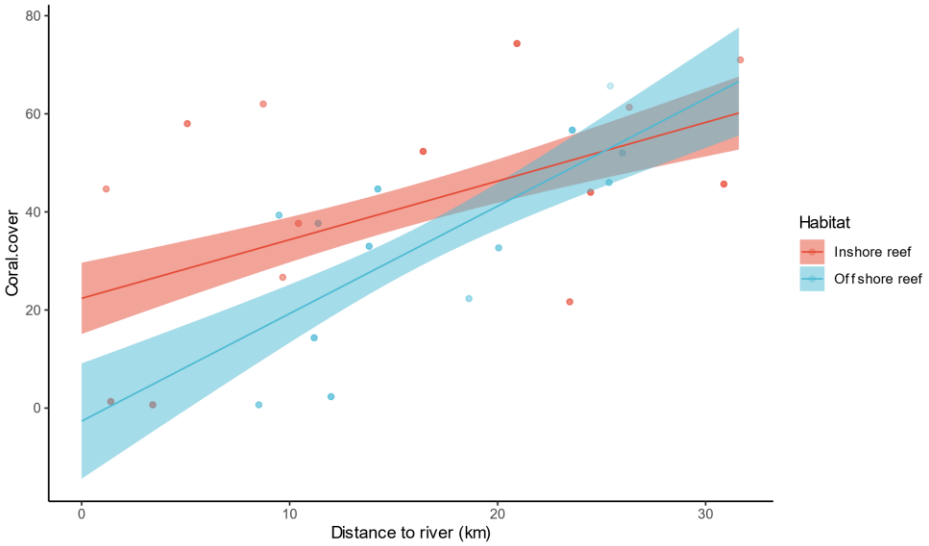

Figure 2. A significant relationship between hard coral cover and distance to river for inshore reef

4 Results

Fish community structure

We identified 3249 fish across 270 species on inshore reefs, offshore reefs and in the mangrove forests of Beqa lagoon. The most species seen at one site was 73, occurring at the fourth offshore reef site outside of the flood plume. The most abundant fish families identified on RUVS were Pomacentridae (damselfishes), Scaridae (parrotfishes), Acanthuridae (surgeon and unicornfish) and Labridae (wrasses), which dominated the fish community. We identified fish across seven functional feeding groups, with the most abundant being zoobenthivores, herbivores, corallivores and zooplantivores, while piscivores and detritivores were the least abundant. Zoobenthivores were the most speciose of all functional groups, containing 132 different species. We identified 45 harvested fish species across all sites and habitats, however, harvested fish species were generally low in abundance across all sites.

Fish abundance, harvested fish abundance and species richness on inshore reefs significantly varied depending on the location of the site relative to the plume (e.g. categorised as inside vs outside and distance to river). Species richness on inshore reefs followed a similar trend, with greater species richness on the inside flood plume sites being on the sites furthest from the river (Figure 3, 6a). Harvested and total fish abundance on inshore reefs was greatest at sites further from the river on the inside flood plume side of the Lagoon, but on the outside flood plume side, distance from the river had minimal effect (Figure 3, 6b-c).

Fish abundance, harvested fish abundance and species richness on offshore reefs significantly varied depending on the location of the site relative to the plume. Species richness on offshore reefs was greatest at sites located further away from the Navua River mouth regardless of whether they were inside or outside of the flood plume (Figure 4, 6a). Harvested and total fish abundance on offshore reefs followed a similar trend to that of species richness and were highest at sites further away from the Navua River mouth (Figure 4, 6b-c).

Fish abundance, harvested fish abundance and species richness in mangrove forests varied throughout sites, but there did not appear to be an effect of the food plume. Species richness and fish abundance was typically low in mangroves compared with other habitats, with the most diverse and abundant mangrove forest being at the mouth of the Navua River (Figure 5, 6a-c).

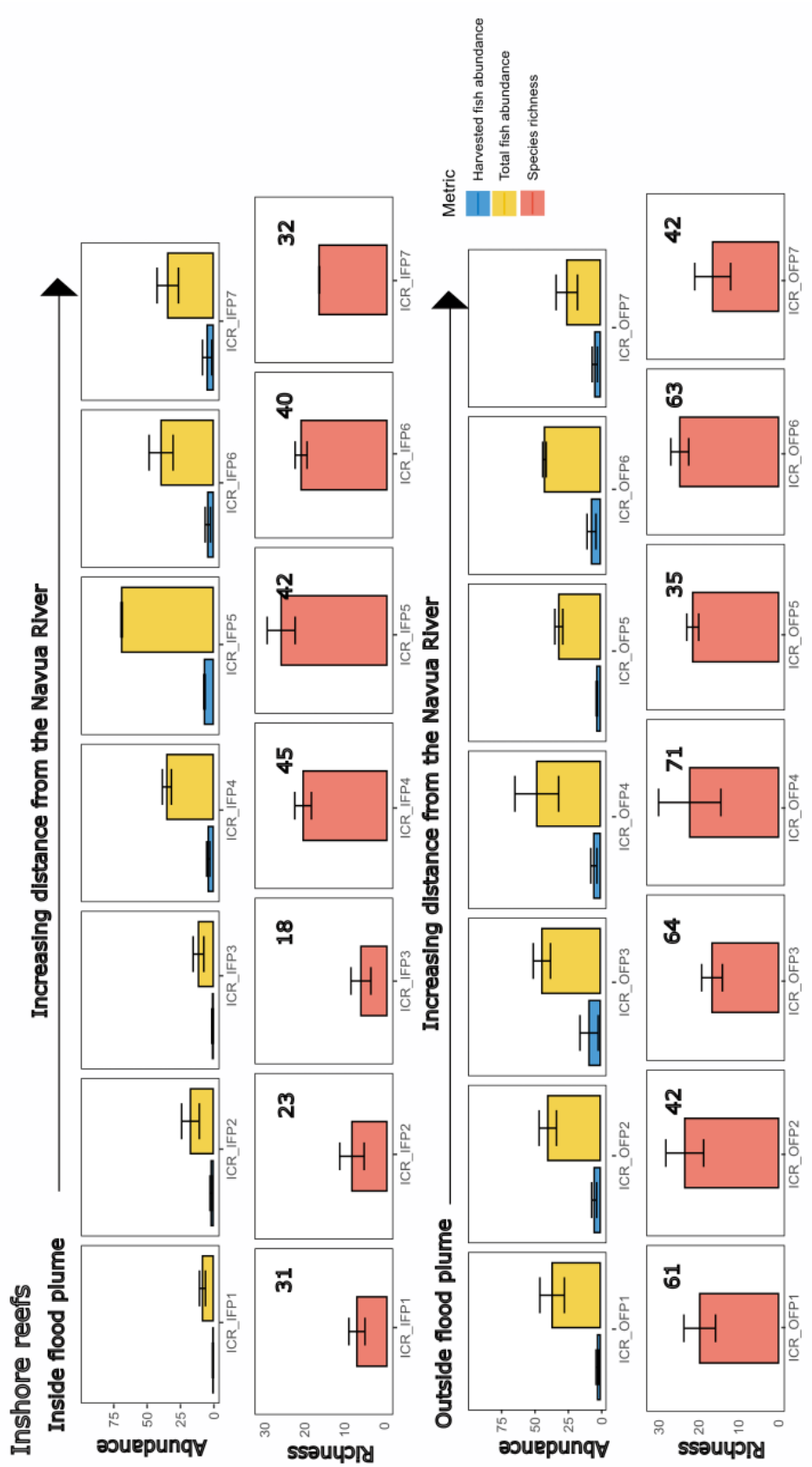

Figure 3. The abundance and richness (mean +/- 1 SE across transects within site) of fish recorded on remote underwater video stations on the inshore reefs of Beqa lagoon, Fiji. Numbers inside richness plots indicate the total number of species recorded at each site (totalled for five transects within site).

Figure 4. The abundance and diversity (mean +/- 1 SE across transects within site) of fish recorded on remote underwater video stations on the offshore reefs of Beqa lagoon, Fiji. Numbers inside richness plots indicate the total number of species recorded at each site (totalled for five transects within site).

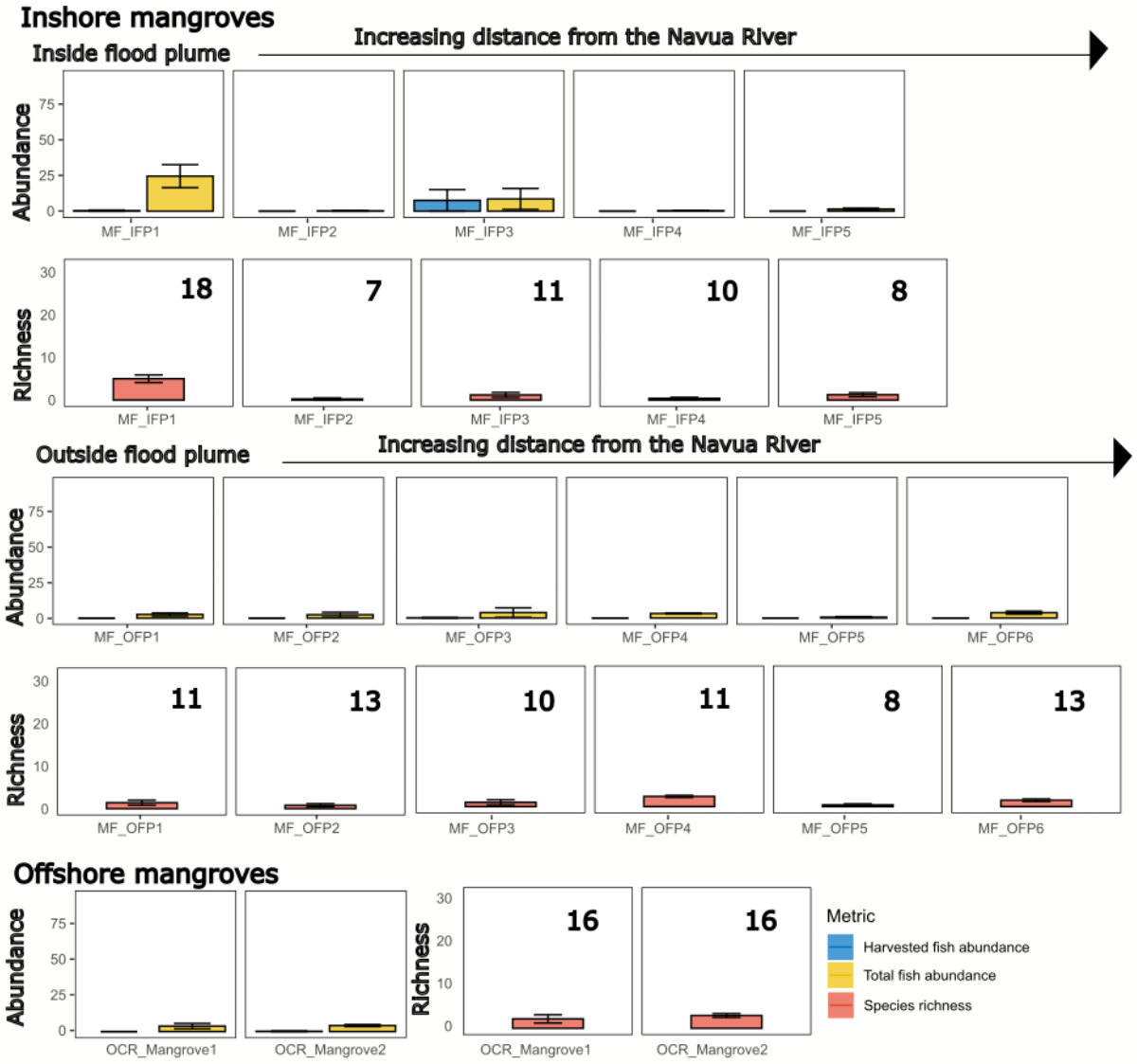

Figure 5. The abundance of harvested fish species, total fish abundance and species richness (mean +/- 1 SE across transects within site) recorded on remote underwater video stations in mangrove forests throughout Beqa lagoon and on Beqa Island, Fiji. Numbers inside richness plots indicate the total number of species recorded at each site (totalled for five transects within site).

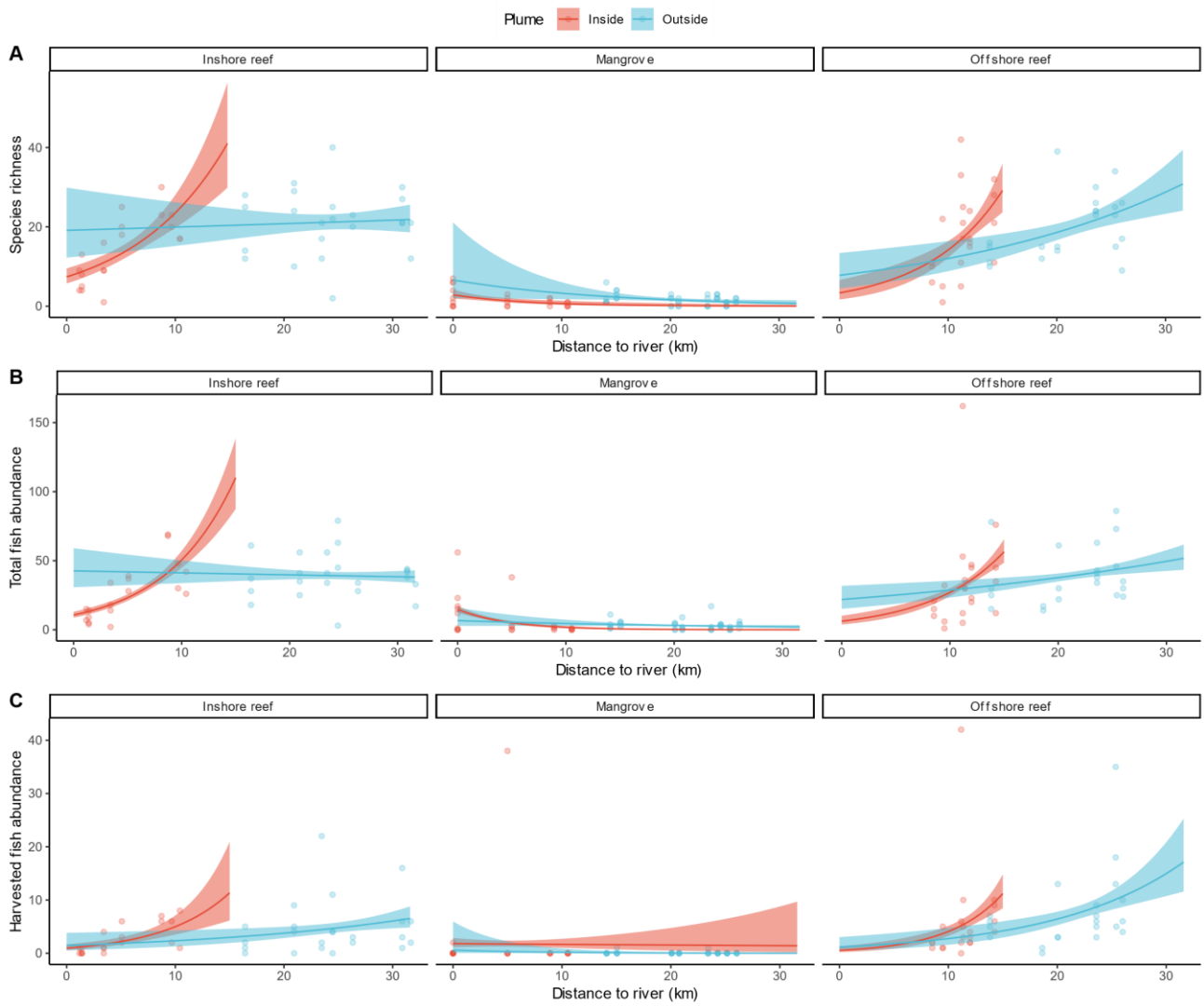

Figure 6. The effects of proximity to the Navua River on the (a) species richness, (b) total fish abundance and (c) abundance of harvested fish recorded on remote underwater video stations throughout Beqa lagoon, Fiji.

Effects of the river on fish functional groups

Herbivores were one of the most common groups found on the inshore and offshore reefs (Figures 7 and 8) but were mostly absent from mangrove forest sites (Figure 9). The most abundant herbivores were *Chlorurus spirulus, Scarus rivulatus, Scarus schlegeli* and Pomacentridae spp., which are important algal consumers on the reefs. Herbivores were more abundant further away from the river mouth at sites that were inside the flood plume, but this effect was not present for herbivores that were outside the flood plume (Figure 10).

Detritivores were one of the least speciose and abundant groups found on reefs and in mangrove forests, with only four species found (Figures 7–9). These included multiple species of mullet, *Scatophargus argus* and the most abundant detritivore, *Crenumugil crenilabis.* Detritivores were most abundant inside mangrove forests and had no clear effect of distance to river modifying their abundance (Figure 10).

Omnivores were similarly low in abundance on inshore and offshore reefs, and in mangrove forests (Figure 7-9). There were nine species of omnivores, with all of these belonging to the Acanthuridae family. The most abundant of these was *Acanthurus nigrofuscus*. There was no clear effect of distance to the river modifying the abundance of omnivores (Figure 10).

Corallivores were abundant throughout all reef sites, including inshore and offshore reefs, but were absent from mangrove forests (Figure 7–9). There were 21 species of corallivore found on reefs of Beqa lagoon, with all of these belonging to the Chaetodontidae family. These species included a mix of facultative and obligate corallivores, with the most abundant species on these reefs being *Chaetodon citrinellus* and *Chaetodon vagabundus*. Corallivore species were significantly impacted by distance to river at sites that were inside the flood plume on both inshore and offshore reefs (Figure 10).

Zooplanktivores were highly abundant across inshore and offshore reef sites and were found at two mangrove sites (Figure 7–9). There were 24 species of zooplanktivore found across all sites in Beqa lagoon, with most of these belonging to the genus *Chromis.* The most abundant zooplanktivore species were *Chromis chrysura, Ctenochaetus striatus* and *Pterocaesio tile*. Zooplanktivores were more abundant at sites further from the river inside the flood plume but were more abundant at sites closer to the river on inshore reefs outside of the flood plume (Figure 10).

Zoobenthivores were the most abundant and speciose group of fish found on inshore and offshore reefs and were the most abundant functional group in mangrove forests (Figure 7–9). There were 132 species of zoobenthivore found throughout Beqa lagoon. The most abundant zoobenthivores were *Lutjanus ehrenbergii* and *Thalassoma hardwicke.* Zoobenthivores were more abundant at reef sites further from the river mouth, and this occurred for sites both inside and outside of the flood plume and on inshore and offshore reefs (Figure 10).

Piscivores generally were in low abundance across all sites, including both reefs and mangroves, however, there were 31 different species (Figure 7-9). The most abundant species of piscivore were *Caranx melampygus, Lutjanus gibbus, Lutganus monostigma* and *Lutjanus semicinctus.* During the entire study, we only recorded 11 individual reef sharks, coming from three different species, *Carcharhinus amblyrhyrnchos, Carcharhinus melanopterus* and *Triaenodon obesus*. Piscivores did not seem to be impacted by the effects of distance to the Navua River mouth in any of the habitats (Figure 10).

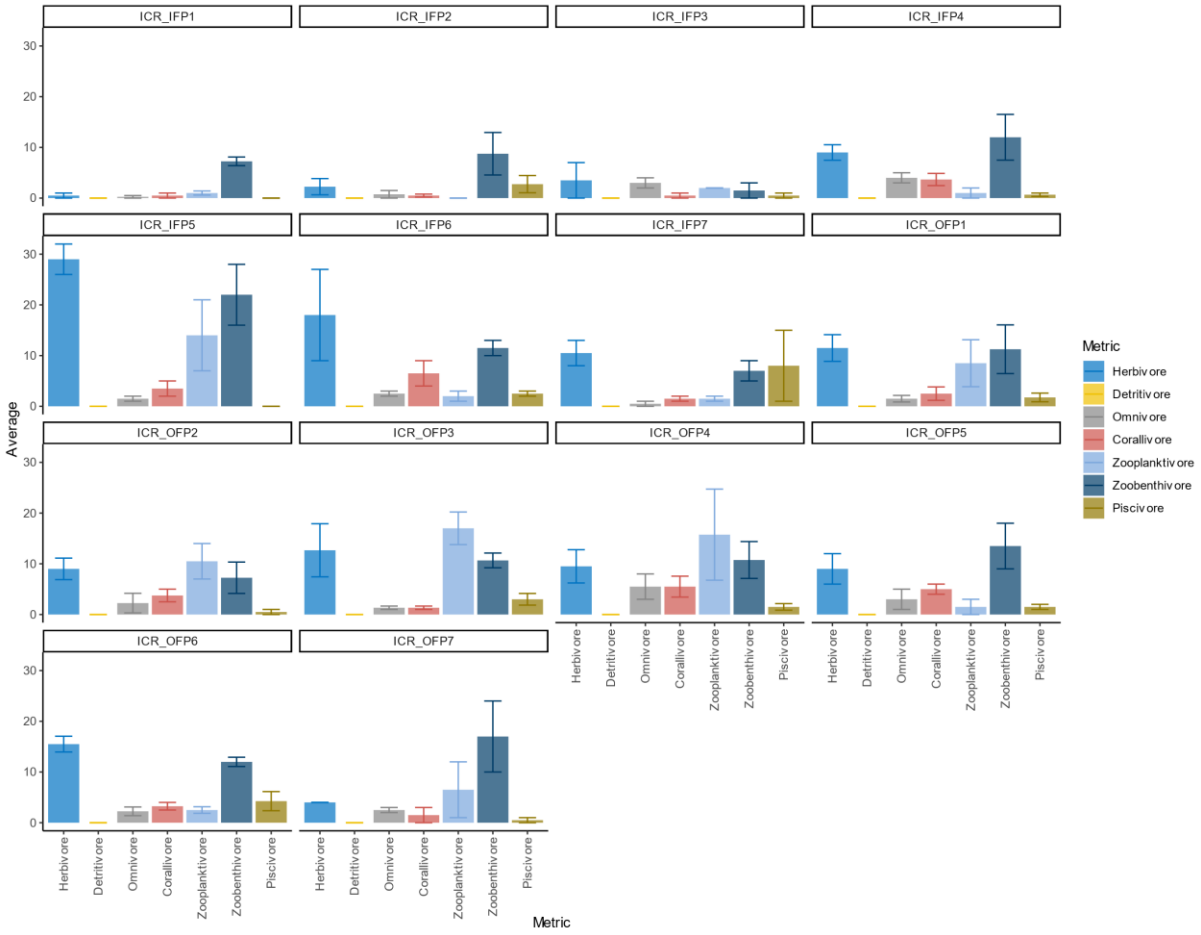

Figure 7. The abundance of each fish functional group recorded on remote underwater video stations on inshore reefs throughout Beqa lagoon and on Beqa Island, Fiji.

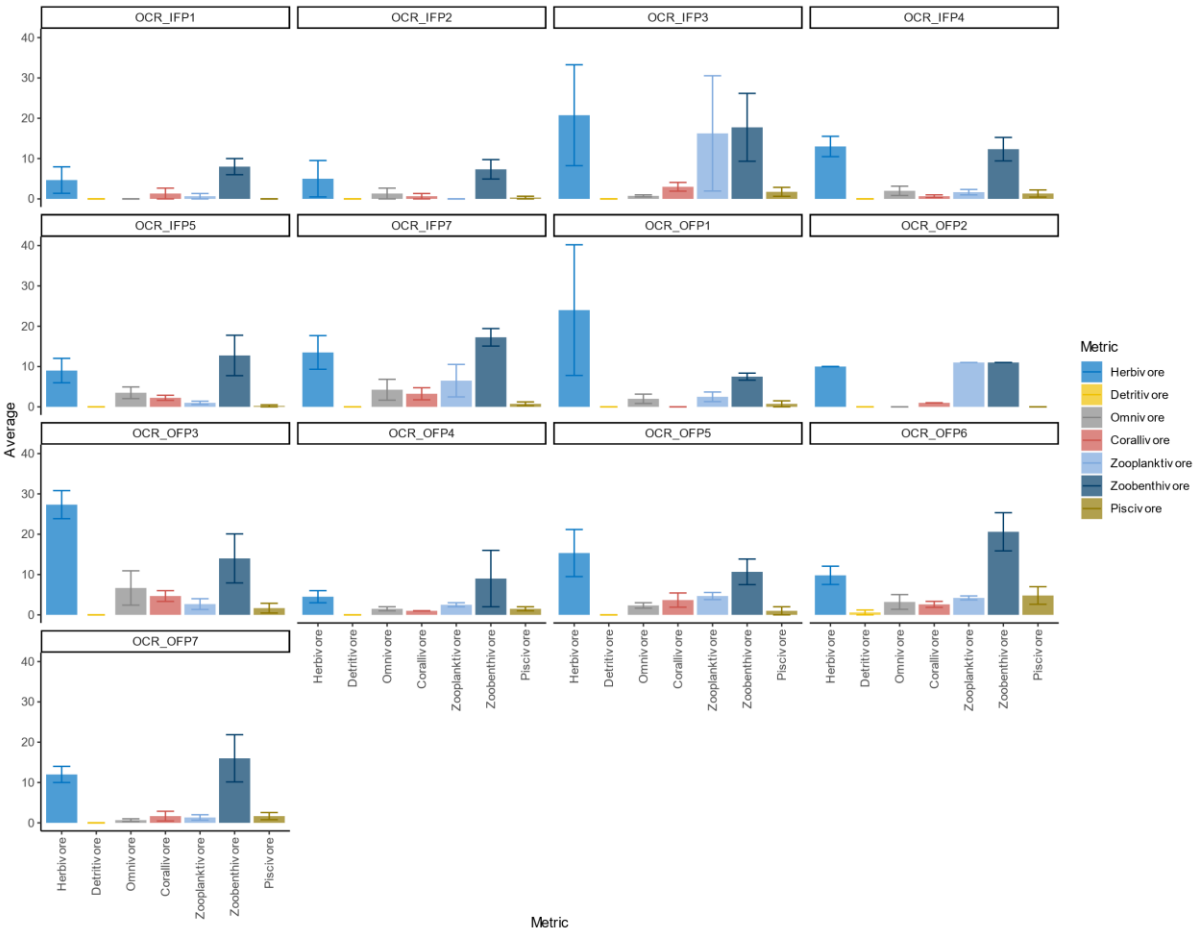

Figure 8. The abundance of each fish functional group recorded on remote underwater video stations on offshore reefs throughout Beqa lagoon and on Beqa Island, Fiji.

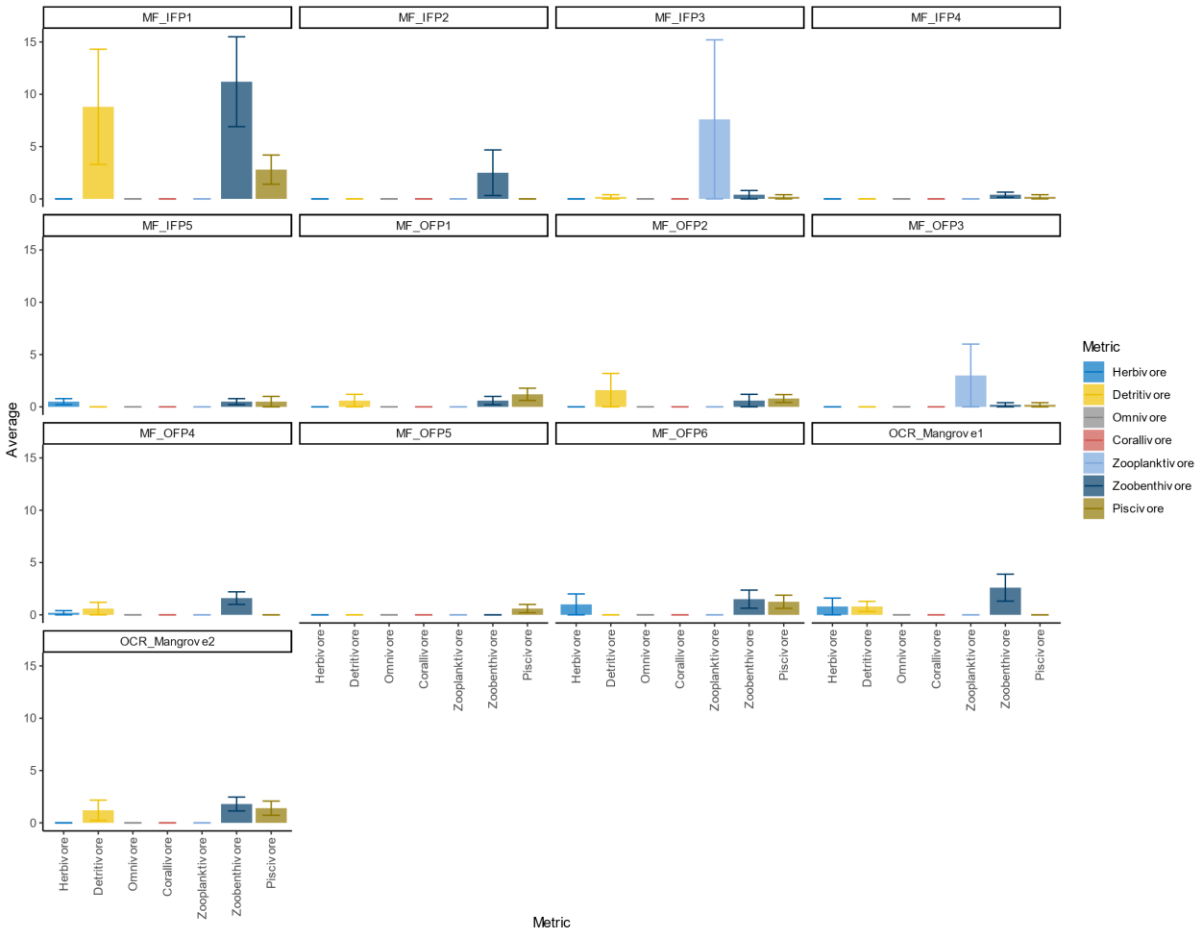

Figure 9. The abundance of each fish functional group recorded on remote underwater video stations in mangrove forests throughout Beqa lagoon and on Beqa Island, Fiji.

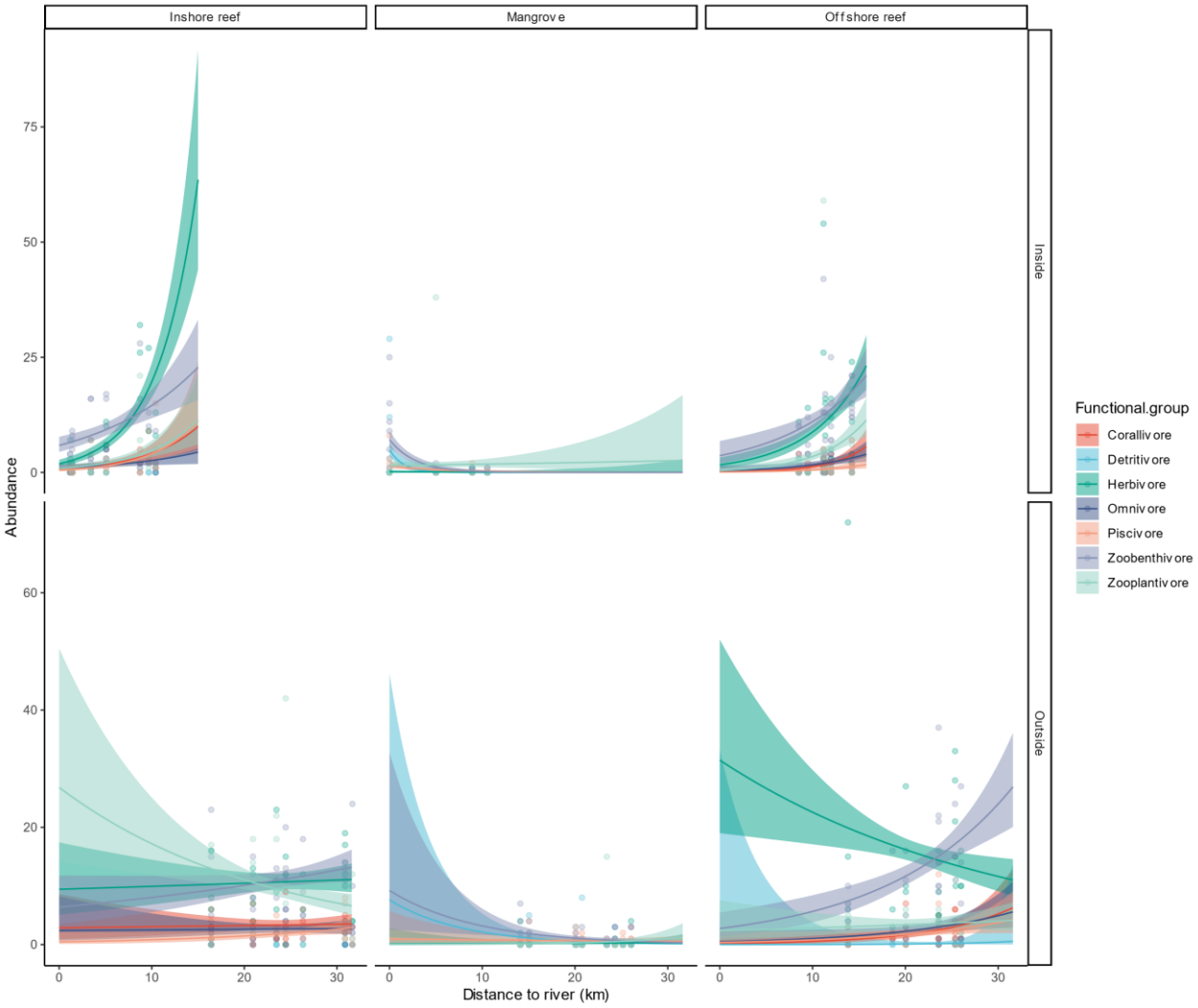

Figure 10. The effects of proximity to the Navua River on the abundance of each fish functional group recorded on remote underwater video stations throughout Beqa lagoon, Fiji.

Benthic cover

We found that the cover of hard corals was significantly correlated with distance to river mouth (Figure 11). While hard coral cover was highest on inshore and offshore reefs further from the Navua River, we found that overall algae cover was highest on reefs that were closest to the river mouth (Figure 11 and 12). The cover of soft corals was low throughout the study region but were found to be more common on inshore reefs (Figure 11). Dead coral/reef base and coral rubble were common features of all reef systems through Beqa lagoon (Figure 11 and 12). We only identified ascidians at three reef sites (ICR_IFP2, ICR_OFP2 and OCR_OFP1), while other common invertebrates found throughout the sampling included blue starfish and crown of thorn starfish, and these were commonly found on the offshore reef sites.

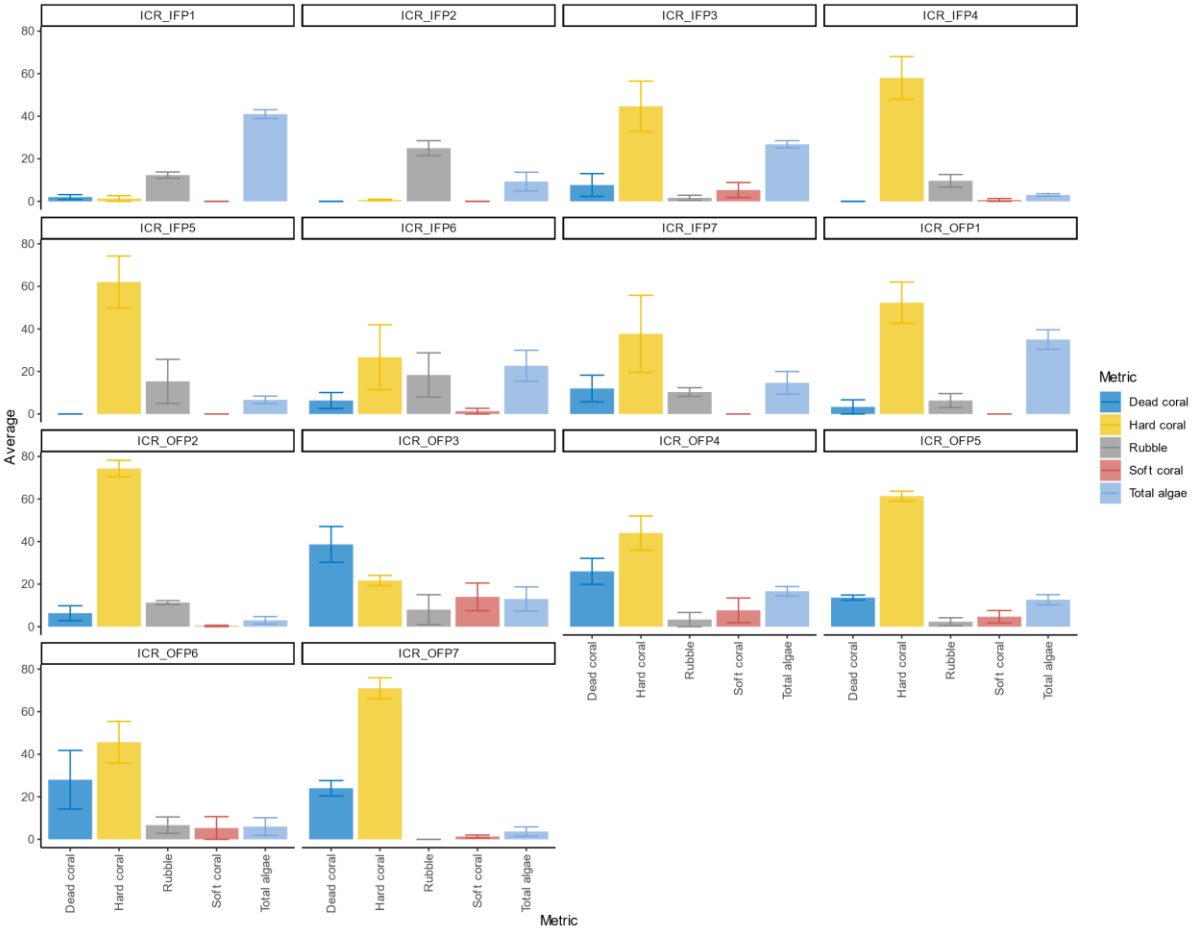

Figure 11. Benthic cover composition on inshore reefs of Beqa lagoon. Benthic cover was recorded during diver operated video surveys with a downward facing camera.

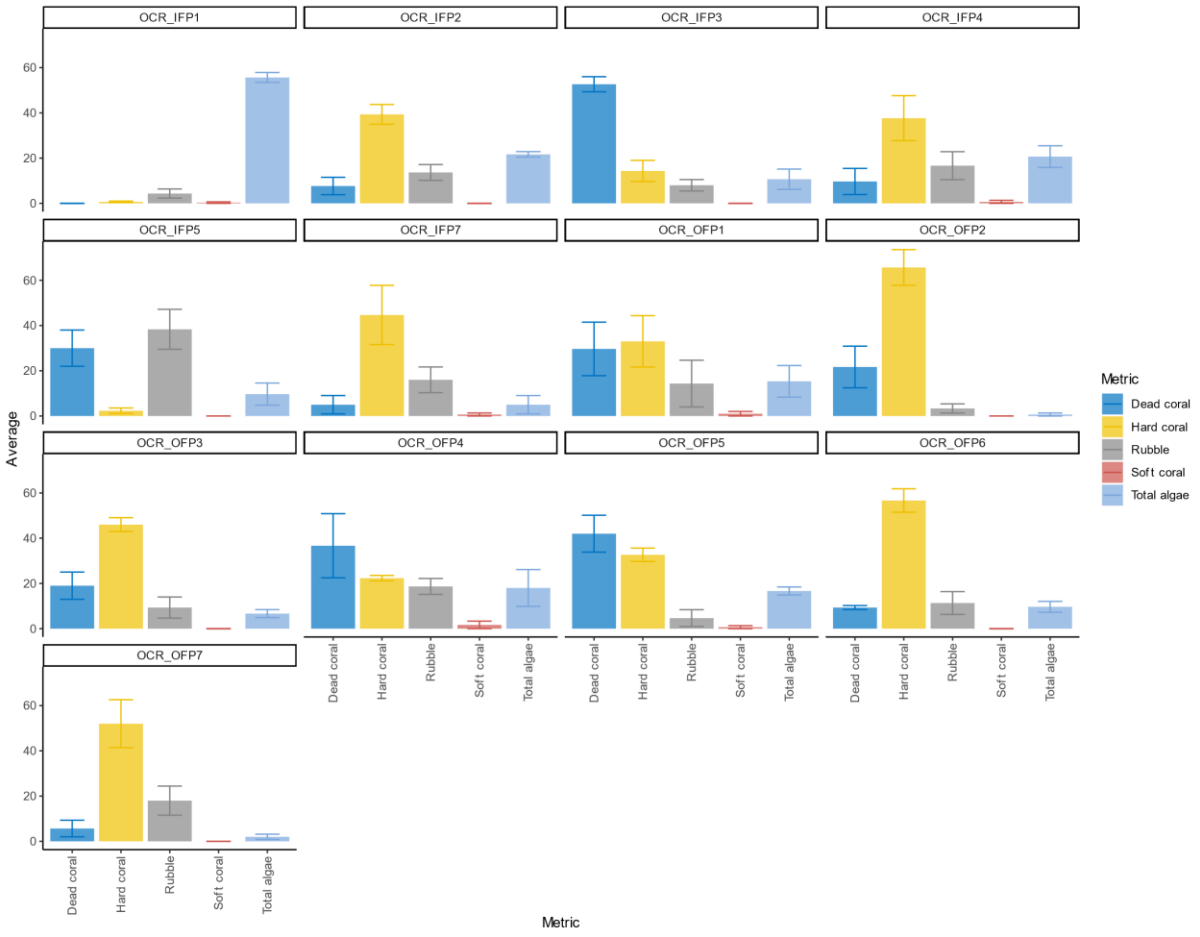

Figure 12. Benthic cover composition on offshore reefs of Beqa lagoon. Benthic cover was recorded during diver operated video surveys with a downward facing camera.

5 Conclusions

Here, we surveyed fish communities on coral reefs and in mangrove forests of Beqa lagoon to assess the biodiversity present throughout the lagoon and determine the drivers of the abundance and diversity of fishes. We surveyed 40 sites across the Beqa lagoon, which included 14 inshore reef sites, 11 inshore mangrove sites, two offshore mangrove sites and 13 offshore reef sites. We identified 270 species of fish across these sites using remote underwater video stations, set to record for 15 minutes per replicate. We highlight that this method is an effective approach to rapidly sample coral reefs throughout the region and should be deployed more frequently as a monitoring tool. Fish communities on reefs were dominated by herbivores, corallivores and mesopredatory zoobenthivores, but higher order species of piscivores were not very common throughout these reefs. Further to this, we did not find harvested fish species in general to be very common throughout Beqa lagoon. We suspect that this region has undergone persistent subsistence and commercial fishing, which is likely to have significantly truncated the food web structure on these reefs, with this result being slightly different to that of other Pacific island nations (Martin et al. 2017). Finally, we found significant effects of the Navua River on fish throughout the lagoon, with sites located within the flood plume (those on the eastern side of the lagoon) experiencing more negative effects compared to other near-shore reefs. This significant change in the fish community is likely due to the sediment load that is deposited on reefs close to the river mouth, which decrease the coral cover and health, leading to a reduction in fish diversity, overall abundance, the abundance of harvested species and the abundance of multiple functional groups.

The long-term impacts of fishing have significantly modified fish communities throughout the Beqa lagoon. This has resulted in a reduction in the numbers of higher order predators (e.g. sharks and piscivores) that are present on both the inshore and offshore reefs. It is worth noting that there is a large amount of shark tourism in the region (close to our site ICR-OFP1 and OCR-IFP2), which may have a significant effect on the fish community and the sharks in the region due to the availability of scavenging opportunities available due to shark diving. This truncated food web is common throughout heavily fished regions (Pauly et al. 1998), where the higher order or larger consumers are fished out first, before the focus moves to lower order species. This can have significant impacts on the functioning of the reef system. To better understand these effects, we suggest future sampling incorporates the methods we have used, but with a focus on stereo cameras, which allow for length measurements, that can then be converted to biomass. Incorporating our current knowledge on the diversity and abundance of fish on the reefs of Beqa lagoon, with an understanding of the biomass, will aid in future management of this system that will support resilient reef systems.

The effects of the Navua River on the lagoon have been significant, with many areas inside the flood plume exhibiting significant sedimentation and degradation to the corals. There is a clear impact of the river on this side of the lagoon, however, it appears that this effect is only modifying the inshore coral reefs within 5 km of the river mouth and the offshore reefs that are within 10 km. Each of these impacted reefs are directly in front of the river mouth and likely experience frequent sedimentation, which would be significantly increased after rain events in the Navua catchment. Management of the catchment should focus on reducing the sediment, and likely other pollutants, that enter the river and are creating an environment that is not suitable for coral reefs (Gilby et al. 2016). This sedimentation is likely impacting the mangroves and seagrasses in the region; however, we did not see an effect of this due to the low diversity and abundance of fish using these habitats.

The data collected from the inshore and offshore reefs and mangrove forests will be incorporated into an Integrated Ecosystem Management Plan for the entire Navua catchment and Beqa lagoon. This data includes;

- Fish diversity and abundance data recorded on RUVS,
- Fish diversity and abundance data recorded on diver operated video systems (DOVS), and
- Coral cover recorded on a downward facing camera on the DOV.

We suggest that this management plan incorporates a focus on improving reef resilience by reducing sedimentation on reefs near the mouth of the Navua River and protecting the fish on reefs throughout the lagoon, with a particular focus on higher order consumers that are currently found in very low numbers on these coral reef systems.

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Supplementary material

Table S1.

Species	Abundance	Species	Abundance
ICR_IFP1			
Acanthrus triostegus	1	*Lethrinus* spp	1
Acanthurus auranticavus	2	*Lutjanus gibbus*	8
Caranx papuensis	1	*Mulloidicthys flavolineatus*	2
Chaetodon rafflessi	4	*Parapercis xanthanzoa*	1
Chaetodon ulietensis	1	*Parupeneus cyclostomus*	4
Chaetodon vagabundus	1	*Parupeneus indicus*	6
Cheilinus chlorourus	1	*Parupeneus multifasciatus*	1
Chrysiptera biocellata	4	*Parupeneus pleurostigma*	4
Gomphosus varius	4	*Pomacentridae* spp	1
Gymnocranius superciliosus	4	*Rinecanthus aculeatus*	1
Halichoeres trimaculatus	1	*Scarus psittacus*	1
Labriadae spp	6	*Scolopsis bilineata*	4
Lethrinus akinsoni	1	*Scolopsis* spp	1
Lethrinus harak	10	*Siganus spinus*	7
Lethrinus obsoletus	1	*Sufflamen chrysopterum*	5
Lethrinus olivaceus	2		
ICR_IFP2			
Acanthurus spp	1	*Labriadae* spp	4
Chaetodon rafflessi	4	*Lethrinus harak*	2
Chaetodon vagabundus	2	*Lethrinus semicinctus*	1
Chromis chrysura	4	*Ostracion cubicus*	1
Chrysiptera biocellata	1	*Paraluteres prionurus*	3
Gomphosus varius	4	*Parupeneus cyclostomus*	4
Gymnocranius superciliosus	4	*Parupeneus indicus*	2
Halichoeres melanurus	2	*Parupeneus pleurostigma*	4
Halichoeres nebulosus	2	*Pomacentrus bankanensis*	1
Halichoeres nigrescens	1	*Scolopsis bilineata*	4
Halichoeres trimaculatus	3	*Siganus spinus*	1
Hemigymnus melapterus	1		

ICR_IFP3			
Acanthrus triostegus	3	*Parupeneus cyclostomus*	2
Acanthurus nigrofuscus	3	*Parupeneus pleurostigma*	2
Atherinomorus lacunosus	2	*Plectroglyphidodon dickii*	1
Carangadae spp	1	*Pomacentridae* spp	1
Chaetodon citrinellus	1	*Pomacentrus chrysurus*	1
Chaetodon rafflessi	2	*Pomacentrus lepidogenys*	1
Chromis chrysura	2	*Scolopsis bilineata*	2
Gomphosus varius	2	*Siganus spinus*	4
Gymnocranius superciliosus	2	*Thalassoma hardwicke*	2
ICR_IFP4			
Abudefduf sexfasciatus	3	*Mulloidicthys flavolineatus*	14
Acanthurus auranticavus	2	*Myripristis murdjan*	1
Acanthurus nigrofuscus	8	*Myripristis violacea*	2
Acanthurus spp	2	*Naso annulatus*	1
Amanses scopas	1	*Naso lituratus*	1
Anampses geographicus	6	*Oxycheilinus digrammus*	1
Chaetedon spp	1	*Paracirrhites arcatus*	1
Chaetodon citrinellus	4	*Parapercis hexaplthma*	3
Chaetodon lunulatus	3	*Parupeneus barberinoides*	1
Chaetodon rafflessi	3	*Parupeneus barberinus*	1
Chaetodon ulietensis	2	*Parupeneus cyclostomus*	3
Chaetodon vagabundus	1	*Parupeneus multifasciatus*	2
Cheilinus chlorourus	1	*Parupeneus pleurostigma*	3
Chlorurus bleekeri	3	*Pomacentridae* spp	3
Fistularia commersoni	1	*Scarus psittacus*	4
Gobiidae spp	1	*Scarus rivulatus*	1
Gomphosus varius	3	*Scarus schlegeli*	4
Gymnocranius superciliosus	3	*Scarus tricolor*	5
Halichoeres hortulanus	4	*Scolopsis bilineata*	3
Hemigymnus melapterus	2	*Siganus doliatus*	1
Labriadae spp	3	*Sufflamen bursa*	1
Lutjanus gibbus	1	*Zebrasoma scopus*	1

Melichthys niger	1	*Hemigymnus melapterus*	1
ICR_IFP5			
Abudefduf sexfasciatus	10	*Labriadae* spp	15
Acanthurus auranticavus	2	*Novaculichthys taeniourus*	1
Acanthurus nigrofuscus	1	*Parapercis hexaplthma*	2
Balistidae spp	1	*Parupeneus barberinus*	2
Centropyge bicolor	3	*Parupeneus cyclostomus*	2
Chaetedon spp	1	*Parupeneus pleurostigma*	2
Chaetodon baronessa	2	*Pomacentridae* spp	14
Chaetodon citrinellus	1	*Pomacentrus adelus*	2
Chaetodon rafflessi	2	*Sargocentron ensifer*	1
Chaetodon reticulatus	3	*Sargocentron microstima*	1
Cheilinus chlorourus	1	*Scarus psittacus*	3
Cheilinus trilobatus	1	*Scarus rivulatus*	13
Chlorurus spirilus	5	*Scarus schlegeli*	6
Chromis chrysura	17	*Scarus tricolor*	3
Coris gaimard	1	*Scolopsis bilineata*	2
Dascyllus aruanus	11	*Sufflamen chrysopterum*	1
Epibulus insidiator	1	*Thalassoma hardwicke*	1
Gomphosus varius	2	*Thalassoma lunare*	1
Gymnocranius superciliosus	2	*Thalassoma lutescens*	1
Halichoeres hortulanus	1	*Zebrasoma scopus*	2
ICR_IFP6			
Acanthurus auranticavus	1	*Fistularia commersoni*	1
Acanthurus nigrofuscus	2	*Gomphosus varius*	2
Acanthurus spp	2	*Gymnocranius superciliosus*	2
Carangadae spp	1	*Hemigymnus melapterus*	3
Carangoides orthogrammus	1	*Lethrinus akinsoni*	1
Caranx melampygus	1	*Lutjanus semicinctus*	1
Chaetedon spp	1	*Novaculichthys taeniourus*	2
Chaetodon baronessa	1	*Parapercis xanthanzoa*	1
Chaetodon citrinellus	2	*Parupeneus cyclostomus*	2
Chaetodon lunulatus	2	*Parupeneus multifasciatus*	1

Chaetodon rafflessi	2	*Parupeneus pleurostigma*	2
Chaetodon ulietensis	2	*Pomacentridae* spp	20
Chaetodon vagabundus	4	*Scarus psittacus*	2
Cheilinus chlorourus	1	*Scarus schlegeli*	5
Cheilinus fasciatus	1	*Scolopsis bilineata*	2
Cheilinus trilobatus	2	*Siganus argenteus*	2
Cheilio inermis	2	*Siganus doliatus*	3
Chlorurus spirilus	2	*Thalassoma hardwicke*	1
Ctenochaetus striatus	3	*Zebrasoma scopus*	2
Dascyllus aruanus	1		
ICR_IFP7			
Acanthurus nigrofuscus	1	*Lutjanus gibbus*	14
Centropyge bicolor	1	*Parapercis hexaplthma*	1
Chaetodon lunulatus	2	*Parupeneus cyclostomus*	2
Chaetodon rafflessi	2	*Parupeneus indicus*	2
Chaetodon vagabundus	1	*Parupeneus pleurostigma*	2
Cheilinus chlorourus	3	*Pomacentridae* spp	4
Chlorurus spirilus	1	*Pomacentrus chrysurus*	1
Ctenochaetus striatus	3	*Pomacentrus coelestis*	2
Epinephelus merra	1	*Scarus psittacus*	1
Fistularia commersoni	1	*Scarus rivulatus*	2
Gomphosus varius	2	*Scarus schlegeli*	4
Gymnocranius superciliosus	2	*Scolopsis bilineata*	2
Hemigymnus melapterus	1	*Thalassoma hardwicke*	1
Labroides dimidas	1	*Thalassoma lunare*	1
Lethrinus harak	10	*Zanclus cornutus*	1
Lethrinus obsoletus	1	*Zebrasoma scopus*	6
ICR_OFP1			
Acanthurus nigrofuscus	4	*Lutjanus semicinctus*	1
Acanthurus spp	2	*Monotaxis grandoculis*	1
Amanses scopas	5	*Muraenidae* spp	1
Bodianus axillaris	1	*Naso annulatus*	3
Bodianus bimaculatus	1	*Naso lituratus*	3

Carangadae spp	1	*Naso unicornis*	7
Carcharhinus melanopterus	1	*Neoglyphidodon carlsoni*	2
Centropyge heraldi	1	*Parupeneus cyclostomus*	4
Cephalopholis leopardus	1	*Parupeneus multifasciatus*	2
Chaetedon spp	1	*Parupeneus pleurostigma*	4
Chaetodon citrinellus	1	*Pomacentridae* spp	2
Chaetodon lunulatus	2	*Pomacentrus brachialis*	1
Chaetodon ornatissimus	1	*Pomacentrus lepidogenys*	1
Chaetodon pelewensis	3	*Pterocaesio tile*	7
Chaetodon rafflessi	4	*Scaridae* spp	1
Chaetodon reticulatus	2	*Scarus frenatus*	4
Chlorurus bleekeri	2	*Scarus ghobban*	1
Chromis chrysura	10	*Scarus longipinnis*	3
Clupeidae spp	12	*Scarus niger*	1
Ctenochaetus striatus	3	*Scarus psittacus*	1
Gobiidae spp	1	*Scarus rivulatus*	3
Gomphosus varius	4	*Scolopsis bilineata*	4
Gymnocranius superciliosus	4	*Siganus doliatus*	2
Halichoeres hortulanus	2	*Siganus punctatissimus*	1
Hemigymnus melapterus	2	*Thalassoma hardwicke*	3
Hemiramphidae spp	2	*Thalassoma lunare*	2
Kyphosus viagenis	2	*Tylosurus crocodilus*	1
Labriadae spp	12	*Zanclus cornutus*	2
Labroides dimidas	1	*Zebrasoma scopus*	5
Lutjanus bohar	1	*Zebrasoma zelifer*	3
		ICR_OFP2	
Acanthurus nigrofuscus	4	*Meiacanthus oualanensis*	1
Balistidae spp	1	*Mulloidicthys vanicolensis*	4
Carcharhinus melanopterus	1	*Naso lituratus*	2
Centropyge heraldi	1	*Parupeneus cyclostomus*	3
Chaetodon citrinellus	2	*Parupeneus indicus*	1
Chaetodon ephippium	1	*Parupeneus multifasciatus*	1
Chaetodon rafflessi	3	*Parupeneus pleurostigma*	3

Chaetodon vagabundus	1	*Pomacentridae* spp	25
Chromis chrysura	15	*Pomacentrus vaiuli*	2
Chromis viridis	1	*Sardinella fijiensis*	21
Ctenochaetus striatus	3	*Scaridae* spp	2
Dascyllus aruanus	1	*Scarus psittacus*	1
Gomphosus varius	3	*Scarus schlegeli*	4
Gymnocranius superciliosus	3	*Scolopsis bilineata*	3
Hemigymnus fasciatus	1	*Serranidae* spp	2
Hemiramphidae spp	10	*Sphyraena obtusta*	4
Holocentridae spp	2	*Synodontidae* spp	1
Labriadae spp	1	*Thalassoma hardwicke*	5
Labroides dimidas	1	*Thalassoma lunare*	1
Lutjanus monostigma	2	*Zanclus cornutus*	1
Macolor macularis	1	*Zebrasoma scopus*	2
ICR_OFP3			
Acanthurus auranticavus	11	*Gymnocranius superciliosus*	4
Acanthurus bariene	2	*Halichoeres hortulanus*	1
Acanthurus nigrofuscus	9	*Hemigymnus melapterus*	1
Amanses scopas	1	*Holocentridae* spp	2
Anampses geographicus	2	*Lutjanus fulvus*	2
Balistapus undulatus	1	*Lutjanus gibbus*	2
Bodianus axillaris	1	*Lutjanus semicinctus*	1
Caranx melampygus	1	*Mulloidicthys flavolineatus*	6
Caranx papuensis	1	*Myripristis murdjan*	8
Centropyge heraldi	2	*Naso lituratus*	5
Cephalopholis urodeta	1	*Parapercis hexaplthma*	1
Chaetedon spp	1	*Parupeneus barberinus*	1
Chaetodon ephippium	1	*Parupeneus cyclostomus*	4
Chaetodon linoelatus	5	*Parupeneus pleurostigma*	4
Chaetodon lunula	1	*Plectorhinchis vittatus*	1
Chaetodon lunulatus	3	*Pomacentridae* spp	7
Chaetodon merternsii	3	*Pomacentrus coelestis*	2
Chaetodon plebeius	2	*Pomacentrus microspilus*	1

Chaetodon rafflessi	4	*Pterocaesio tile*	25
Chaetodon unimaculatus	1	*Pygoplites diacanthus*	1
Chaetodon vagabundus	3	*Sargocentron caudimaculatum*	1
Cheilinus chlorourus	1	*Scaridae* spp	4
Cheilinus trilobatus	1	*Scarus ghobban*	1
Chlorurus bleekeri	1	*Scarus rivulatus*	2
Chlorurus spirilus	2	*Scarus schlegeli*	5
Chromis chrysura	20	*Scolopsis bilineata*	4
Chromis iomelas	4	*Siganus argenteus*	1
Chromis ternatensis	1	*Siganus doliatus*	1
Ctenochaetus striatus	5	*Thalassoma hardwicke*	1
Forcipiger flavissimus	2	*Thalassoma lutescens*	1
Gomphosus varius	4	*Zanclus cornutus*	2
Gymnocranius euanus	3	*Zebrasoma scopus*	6
ICR_OFP4			
Acanthurus auranticavus	4	*Heniochus monoceros*	1
Acanthurus nigrofuscus	2	*Heniochus varius*	1
Acanthurus thompsoni	3	*Labriadae* spp	7
Amblyglyphidodon leucogaster	3	*Lethrinus obsoletus*	4
Atule mate	2	*Lutjanus fulvus*	1
Centropyge bicolor	2	*Lutjanus semicinctus*	1
Centropyge bispinosa	1	*Meiacanthus oualanensis*	3
Centropyge heraldi	1	*Naso annulatus*	2
Chaetodon auriga	2	*Naso unicornis*	1
Chaetodon baronessa	2	*Neopomacentrrus violascens*	2
Chaetodon ephippium	2	*Oxycheilinus digrammus*	2
Chaetodon lineolatus	2	*Parapercis hexaplthma*	1
Chaetodon lunulatus	2	*Parupeneus barberinoides*	1
Chaetodon merternsii	2	*Parupeneus cyclostomus*	4
Chaetodon rafflessi	4	*Parupeneus multifasciatus*	1
Chaetodon vagabundus	3	*Parupeneus pleurostigma*	4
Cheilinus chlorourus	1	*Pomacentridae* spp	3
Cheilinus fasciatus	1	*Pomacentrus brachialis*	1

Chlorurus bleekeri	1	*Pomacentrus imitator*	1
Chlorurus spirilus	2	*Pomacentrus lepidogenys*	5
Chromis chrysura	15	*Pomacentrus nigromarginatus*	1
Chromis viridis	1	*Pygoplites diacanthus*	2
Chromis ternatensis	1	*Scaridae* spp	2
Chromis xanthura	1	*Scarus frenatus*	1
Ctenochaetus striatus	4	*Scarus ghobban*	2
Dascyllus aruanus	15	*Scarus longipinnis*	2
Epibulus insidiator	3	*Scarus psittacus*	3
Gomphosus varius	4	*Scarus rivulatus*	2
Gymnocranius superciliosus	4	*Scarus schlegeli*	2
Halichoeres hortulanus	1	*Scolopsis bilineata*	4
Halichoeres nigrescens	1	*Serranidae* spp	1
Halichores prosopeion	2	*Siganus punctatissimus*	2
Halichores richmondi	1	*Thalassoma lunare*	4
Hemigymnus melapterus	3	*Zebrasoma scopus*	3
Heniochus acuminatus	3		
ICR_OFP5			
Acanthurus nigricauda	1	*Halichoeres hortulanus*	3
Acanthurus nigrofuscus	4	*Labrichthys unilineatus*	1
Amanses scopas	1	*Labroides dimidas*	1
Anampses geographicus	1	*Myripristis murdjan*	2
Atule mate	3	*Ostracion cubicus*	1
Blennidae spp	2	*Oxycheilinus digrammus*	1
Caranx melampygus	1	*Parupeneus crassilabris*	1
Chaetodon lunulatus	2	*Parupeneus cyclostomus*	2
Chaetodon melannotus	1	*Parupeneus pleurostigma*	2
Chaetodon rafflessi	2	*Pomacentridae* spp	4
Chlorurus spirilus	1	*Pomacentrus bankanensis*	1
Chromis iomelas	1	*Pterocaesio tile*	1
Chromis margaritifer	3	*Pygoplites diacanthus*	1
Chromis ternatensis	5	*Scarus longipinnis*	1
Chromis xanthura	1	*Scarus schlegeli*	1

Coris dorsomacula	1	*Scolopsis bilineata*	2
Gomphosus varius	2	*Thalassoma hardwicke*	2
Gymnocranius superciliosus	2		
ICR_OFP6			
Acanthurus auranticavus	4	*Lutjanus semicinctus*	5
Acanthurus nigrofuscus	5	*Meiacanthus oualanensis*	1
Amanses scopas	2	*Monotaxis grandoculis*	5
Amblyglyphidodon curacao	2	*Mulloidicthys flavolineatus*	6
Balistapus undulatus	1	*Naso annulatus*	1
Caranx melampygus	1	*Naso lituratus*	2
Centropyge bicolor	2	*Neoniphon argentus*	1
Centropyge heraldi	1	*Parapercis hexaplthma*	1
Chaetodon citrinellus	3	*Parupeneus barberinus*	2
Chaetodon linoelatus	1	*Parupeneus cyclostomus*	4
Chaetodon merternsii	4	*Parupeneus indicus*	1
Chaetodon pelewensis	4	*Parupeneus multifasciatus*	5
Chaetodon rafflessi	4	*Parupeneus pleurostigma*	4
Chaetodon vagabundus	1	*Pomacentridae* spp	10
Chlorurus bleekeri	1	*Pomacentrus adelus*	2
Chlorurus spirilus	6	*Pomacentrus brachialis*	1
Ctenochaetus striatus	10	*Scaridae* spp	6
Gomphosus varius	4	*Scarus longipinnis*	6
Gymnocranius euanus	1	*Scarus oviceps*	1
Gymnocranius superciliosus	4	*Scarus psittacus*	1
Halichoeres hortulanus	3	*Scarus rivulatus*	5
Halichores prosopeion	1	*Scarus schlegeli*	8
Hipposcarus longiceps	2	*Scolopsis bilineata*	4
Labriadae spp	1	*Serranidae* spp	1
Lethrinus ambionensis	1	*Siganus doliatus*	4
Lethrinus nebulosus	1	*Sufflamen bursa*	1
Lethrinus obsoletus	1	*Thalassoma hardwicke*	1
Lutjanus bohar	1	*Thalassoma lunare*	1
Lutjanus ehrenbergii	7	*Zanclus cornutus*	1

Lutjanus fulviflumma	1	*Zebrasoma scopus*	3
Lutjanus fulvus	1	*Zebrasoma zelifer*	1
Lutjanus monostigma	8		
ICR_OFP7			
Acanthurus nigrofuscus	3	*Monotaxis heterodon*	2
Acanthurus pyroferus	2	*Myripristis murdjan*	3
Acanthurus spp	1	*Naso lituratus*	1
Balistapus undulatus	1	*Neoniphon argentus*	3
Chaetodon lineolatus	1	*Parupeneus barberinus*	1
Chaetodon lunulatus	2	*Parupeneus cyclostomus*	2
Chaetodon merternsii	3	*Parupeneus multifasciatus*	1
Chaetodon rafflessi	2	*Parupeneus pleurostigma*	2
Chaetodon bennetti	1	*Pomacentridae* spp	4
Chaetodon vagabundus	1	*Psueudobalistes flavimarginatus*	1
Cheilinus fasciatus	1	*Pygoplites diacanthus*	1
Epibulus insidiator	1	*Scaridae* spp	2
Forcipiger flavissimus	2	*Scarus ghobban*	1
Gomphosus varius	2	*Scarus oviceps*	1
Gymnocranius superciliosus	2	*Scarus psittacus*	1
Halichoeres hortulanus	1	*Scarus schlegeli*	3
Halichores prosopeion	1	*Scolopsis bilineata*	2
Labriadae spp	1	*Siganus doliatus*	2
Lutjanus fulvus	1	*Zanclus cornutus*	2
Lutjanus monostigma	3	*Zebrasoma scopus*	1
Monotaxis grandoculis	2	*Zebrasoma zelifer*	2
MF_IFP1			
Caranx ignoblis	4	*Lutjanus argentimaculatus*	2
Caranx sexfasciatus	8	*Lutjanus ehrenbergii*	2
Chaetodon rafflessi	5	*Mesopristes kneri*	8
Crenumugil crenilabis	44	*Monodactylus argenteus*	13
Gerres oyena	17	*Parupeneus cyclostomus*	5
Gobiidae spp	1	*Parupeneus pleurostigma*	5
Gomphosus varius	5	*Scolopsis bilineata*	5

Gymnocranius superciliosus	5	*Terapon jarbua*	7
Lethrinus harak	4	*Trachinotus baillonii*	13
MF_IFP2			
Chaetodon rafflessi	4	*Parupeneus cyclostomus*	4
Gomphosus varius	4	*Parupeneus pleurostigma*	4
Gymnocranius superciliosus	4	*Scolopsis bilineata*	4
Mesopristes kneri	1		
MF_IFP3			
Caranx sexfasciatus	1	*Parupeneus cyclostomus*	5
Chaetodon rafflessi	5	*Parupeneus pleurostigma*	5
Gomphosus varius	5	*Sardinella fijiensis*	38
Gymnocranius superciliosus	5	*Scolopsis bilineata*	5
Mesopristes kneri	1	*Terapon jarbua*	2
Muglidae spp	1		
MF_IFP4			
Caranx ignoblis	2	*Parupeneus cyclostomus*	4
Chaetodon rafflessi	4	*Parupeneus pleurostigma*	4
Gerres oyena	1	*Scolopsis bilineata*	4
Gomphosus varius	4	*Siganus vermiculatus*	2
Gymnocranius superciliosus	4	*Terapon jarbua*	1
MF_IFP5			
Caranx ignoblis	1	*Gymnocranius superciliosus*	5
Chaetodon rafflessi	5	*Parupeneus cyclostomus*	5
Gobiidae spp	1	*Parupeneus pleurostigma*	5
Gomphosus varius	5	*Scolopsis bilineata*	5
MF_OFP1			
Ambasis spp	15	*Monodactylus argenteus*	1
Caranx sexfasciatus	1	*Parupeneus cyclostomus*	5
Chaetodon rafflessi	5	*Parupeneus pleurostigma*	5
Gomphosus varius	5	*Scolopsis bilineata*	5
Gymnocranius superciliosus	5	*Terapon jarbua*	1
Lutjanus ehrenbergii	1		
MF_OFP2			

Albula spp	1	*Mullidae* spp	2
Caranx ignoblis	2	*Parupeneus barberinus*	1
Caranx papuensis	3	*Parupeneus cyclostomus*	5
Chaetodon rafflessi	5	*Parupeneus pleurostigma*	5
Gomphosus varius	5	*Scolopsis bilineata*	5
Gymnocranius superciliosus	5	*Sphyraena barracuda*	1
Muglidae spp	3		
MF_OFP3			
Carangoides oblongus	2	*Gymnocranius superciliosus*	5
Caranx ignoblis	1	*Parupeneus cyclostomus*	5
Caranx papuensis	1	*Parupeneus pleurostigma*	5
Chaetodon rafflessi	5	*Scatophagus argus*	8
Gomphosus varius	5	*Scolopsis bilineata*	5
MF_OFP4			
Carangoides oblongus	1	*Lutjanus fulvus*	6
Caranx sexfasciatus	1	*Parupeneus cyclostomus*	4
Chaetodon rafflessi	4	*Parupeneus pleurostigma*	4
Gomphosus varius	4	*Scolopsis bilineata*	4
Gymnocranius superciliosus	4	*Siganus vermiculatus*	4
Lutjanus argentimaculatus	3		
MF_OFP5			
Carangoides ferdau	2	*Gymnocranius superciliosus*	5
Caranx ignoblis	1	*Parupeneus cyclostomus*	5
Chaetodon rafflessi	5	*Parupeneus pleurostigma*	5
Gomphosus varius	5	*Scolopsis bilineata*	5
MF_OFP6			
Chaetodon rafflessi	5	*Parupeneus cyclostomus*	5
Gerres oyena	3	*Parupeneus pleurostigma*	5
Gobiidae spp	1	*Scatophagus argus*	1
Gomphosus varius	5	*Scolopsis bilineata*	5
Gymnocranius superciliosus	5	*Siganus vermiculatus*	1
Lutjanus fulvus	4	*Terapon jarbua*	4
Muglidae spp	2		

OCR_IFP1			
Abudefduf sexfasciatus	6	*Oxycheilinus digrammus*	1
Abudefduf vaigensis	6	*Parapercis hexaplthma*	1
Acanthurus nigrofuscus	2	*Parapercis millepunctata*	1
Acanthurus spp	1	*Parupeneus barberinus*	1
Anampses neoguinaicus	1	*Parupeneus ciliatus*	1
Arothron nigropunctatus	1	*Parupeneus crassilabris*	2
Balistapus undulatus	1	*Parupeneus cyclostomus*	4
Caranx ignoblis	1	*Parupeneus multifasciatus*	1
Caranx melampygus	1	*Parupeneus pleurostigma*	4
Chaetodon baronessa	1	*Pomacentridae* spp	13
Chaetodon citrinellus	5	*Pomacentrus adelus*	5
Chaetodon ephippium	1	*Pomacentrus brachialis*	3
Chaetodon lineolatus	1	*Pomacentrus chrysurus*	1
Chaetodon lunulatus	2	*Pomacentrus coelestis*	1
Chaetodon rafflessi	4	*Pomacentrus flavioculus*	1
Chaetodon vagabundus	1	*Pomacentrus imitator*	6
Cheilinus chlorourus	1	*Pterocaesio tile*	56
Cheilinus trilobatus	1	*Scarus chameleon*	1
Chlorurus japanensis	1	*Scarus globiceps*	1
Chlorurus spirilus	6	*Scarus longipinnis*	1
Chromis chrysura		*Scarus psittacus*	1
Ctenochaetus striatus	3	*Scarus rivulatus*	11
Dascyllus reticulatus	1	*Scarus schlegeli*	3
Gobiidae spp	1	*Scolopsis bilineata*	4
Gomphosus varius	4	*Scomberoides lysan*	1
Gymnocranius superciliosus	4	*Siganus argenteus*	2
Hemigymnus melapterus	1	*Siganus doliatus*	4
Kyphosus viagenis	1	*Siganus spinus*	4
Labriadae spp	1	*Stethojulis strigiventer*	1
Labroides dimidas	1	*Stethojulis trilineata*	2
Lethrinus harak	1	*Thalassoma hardwicke*	4
Lutjanus ehrenbergii	29	*Thalassoma lunare*	1

Lutjanus gibbus	3	*Thalassoma lutescens*	1
Lutjanus semicinctus	1	*Thalassoma nigrofasciatum*	1
Mulloidicthys vanicolensis	1	*Zebrasoma scopus*	3
Naso unicornis	1	*Zebrasoma zelifer*	1
OCR_IFP2			
Balistidae spp	1	*Labriadae* spp	3
Chaetodon rafflessi	3	*Novaculichthys taeniourus*	1
Chaetodon vagabundus	4	*Parapercis millepunctata*	1
Cheilinus chlorourus	1	*Parupeneus cyclostomus*	3
Chlorurus spilurus	1	*Parupeneus pleurostigma*	3
Chrysiptera biocellata	2	*Pomacentrus adelus*	1
Coris gaimard	1	*Scarus oviceps*	1
Dascyllus aruanus	2	*Scarus rivulatus*	11
Gomphosus varius	3	*Scolopsis bilineata*	3
Gymnocranius superciliosus	3	*Stegastes albifasciatus*	3
Halichoeres nebulosus	2	*Sufflamen bursa*	1
Halichoeres trimaculatus	4	*Sufflamen chrysopterum*	2
Hemigymnus melapterus	1	*Valenciennea strigata*	2
OCR_IFP3			
Acanthurus auranticavus	2	*Parapercis millepunctata*	1
Acanthurus nigrofuscus	2	*Parupeneus cyclostomus*	3
Balistidae spp	1	*Parupeneus multifasciatus*	1
Carcharhinus melanopterus	1	*Parupeneus pleurostigma*	3
Chaetodon rafflessi	3	*Pomacentridae* spp	5
Chaetodon vagabundus	1	*Psuedocoris yamasshiroi*	1
Cheilinus chlorourus	1	*Scaridae* spp	1
Cheilinus trilobatus	2	*Scarus ghobban*	1
Chlorurus spirilus	1	*Scarus globiceps*	1
Gomphosus varius	3	*Scarus longipinnis*	1
Gymnocranius superciliosus	3	*Scarus rivulatus*	
Halichoeres trimaculatus	2	*Scarus schlegeli*	3
Hemigymnus melapterus	1	*Scolopsis bilineata*	3
Labriadae spp	2	*Scolopsis trilineata*	1

Labropsis xanthonata	2	*Zanclus cornutus*	1
Lethrinus harak	1	*Zebrasoma scopus*	1
OCR_IFP4			
Acanthurus auranticavus	1	*Parupeneus barberinus*	3
Acanthurus nigrofuscus	5	*Parupeneus ciliatus*	3
Acanthurus olivaceus	3	*Parupeneus cyclostomus*	4
Acanthurus thompsoni	5	*Parupeneus multifasciatus*	6
Chaetedon spp	1	*Parupeneus pleurostigma*	4
Chaetodon citrinellus	5	*Pervagor melanocephalus*	1
Chaetodon lineolatus	1	*Plotosus lineatus*	1
Chaetodon rafflessi	4	*Pomacentridae* spp	12
Chaetodon vagabundus	1	*Pomacentrus bankanensis*	1
Cheilinus trilobatus	8	*Pomacentrus chrysurus*	1
Chlorurus spirilus	1	*Scaridae* spp	2
Coris gaimard	2	*Scarus oviceps*	1
Ctenochaetus striatus	4	*Scarus rivulatus*	9
Gomphosus varius	4	*Scarus schlegeli*	1
Gymnocranius superciliosus	4	*Scolopsis bilineata*	4
Halichoeres hortulanus	1	*Scolopsis* spp	2
Halichoeres nebulosus	7	*Siganus punctatissimus*	1
Hemigymnus melapterus	1	*Siganus spinus*	5
Labriadae spp	8	*Stegastes albifasciatus*	5
Labroides dimidas	2	*Sufflamen chrysopterum*	4
Lethrinus harak	5	*Thalassoma hardwicke*	9
Lethrinus olivaceus	1	*Zanclus cornutus*	1
Naso lituratus	1	*Zebrasoma scopus*	1
OCR_IFP5			
Acanthurus auranticavus	3	*Gymnocranius superciliosus*	4
Acanthurus nigrofuscus	6	*Halichoeres hortulanus*	3
Acanthurus olivaceus	6	*Halichoeres trimaculatus*	1
Acanthurus thompsoni	2	*Hemigymnus melapterus*	2
Balistapus undulatus	1	*Lethrinus obsoletus*	2
Balistidae spp	1	*Macropharyngodon negrosensis*	1

Carcharhinus amblyrhynchos	1	*Mulloidicthys flavolineatus*	6
Carcharhinus melanopterus	1	*Myripristis murdjan*	2
Centropyge heraldi	1	*Parapercis xanthanzoa*	1
Cephalopholis microprion	1	*Parupeneus barberinus*	2
Chaetedon spp	2	*Parupeneus cyclostomus*	4
Chaetodon citrinellus	2	*Parupeneus multifasciatus*	4
Chaetodon lineolatus	2	*Parupeneus pleurostigma*	4
Chaetodon rafflessi	4	*Pomacentridae* spp	3
Chaetodon reticulatus	2	*Pomacentrus adelus*	1
Chaetodon bennetti	1	*Scaridae* spp	1
Chaetodon trifascialis	1	*Scarus oviceps*	1
Chaetodon vagabundus	1	*Scarus rivulatus*	8
Cheilinus trilobatus	4	*Scarus schlegeli*	13
Cheilio inermis	1	*Scolopsis bilineata*	4
Chlorurus bleekeri	1	*Scolopsis temporalis*	2
Chlorurus spirilus	18	*Siganus argenteus*	3
Coris aygula	2	*Stethojulis bandanensis*	3
Coris gaimard	3	*Sufflamen chrysopterum*	1
Ctenochaetus striatus	14	*Thalassoma hardwicke*	4
Dascyllus aruanus	4	*Thalassoma lunare*	2
Dascyllus reticulatus	6	*Thalassoma lutescens*	1
Epibulus insidiator	2	*Zanclus cornutus*	2
Gomphosus varius	4	*Zebrasoma scopus*	5
OCR_IFP7			
Acanthurus nigrofuscus	5	*Lethrinus lauticaudus*	1
Acanthurus spp	1	*Lethrinus obsoletus*	1
Amblyglyphidodon leucogaster	3	*Lutjanus semicinctus*	1
Arothron nigropunctatus	1	*Monotaxis grandoculis*	3
Balistapus undulatus	1	*Naso annulatus*	1
Balistidae spp	1	*Oxycheilinus digrammus*	2
Carangadae spp	1	*Parupeneus barberinoides*	1
Caranx melampygus	1	*Parupeneus barberinus*	1
Carcharhinus melanopterus	1	*Parupeneus cyclostomus*	3

Centropyge bispinosa	1	*Parupeneus multifasciatus*	3
Chaetodon citrinellus	1	*Parupeneus pleurostigma*	3
Chaetodon ephippium	1	*Pomacentridae* spp	17
Chaetodon rafflessi	3	*Pomacentrus chrysurus*	2
Cheilinus chlorourus	2	*Scaridae* spp	1
Cheilinus trilobatus	1	*Scarus rivulatus*	4
Chlorurus bleekeri	1	*Scarus schlegeli*	3
Chlorurus spirilus	4	*Scolopsis bilineata*	3
Ctenochaetus striatus	2	*Siganus doliatus*	2
Gomphosus varius	3	*Siganus spinus*	1
Gymnocranius superciliosus	3	*Stethojulis trilineata*	1
Halichoeres hortulanus	1	*Sufflamen chrysopterum*	1
Halichoeres trimaculatus	1	*Thalassoma hardwicke*	1
Hemigymnus melapterus	2	*Thalassoma lunare*	1
Labriadae spp	4	*Zebrasoma scopus*	2
Labroides dimidas	1	*Zebrasoma zelifer*	1
Lethrinus harak	3		
OCR_Mangrove1			
Chaetodon rafflessi	5	*Parupeneus indicus*	1
Crenumugil crenilabis	2	*Parupeneus pleurostigma*	5
Ellochelon vaigiensis	2	*Plectorhinchis gibbosus*	3
Gerres oyena	2	*Pomacentridae* spp	2
Gomphosus varius	5	*Scarus rivulatus*	2
Gymnocranius superciliosus	5	*Scolopsis bilineata*	5
Mulloidicthys vanicolensis	2	*Stethojulis bandanensis*	3
Parupeneus cyclostomus	5		
OCR_Mangrove2			
Arothron manilensis	1	*Lutjanus argentimaculatus*	2
Caranx ignoblis	1	*Lutjanus fulvus*	1
Caranx papuensis	3	*Lutjanus russeli*	2
Chaetodon rafflessi	5	*Parupeneus cyclostomus*	5
Crenumugil crenilabis	6	*Parupeneus pleurostigma*	5
Gerres oyena	1	*Scolopsis bilineata*	5

Gomphosus varius	5	*Sphyraena barracuda*	1
Gymnocranius superciliosus	5	*Terapon jarbua*	3
OCR_OFP1			
Abudefduf sexfasciatus	9	*Lutjanus gibbus*	3
Abudefduf vaigensis	58	*Oxycheilinus digrammus*	1
Acanthurus nigrofuscus	3	*Parupeneus barberinus*	2
Acanthurus olivaceus	2	*Parupeneus cyclostomus*	4
Acanthurus thompsoni	3	*Parupeneus multifasciatus*	4
Balistapus undulatus	1	*Parupeneus pleurostigma*	4
Centropyge flavissima	1	*Pomacentrus bankanensis*	2
Chaetodon rafflessi	4	*Pomacentrus brachialis*	1
Cheilinus chlorourus	1	*Pomacentrus chrysurus*	2
Cheilinus trilobatus	1	*Pomacentrus coelestis*	3
Chlorurus spirilus	5	*Pomacentrus microspilus*	1
Coris dorsomacula	1	*Scarus globiceps*	4
Ctenochaetus striatus	5	*Scarus rivulatus*	3
Dascyllus reticulatus	5	*Scolopsis bilineata*	4
Gomphosus varius	4	*Siganus spinus*	4
Gymnocranius superciliosus	4	*Stethojulis trilineata*	1
Hemigymnus melapterus	1	*Sufflamen chrysopterum*	2
Hipposcarus longiceps	1	*Thalassoma hardwicke*	3
Labriadae spp	5	*Zebrasoma scopus*	2
Labroides dimidas	1	*Zebrasoma velifer*	1
Lethrinus spp	1		
OCR_OFP2			
Amblyglyphidodon leucogaster	2	*Parupeneus cyclostomus*	1
Chaetodon rafflessi	1	*Parupeneus pleurostigma*	1
Chaetodon vagabundus	1	*Pomacentrus chrysurus*	2
Cheilinus fasciatus	1	*Pomacentrus coelestis*	1
Chromis iomelas	1	*Pomacentrus microspilus*	1
Chromis ternatensis	4	*Scarus dimidiatus*	1
Ctenochaetus striatus	4	*Scolopsis bilineata*	1
Gomphosus varius	1	*Siganus doliatus*	2

Gymnocranius superciliosus	1	*Siganus uspi*	1
Heniochus singularis	1	*Siganus vermiculatus*	2
Oxycheilinus digrammus	1		
OCR_OFP3			
Acanthrus triostegus	14	*Lethrinus semicinctus*	1
Acanthurus nigrofuscus	6	*Lutjanus ehrenbergii*	23
Arothron nigropunctatus	1	*Lutjanus semicinctus*	2
Balistapus undulatus	1	*Mulloidicthys flavolineatus*	4
Balistidae spp	1	*Parupeneus barberinus*	1
Centropyge flavissima	2	*Parupeneus cyclostomus*	3
Chaetodon auriga	3	*Parupeneus multifasciatus*	1
Chaetodon citrinellus	4	*Parupeneus pleurostigma*	3
Chaetodon lineolatus	6	*Pomacentridae* spp	2
Chaetodon lunulatus	2	*Pomacentrus bankanensis*	1
Chaetodon rafflessi	3	*Pomacentrus coelestis*	4
Cheilinus trilobatus	2	*Scarus frenatus*	1
Chlorurus spirilus	25	*Scarus globiceps*	1
Coris aygula	4	*Scarus longipinnis*	6
Coris gaimard	2	*Scarus oviceps*	17
Ctenochaetus striatus	8	*Scarus psittacus*	1
Gomphosus varius	3	*Scarus rivulatus*	9
Gymnocranius superciliosus	3	*Scarus schlegeli*	4
Halichoeres hortulanus	3	*Scolopsis bilineata*	3
Halichoeres trimaculatus	1	*Scolopsis temporalis*	1
Hemigymnus fasciatus	1	*Siganus argenteus*	8
Hemigymnus melapterus	4	*Sufflamen chrysopterum*	1
Hologymnosus doliatus	2	*Thalassoma hardwicke*	1
Lethrinus akinsoni	1	*Thalassoma lunare*	2
Lethrinus lauticaudus	1	*Triaenodon obesus*	2
Lethrinus nebulosus	1	*Zanclus cornutus*	1
Lethrinus obsoletus	3	*Zebrasoma scopus*	3
OCR_OFP4			
Acanthrus triostegus	12	*Lethrinus olivaceus*	1

Acanthurus auranticavus	1	*Lethrinus* spp	2
Acanthurus olivaceus	1	*Lethrinus xanthochilus*	3
Acanthurus thompsoni	2	*Lutjanus bohar*	2
Amanses scopas	1	*Lutjanus fulviflumma*	3
Bodianus mesothorax	1	*Lutjanus gibbus*	9
Caranx melampygus	8	*Lutjanus kasmira*	1
Centropyge flavissima	2	*Lutjanus semicinctus*	1
Centropyge heraldi	1	*Monotaxis grandoculis*	2
Chaetodon auriga	2	*Mulloidicthys flavolineatus*	3
Chaetodon baronessa	4	*Parapercis millepunctata*	3
Chaetodon citrinellus	5	*Parupeneus barberinus*	3
Chaetodon lineolatus	1	*Parupeneus crassilabris*	1
Chaetodon lunulatus	3	*Parupeneus cyclostomus*	5
Chaetodon rafflessi	5	*Parupeneus multifasciatus*	1
Cheilinus trilobatus	2	*Parupeneus pleurostigma*	5
Cheilio inermis	2	*Plotosus lineatus*	1
Chlorurus bleekeri	1	*Pomacentridae* spp	8
Chlorurus spirilus	9	*Pomacentrus bankanensis*	2
Chromis iomelas	2	*Pomacentrus coelestis*	2
Coris aygula	8	*Pygoplites diacanthus*	1
Coris gaimard	1	*Scarus frenatus*	1
Crenumugil crenilabis	3	*Scarus globiceps*	2
Ctenochaetus striatus	9	*Scarus longipinnis*	1
Dascyllus aruanus	10	*Scarus oviceps*	7
Epibulus insidiator	1	*Scarus rivulatus*	2
Gnathodentex aureolineatus	5	*Scarus schlegeli*	4
Gomphosus varius	5	*Scolopsis bilineata*	5
Gymnocranius superciliosus	5	*Siganus argenteus*	2
Halichoeres hortulanus	5	*Siganus spinus*	2
Halichoeres nebulosus	2	*Stethojulis bandanensis*	1
Halichoeres trimaculatus	5	*Stethojulis trilineata*	1
Hemigymnus fasciatus	1	*Sufflamen chrysopterum*	1
Hemigymnus melapterus	6	*Thalassoma hardwicke*	6

Hologymnosus doliatus	1	*Zebrasoma scopus*	6
Lethrinus obsoletus	7		
OCR_OFP5			
Acanthrus triostegus	1	*Lutjanus gibbus*	1
Acanthurus nigrofuscus	1	*Mulloidicthys flavolineatus*	5
Apogonidae spp	1	*Naso annulatus*	1
Carcharhinus amblyrhynchos	1	*Neoglyphidodon carlsoni*	1
Carcharhinus melanopterus	1	*Neopomacentrrus violascens*	2
Centropyge flavissima	3	*Parapercis millepunctata*	1
Chaetodon lineolatus	2	*Parupeneus barberinus*	2
Chaetodon rafflessi	3	*Parupeneus crassilabris*	1
Chaetodon vagabundus	3	*Parupeneus cyclostomus*	3
Cheilinus chlorourus	1	*Parupeneus pleurostigma*	3
Chlorurus spilurus	3	*Pomacentridae* spp	15
Chromis lepidolepis	1	*Pomacentrus coelestis*	9
Coris aygula	1	*Pomacentrus spilotoceps*	2
Ctenochaetus striatus	1	*Pomacentrus vaiuli*	1
Gnathodentex aureolineatus	1	*Scarus chameleon*	1
Gomphosus varius	3	*Scarus oviceps*	1
Gymnocranius superciliosus	3	*Scarus rivulatus*	2
Halichoeres hortulanus	1	*Scarus schlegeli*	1
Halichoeres trimaculatus	2	*Scolopsis bilineata*	3
Labriadae spp	1	*Stethojulis bandanensis*	2
Lethrinus nebulosus	1	*Thalassoma hardwicke*	2
Lethrinus obsoletus	3	*Thalassoma lunare*	2
Lethrinus semicinctus	3	*Triaenodon obesus*	1
Lethrinus spp	3		
OCR_OFP6			
Abudefduf sexfasciatus	3	*Labroides dimidas*	2
Acanthurus auranticavus	1	*Labropsis australis*	3
Acanthurus nigrofuscus	2	*Lethrinus* spp	1
Acanthurus olivaceus	3	*Lutjanus bohar*	1
Acanthurus spp	1	*Lutjanus gibbus*	2

Arothron nigropunctatus	1	*Naso annulatus*	2
Bodianus axillaris	1	*Naso lituratus*	2
Centropyge bicolor	2	*Naso unicornis*	9
Cetoscarus ocellatus	1	*Oxycheilinus digrammus*	2
Chaetodon baronessa	2	*Parupeneus cyclostomus*	3
Chaetodon citrinellus	2	*Parupeneus multifasciatus*	1
Chaetodon lineolatus	1	*Parupeneus pleurostigma*	3
Chaetodon lunula	1	*Pomacentridae* spp	2
Chaetodon pelewensis	1	*Pomacentrus chrysurus*	1
Chaetodon rafflessi	3	*Pomacentrus microspilus*	1
Chaetodon vagabundus	1	*Scaridae* spp	5
Chlorurus spirilus	7	*Scarus longipinnis*	3
Chrysiptera taupou	6	*Scarus oviceps*	1
Coris aygula	1	*Scarus rivulatus*	2
Ctenochaetus striatus	8	*Scarus schlegeli*	2
Gobiidae spp	1	*Scolopsis bilineata*	3
Gomphosus varius	3	*Siganus punctatissimus*	1
Gymnocranius superciliosus	3	*Stethojulis trilineata*	1
Halichoeres hortulanus	1	*Thalassoma hardwicke*	4
Halichoeres nebulosus	1	*Thalassoma lunare*	2
Halichoeres trimaculatus	1	*Thalassoma lutescens*	2
Hemigymnus melapterus	1	*Zebrasoma scopus*	2
Labriadae spp	1	*Zebrasoma zelifer*	2
OCR_OFP7			
Abudefduf sexfasciatus	2	*Halichores prosopeion*	1
Acanthurus nigrofuscus	2	*Hemigymnus melapterus*	1
Acanthurus thompsoni	1	*Lethrinus akinsoni*	2
Calloplesiops altivelis	1	*Lutjanus semicinctus*	1
Caranx melampygus	1	*Meiacanthus oualanensis*	2
Chaetodon citrinellus	1	*Naso unicornis*	1
Chaetodon ephippium	1	*Parupeneus cyclostomus*	2
Chaetodon rafflessi	2	*Parupeneus pleurostigma*	2
Chlorurus spirilus	1	*Pomacentrus flavioculus*	2

Chrysiptera taupou	4	*Pygoplites diacanthus*	1
Ctenochaetus striatus	1	*Scarus schlegeli*	2
Gomphosus varius	2	*Scolopsis bilineata*	2
Gymnocranius superciliosus	2	*Thalassoma hardwicke*	1
Halichoeres hortulanus	1	*Zebrasoma scopus*	1

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