PART 1

Preliminary Scientific Report - Coral Reef Environments between the southern limits of the Santuário Bravio de Vilanculos and Pomene National Reserve – Inhambane Province, Mozambique.

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SPONSORS

WIORI
WEST INDIAN OCEAN RESEARCH INITIATIVE
ENLIGHTENING OTHERS THROUGH ACTIVE MARINE ECOLOGY RESEARCH

NATURA MOÇAMBIQUE

HQ² EXPEDITIONS

AVM – CONSULTORES, Lda.

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This report has been prepared by WIORI and NATURA with contributions from UFF (LECAR) scientists, Universidade Pedagógica (Maputo), in order that interested parties are afforded an opportunity to evaluate the OCEANOGRAPHIC EXPEDITION arranged by WIORI, NATURA AND AVM Consultores undertaken by HQ2 Charters Lda, (The Sponsors), that a decision can be made by the Government of Mozambique on the part of the Authority (ANAC) to declare the area reviewed from the southern boundary of VCWS[4] to Baixo Silva Pomene, a Protected Area .

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[4] Vilanculos Coastal Wildlife Sanctuary

SPONSORS NOTE

Global Warming[5] has now become firmly defined and understood all over the world as Climate Change[6]. The number of people affected by natural disasters doubled from approximately 102 million in 2015 to 204 million in 2017[7]. And this number has risen in 2019, at a high price, these events cost US$335 billion in 2017, a 49% increase in economic losses over the previous decade for the same reasons, these losses disrupting basic infrastructure and affecting poorer countries the most.

Mozambique ranks third amongst African countries most exposed to risks from multiple weather related hazards, and Climate Change meaning cyclic floods, tropical cyclones and droughts. Cognisance of this threat is essential at all levels of leadership in Mozambique. We must have a coordinated set of actions based on scientific knowledge and data, to preserve the Mozambique Channel and integrity of bio-diversity

HUGH BROWN (WIORI) - JANUARY 2020

The unique marine ecological characteristics of the Mozambican coast in terms of water temperature, nutrient rich currents which provide marine life with the essential breeding grounds, the beauty and complexity of our reefs , the diversity of its invertebrate, fish and mammal species, and its diversity of coral species makes this coastline one of the largest nurseries in the Indian Ocean, and therefore this makes the Mozambican coast, as a whole, one of the largest biodiversity hotspots of the world.

Understanding, protecting and sustainably enhancing its value to the benefit of all Mozambicans in a multifaceted way and guarding it against predation and unsustainable practices must be a national imperative. Let us embrace this urgent mission and mobilize the country, the region and the world to face and win one of our greatest bio-diversity challenges. There is no other Mozambique Channel therefore we cannot allow it to be lost, eroded or poached.

ANTONIO BRANCO (NATURA) JANUARY 2020

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[5] This decade was the hottest in living memory, measured as 1.1˚C hotter than any other. (NASA)

[6] Climate Change as opposed to Global Warming expresses and defines the now emerging affects of Global Warming.

[7] UN Report on Climate Change 2017

REPORT CONTENTS

1. FOREWORD

WIORI is a foundation currently being established in Maputo under Mozambique legislation. The Foundation has a partnership with NATURA, and in association with Universidade Pedagógica – the Public University (UP) (Maputo), and the Reef Systems Research and Conservation Laboratory (LECAR) at Universidade Federal Fluminense (Brazil). WIORI is based at Vilanculos Coastal Wildlife Sanctuary (VCWS) (see map) in Inhambane, Mozambique's only privately managed Wildlife Sanctuary.

Associação NATURA Moçambique is a Mozambican NGO registered in the Conservatória de Registo das Entidades Legais de Moçambique, and is adquartered at Avenida Amílcar Cabral n. 528, Maputo. NATURA's goal is to support conservation projects across Mozambique by sponsoring environmental restoration and education programs as well as coastal health and marine research activities. NATURA has a long history of involvement in credible conservation programmes including management and development of the Niassa National Reserve and in both marine and terrestrial conservation projects, in partnership with reputed private and public entities as Universidade Pedagógica de Maputo.

The Expedition to survey the underwater areas between San Sebastian Lighthouse and Pomene Point from a depth of 7m to 30m, would be as follows;

- To undertake a series of underwater dives on a daily basis to determine the nature of the sea bed in the area designated, within the boundaries nominated.
- Locate and map the extent of all underwater reef structures located in the area designated, down to a depth of 30m.
- Undertake a survey of each structure and determine its location, general description of reef structures, assessment of reef fish assemblages, condition of corals and main invertebrate populations included in the benthic community focused on key species, and any overall impacts currently having an effect on these communities that can be identified through observation.
- To plot a chart of the seabed from the up to 40m line in the designated area.
- To collect this data, summarize all data collected electronically, and then document these observations by means of notes, photographs, mapping and reports using specialized equipment including side scan sonar.
- To report on the survey to the sponsors comprehensively in writing (a report) commensurate with a full scientific profile of the area with specific data, photographs, maps, charts and required to provide and underpin stated conclusions, and a visual presentation so that informed decisions can be made relating to;
- Extensiveness and requirements of protection measures needed in the area including motivation to establish a National Park of the area;

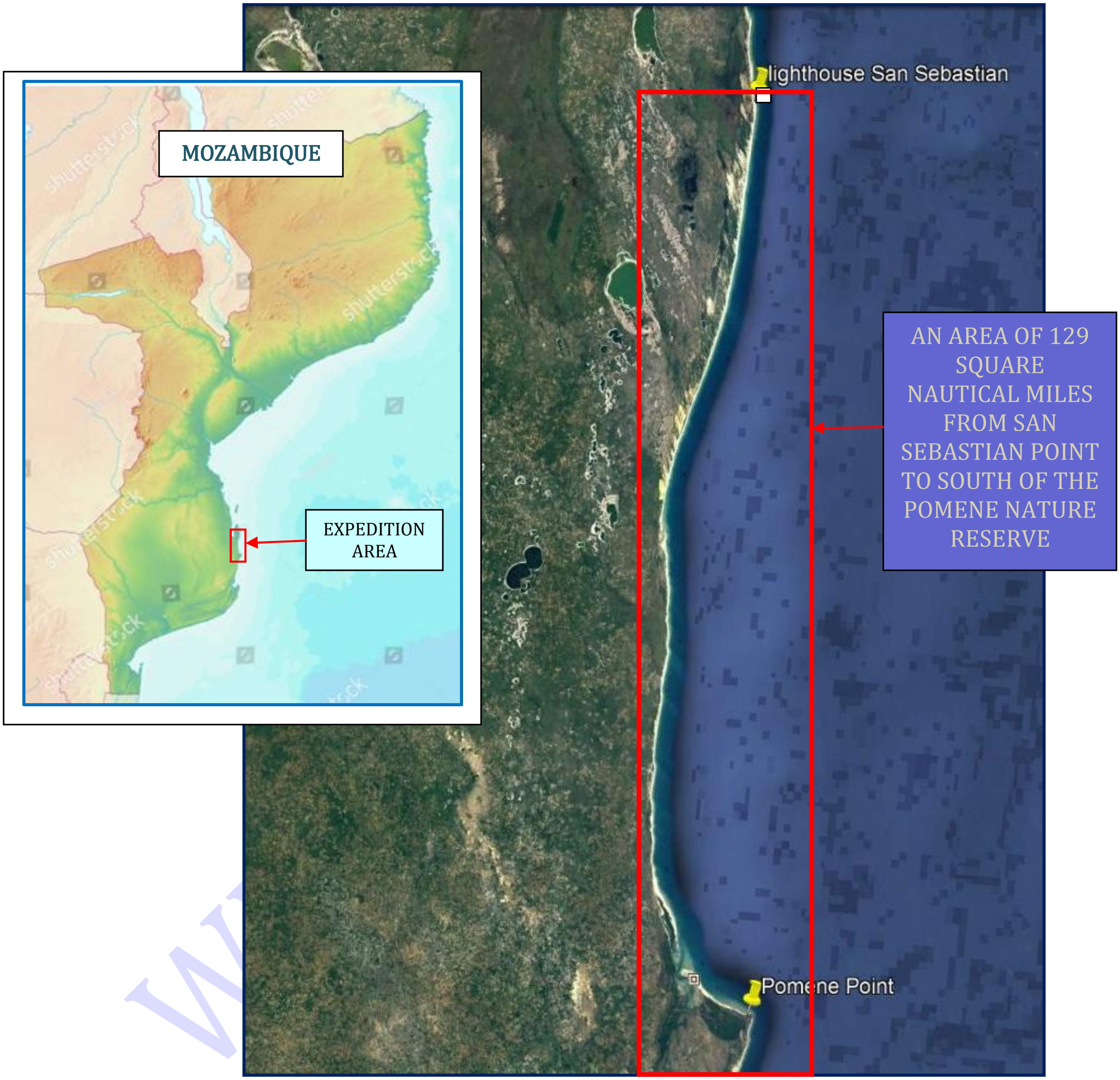


Figure 1. – Map of Expedition Area

2. SCIENTIFIC RESEARCH WORK

Marine environments provide goods and services that are vital to billions of peoples around the globe (Worm et al., 2006). Historical data shows a long and close relationship between humans and the sea, relate to fishing and gathering of marine organisms (Jackson, 2010). The exploitation on reef areas has been increasing exponentially, with several places suffering negative effects of recreational and industrial fisheries, resulting in overfishing of species and degradation of marine environments (Link and Watson, 2019). Fish is the main overexploited marine resource, but it is not the only one, with several invertebrates (e.g. sea cucumbers, scallops, crabs, shrimps and lobster) being a target of a lucrative market (Anderson et al., 2011). The industrial fisheries also have severe direct and indirect destructive impacts on the environment, with the worst impact due trawling and dredging, which level and transform the complex underwater forests of sponges, corals and shellfish on the seafloor to level plains of mud, indiscriminately capturing all the species on the bottom, most of which are discarded (Jackson, 2010).

Life in the ocean is now experiencing massive anthropogenic environmental changes, and the synergy with climate change jeopardizes their benefits and services. Mozambique lies on the east coast of Africa, and has the third largest coastline in the western Indian Ocean, about 2700 km. A variety of habitats characterizes the coastline: estuaries, sandy beaches, rocky shores, mangroves, sea grasses and coral reefs (Rodrigues et al., 2000), which shelter a wide diversity of animals amongst marine mammals, turtles, corals, crustaceans and mollusks (Hoguane, 2007). Coral reefs in Mozambique have an estimated area of 1290 km^2 (Motta, 2000), exhibiting great biodiversity (e.g. Riegl, 1996; Pereira, 2000; Benayahu et al., 2003) and providing food and income for a large proportion of the country's coastal communities, as more than 45% of the Mozambican population live within coastal districts (INE, 2019).

Coral reefs of Mozambique are southern continuations of the well-developed fringing reefs that occur along major sections of the narrow continental shelf of the East African coast (Rodrigues et al., 2000). Mozambican reefs shelter around 181 species of soft and hard corals, mainly Acropora and Porites (Hoguane, 2007), and exhibit places with high percentage cover of live hard corals, like found at Ponta Torres (Maputo) and Bazaruto Island reefs (Linden & Souter, 2005). Mozambique coastal waters support high diversity of reef-associated fishes, 794 species being recorded, where the Labridae family was the most representative with 67 species, followed by Serranidae and Pomacentridae (57 and 44 species respectively) (Pereira, 2000). Despite the fact that coral reefs are clearly important to the coastal communities and the national economy (Rodrigues et al., 1999), scientific studies about coral reefs remain scarce. Considering events of bleaching in the WIO (Gudka et al., 2019), the growing pressure from artisanal and especially commercial fishing (Samoilys et al., 2019), and the prospection and exploration for oil and gas along the Mozambican coast (Andreasson, 2018) **there is an urgent need to register and monitor reef sites along the coast to establish a baseline, and check the effectiveness of established marine protected areas.**

Regarding this subject, this study aimed at (1) to describe the benthic composition of surveyed reefs according to relative cover and composition, (2) quantify and characterize the reef fish assemblages indicating dominant species and functional groups, and (3) report perceived anthropogenic impacts on the surveyed shallow reef (up to 30 m deep) formations between the southern limits of the Santuário Bravio de Vilanculos[3] (VCWS) and the Pomene National Reserve.

[3] San Sebastian Lighthouse

3. THE EXPEDITION

The 50 ton expedition catamaran HQ2 sailed from Durban on the 6th of September 2019 arriving in Maputo on the 8th of September 2019, staying alongside in the fishing port overnight and leaving for Vilanculos on the 10th of September.

Figure 2. – HQ2 Expedition Catamaran.

HQ2 arrived in Vilanculos late on the 11th of September 2019. The selected scientists from Brazil and Maputo arrived by air and ground transportation in Vilanculos on the 12th of September 2019 and re-located by ski boat from the shoreline in Vilanculos to the VCWS (Msasa House) to prepare. The team proceeded to prepare stores equipment and the ship for the forthcoming expedition, sourcing fuel and food, equipment and other stores in Vilanculos, loaded onboard between the 13th and 14th of September 2019.

HQ2 sailed for Pomene on the 15th of September 2019 and commenced work on the more exposed southern boundary of the expedition area due to weather forecasts which predicted windy weather between the 20th and 25th of September 2019.

It became obvious from repetitive windy days, (where the wind was blowing at between 20 and 25 knots north east, immediately followed by winds blowing from the South East at 20 – 30 knots 24 to 28 hours later) that up to 3 dives per day would be required if the entire expedition was to completed by the 12th of October 2019.

Figure 3. – Divers launching from HQ2 at Baixo Silva (Refer to **Video 1** in the Video Attachments file in DropBox and click in the file box in the left margin and then on open to see live)

Side scan sonar sweeps were made commencing immediately on arrival in the southern section on the 16th of October 2019 due to 3 days of initial fine weather being forecasted and utilized. This has provided data which will when plotted and produced as maps and diagrams by end February 2020 providing new charts and profiles of the structures reviewed. The motor boat rib belonging to HQ2 was utilized to place divers exactly over the targeted areas defined by sailing over areas in HQ2 and confirming/identifying various structures in advance, and comparing this with actual local fisherman knowledge and charts, as well as information gathered in preparation for the expedition from local and international diving sources. Below, is a summary of the Expedition uptime on mission and activities (table 1).

Table 1: Summary of Expedition Activities dates and locations.

DATE	LOCATION	ACTIVITIES
September 16 2019	Vilanculos (anchoring point)	Navigation to Pomene point
September 17 2019	Baixo Silva	Fish and benthic surveys, reef mapping
September 18 2019	Baixo Silva	Fish and benthic surveys, reef mapping
September 19 2019	Baixo Silva and Pomene	Fish and benthic surveys, reef mapping
September 20 2019	Baixo Zambia	Fish and benthic surveys, reef mapping
September 21 2019	Baixo Africa	Fish and benthic surveys, reef mapping
September 22 2019	Bazaruto National Park (anchoring point)	Screening of The Sanctuary reefs
September 23 2019	Bazaruto National Park (anchoring point)	Screening of the Sanctuary reefs (Bluefin)
September 24 2019	Vilanculos (anchoring point)	Data entering and setting, files organization
September 25 2019	Vilanculos (anchoring point)	Data entering and setting, files organization
September 26 2019	Vilanculos (anchoring point)	Data entering and setting, files organization
September 27 2019	Vilanculos (anchoring point)	Data entering and setting, files organization
September 28 2019	Vilanculos (anchoring point)	Data entering and setting, files organization, sampling planning for next days
September 29 2019	Vilanculos (anchoring point)	Data entering and setting, files organization, sampling planning for next 4 days
September 30 2019	Vilanculos (anchoring point)	Data entering and setting, files organization, sampling planning for next 4 days
October 1 2019	Vilanculos (anchoring point)	Data entering and setting, files organization, sampling planning for next days, boat provision and maintenance
October 2 2019	Vilanculos (anchoring point)	sampling planning for next 5 days, boat provision and maintenance
October 3 2019	Vilanculos (anchoring point)	sampling planning for next 4 days, boat provision and maintenance
October 4 2019	Baixo Silva and Pomene	Fish and benthic surveys, and reef mapping
October 5 2019	Baixo Zambia	Fish and benthic surveys, and reef mapping
October 6 2019	Baixo Africa	Fish and benthic surveys, and reef mapping
October 7 2019	Vilanculos (anchoring point)	Fish and benthic photographic register, and reef mapping (Amphitheater and Bluefin)
October 8 2019	Vilanculos (anchoring point)	Return to the Santuário Bravio de Vilanculos (Msasa House)
October 9 2019	Santuário Bravio de Vilanculos	Data entering and setting, filing, organization of data
October 10 2019	Santuário Bravio de Vilanculos	Data entering and setting, filing organization of data, expedition evaluation
October 11 2019	Santuário Bravio de Vilanculos	Expedition evaluation, equipment cleaning and packing

The expedition was concluded on the 13th of October 2019, following 3 days of discussion between the Sponsors and the team and crew of HQ2 at Msasa House.

4. SCIENTIFIC TEAM, DIVE SITES, MATERIAL AND METHODS

The Scientific Team

The expedition team was composed of four scientists, an undergraduate student and three people from the crew. The scientific leader (Dr. Cesar Cordeiro) was in charge of the planning of diving and scientific activities, including fish surveys. The coral specialist (Dr. Katia Capel) was responsible for registering the benthic communities from surveyed reefs, and the scientific diver (MSc. Mr. Marcos Bouças) also undertook fish surveys. We also had the assistance of the Biologist and ocean diver BSc. Mr. Fenias Muhate on diving activities and additional underwater photography registers. The undergraduate biologist, Mr. Augusto Nhampossa, helped with diving logistics and onboard image management and storage[4]. Besides the scientific team, Mr. Brendan Walsh (Captain), Ms. Deline Du Toit (Purser) and Mr. Ruben Heard (1st Mate) completed the were the crew of HQ2, in charge of all boat activities and diving support. The expedition started on 17th of September leaving from Vilanculos aboard the HQ2 vessel (75-foot catamaran) and lasted for 21 days. Most of challenges faced by the team were imposed by weather and oceanic conditions. Strong winds (above 25 knots) and high seas (waves higher than 3 m) hindered the access to dive spots and HQ2 was forced to shelter in the Bazaruto Archipelago Notwithstanding, apart from bad weather conditions for eight days, all other days were occupied with up to three dives per day meaning a total of 28 dives on the expedition which was the target.

Dive and Underwater Structure Locations

The surveyed area included approximately a 56 km stretch of coastline within four shallow areas (Baixo Africa, Baixo Zambia, Pomene and Baixo Silva) indicated on nautical charts and known from local communities as fishing and diving sites. All formations run along the coast between 0.5 to 6.5 kilometers from the shore (figure 6) and bear reefs within 5 to 32 meters depth. Ponta Pomene and Baixo Zambia are places where diving activities were more developed (Pereira et al., 2018), although not as popular as other diving areas as the Bazaruto Archipelago – north of the study area. Firstly it was necessary to corroborate the actual locations of the known locations with

[4] The CV's of the scientific team are available in the report DropBox

nautical chart data. The charts were found to be inaccurate, and therefore the mapping aspect of the expedition was important. The first scientific step in the expedition was cataloging species from different groups, such as mangrove and terrestrial plants, but also coral reef species (Louro et al., 2017). Baixo Silva and Baixo Africa are reported by local fishermen and recreational fisherman only now and in the past (pers. comm.). There is no record, nor official register of the location and reports from regular diving, nor previous scientific data collected and published for these areas. Although all reef formations were already included in nautical charts, we used a side-scan sonar (Garmin Plus 92SV and GT51M-TM 260-455 kHz, 500 W) to find and map part of the surveyed reefs (figure 4), **as many differences were found between charts and true sea bed information gathered on sonar and plotted with GPS[5].**

Figure 4. – Mapping the seabed and confirming location of structures using GPS and side scan sonar (Refer to Video 2 in this report DropBox and click on box on the left margin and then on open to see live)

[5] This data will be available in the final report in March 2020

Figure 5. – Locations of the 4 main groups of structures confirmed through integration of local knowledge, historical data, hydrographic charts, and side scan sonar detection form HQ2

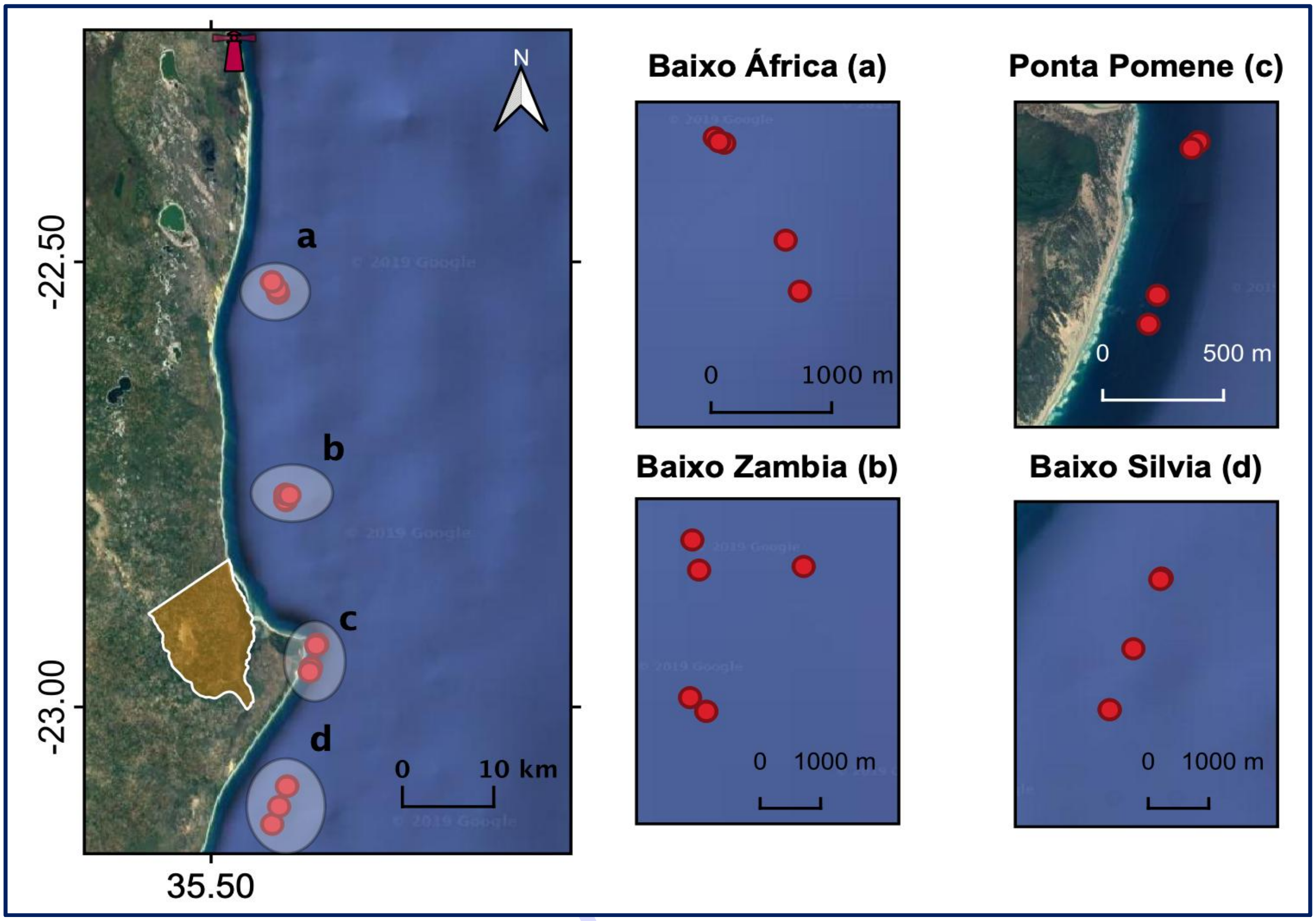


Figure 6. – Confirmed locations and identified reefs along the coastline between SSLH and South Pomene. Letters in figures are relate to panels to the right, indicating the reef formations. Ellipses indicate reef formations, and the red dots indicate the sampling points. The red lighthouse in figure (left) indicates the San Sebastian Lighthouse (southern coastal limit of Santuário Bravio de Vilanculos) and the orange polygon represents the area of the Reserva Nacional de Pomene.

Data Collection and Integration

Six kinds of data were collected:

- Fish abundance, taxonomic identity and estimate size;
- Benthic cover (sessile organisms' relative contribution);
- Mobile invertebrate abundance and taxonomic identity;
- Seabed mapping and structures classification;
- Photographic evidence (still and video);
- Observations (scientific and situational).

In total over 3500 images have been obtained, and more than 40 short videos to gather information on all the species and structures that were reviewed on this expedition.

Reef Fish Surveys

Fish abundance and assemblage composition was assessed by underwater visual census (UVC). This method consists of identifying, counting and estimating the size (total length in cm) of all fish species observed in a determinate area (Ferreira et al 2001). The strip transect technique was used, where a trained scuba diver swam along with a measuring tape of 25 meters length (figure 7). On the way out, the diver counts, identifies and estimates all fishes > 10 cm within a 5 m wide area (2.5 m meters each side of the measuring tape). On the way back, the diver counts cryptic species and fish < 10 cm, covering 100 m^2 each pass.

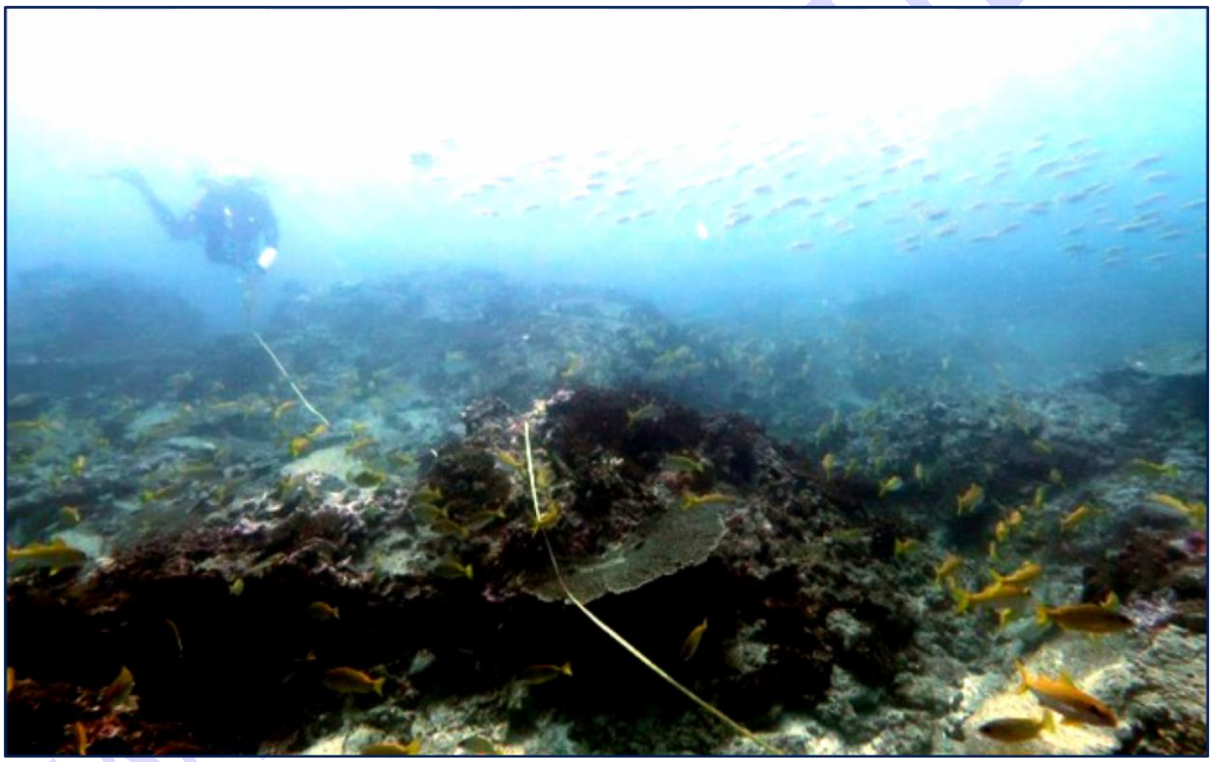


Figure 7. – Diver conducting a fish census along a transection using a measuring tape. Go to Video Attachments in the DropBox click on the box on the left margin on **Video 3** and then click on open to see the surveying in real time.

Benthic Surveys

Estimates of cover were based on non-destructive sampling. The benthic community associated with reef areas was characterized by taking digital images (50 x 50 cm) (figure 8) at two meters intervals along 25 meters long transect and counting all macroinvertebrates (figure 9) found up to one meter distant on both sides of the transect. Each image was analyzed for relative cover with the *photoQuad* software (Trygonis and Sini, 2012) by overlaying 50 random points on each image.

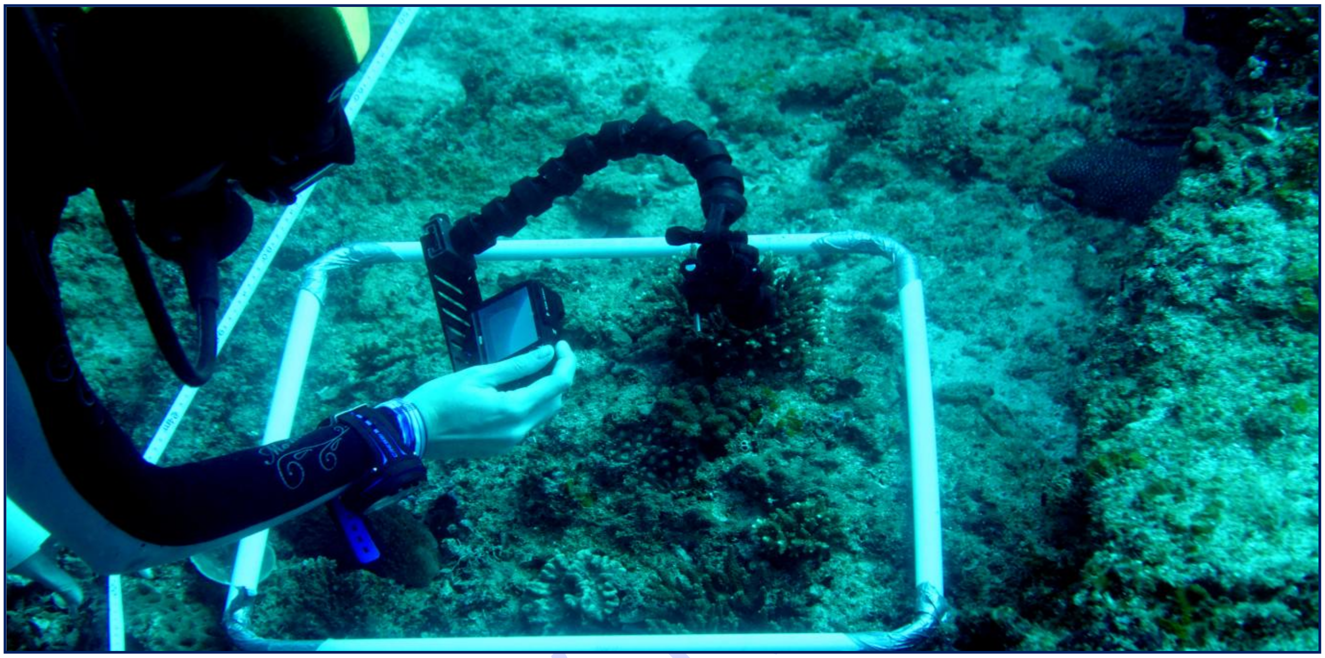


Figure 8. – Diver conducting a benthic cover assessment and mobile invertebrate census along a transection using a measuring tape and PVC quadrat; (a) and assessing coral colonies health state using photographic registering (b).

Benthic organisms were identified at the lowest taxonomic level possible, and then assigned to the following categories for analysis purposes: turf algae, macroalgae, coral, zoanthid, crustose coralline algae (CCA), suspension/filter feeders, other invertebrates, and cyanobacteria. Lost information due to edges, shade or undefined features comprised less than 1% of total cover and were not included in the analysis.

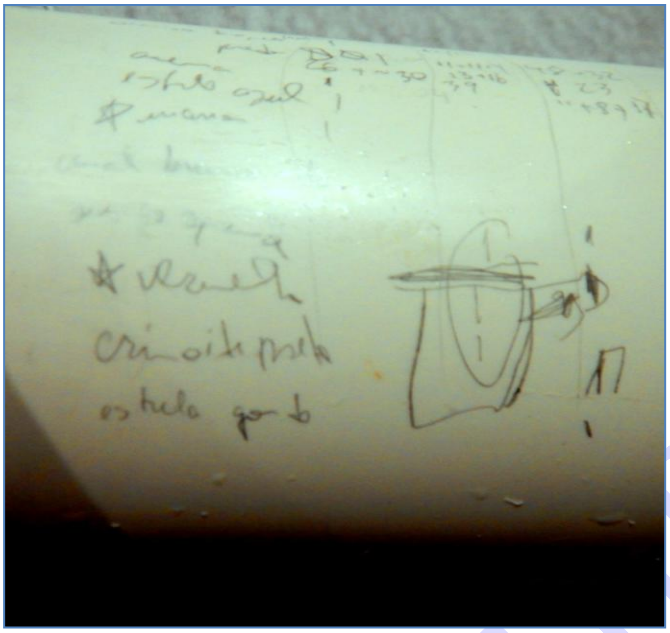


Figure 9. – Underwater writing slate used by scientists to record observations and make diagrams relevant to data and sea bed areas being analyzed.

Figure 10 – BSc Fenias Muhate and MSc. Marcos Lucena approach the depths.

5. PRELIMINARY RESULTS

The preliminary results are described in detail in following pages, and are summarized in table 2, where the conservation status of few species is highlighted due to their extinction concern.

Table 2. – Summary of data outputs of the expedition on reefs along Inhambane Province coast.

Data	Number	Remarks
Fish	209 taxa, including 3 shark species and 3 ray species	The species found from *Carcharhinidae* and *Taenyura* genera are listed as near threatened, while the manta ray is considered as vulnerable by the IUNC (IUCN, 2019).
Invertebrates	22 mobile and 58 sessile invertebrate taxa	47 species of reef building corals
Megafauna	2 mammal species, 2 turtle species	The hawksbill and the loggerhead turtles are listed, consequently, as critically endangered and vulnerable by the IUNC (IUCN, 2019).
Mapping and GPS Data		
Area covered	Unknown	The precise area covered will be indicated in a next report after the conclusion of analysis.
Structures identified	9 main structures within 4 reef groups	The precise number and dimensions of structures will be indicated in a next report after the conclusion of analysis.

Reef Formations

All four main reef formations surveyed were previously sounded with the side-scan sonar to guarantee that all dives would be within the limits of larger formations. Most of the reef formations were parallel to the coastline with a steeper leeward side, a low relief plateau, and a gradual depth range on the seaward side. In general, a few and very sparse partially dead coral colonies were observed in surveyed area, and the odd sign of disease was observed in *Porites* spp. corals, and *Astreopora myriophthalma*. The largest coral cover, with the dominance of branching and plate corals was observed at intermediate depths (12 – 18 m) at almost all visited reef structures, with the exception of Pomene reef that was deeper, but had lower coral cover. The reef flat zone (shallower than 10 m) of Baixo Africa (figure 11), Baixo Zambia was dominated by coral rubble, and broken coral colonies, with small coral recruits, mainly *Acropora* and *Pocillopora*. In general, the most complex structures and higher coral cover (including branching and arborescent forms) was observed on the reef slopes, (as expected), which also had larger concentrations of fish. Some examples of reef features of reviewed formations are indicated in figures 9, to 15.

Figure 11. – An example of reef formations – Baixo Africa.

Baixo Silva

The Baixo Silva reefs are a group of reef formations with 5.5 km long aligned on the 020 degrees line following the coastal contour, about 6 km from the shore. The reefs are composed of three large groups of formations connected by shallow flat areas. The highest structural complexity was found at the edges of the reefs where formations drop from eight to 28 meters. Some of the diving sites showed a more complex relief with a formation of small canyons (5m wide, 6m deep, 10m long) where a higher concentration of fishes was observed. We observed some signs of fishing activities, mainly consisting of fishing lines entangled to corals (figure 12), especially from the genera *Acropora*, *Pocillopora* and *Tubastraea*.

Figure 12. – Fishing lines (left) and rope (right) broken pieces attached to the reef – Baixo Silva.

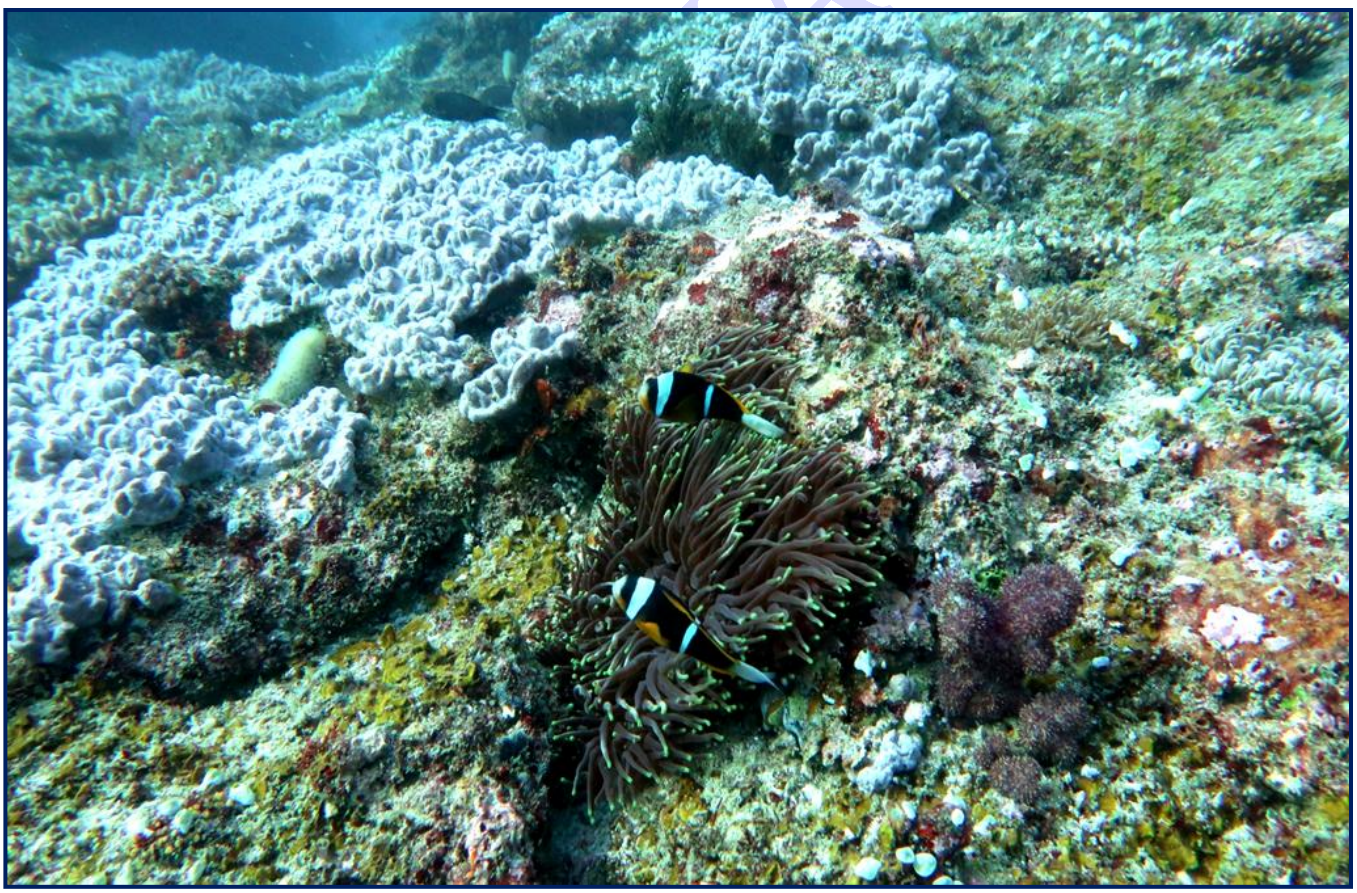
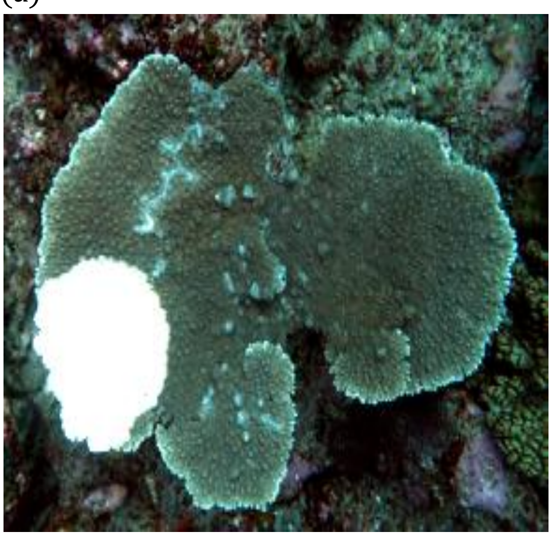


Figure 13. – An example of reef formations - Baixo Silva. Go the Video Attachments file and click on the box in the left margin marked **Video 4** and then click on open to see Baixo Silva Live

Ponta Pomene

The Ponta Pomene (herein referred to as Pomene) area is classified Reserve located inland which carries the same name of the region (Reserva Nacional do Pomene - RNP). The RNP was created in 1972 and is home to several local communities. Besides the local community activities, the region is also a tourism destination with many private residences and a commercial lodge with diving facilities close to the shore. The reefs from Pomene are the most accessible among all reefs surveyed, laying between 500 to 1000 m from the shore. Two groups of reefs (south and north) are separated 1 km apart, with flat sand and scattered reef bommies in between them. In general, all reefs in the Pomene area showed high structural complexity, with walls, arches, and canyons, especially the north group. Strong currents are characteristic along the Pomene reefs, as well as the deeper reefs (up to 30m). The reefs at Pomene are already exposed to tourism diving activities and recreational fishing. We found a considerable amount of fishing lines entangled in corals and rocks, and a few coral colonies partially dead or bleached (see figure 14). Many fishermen fish from the cliffs at Pomene, but we also observed several bait fishing activities by local fishermen using hand lines from small kayaks, probably for supplying protein to the local communities[8].

(a)



(b)

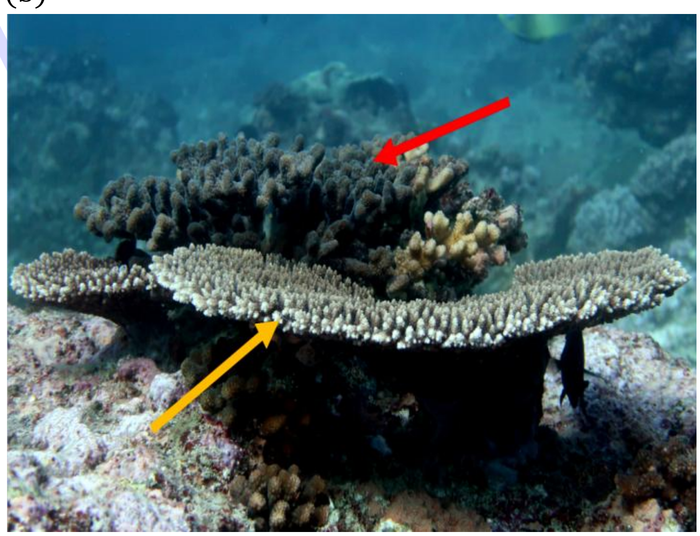


Figure 14. – Partially dead colony of *Acropora* coral species (a), and (b) example of *Pocillopora* (red arrow pointing down) and Acropora species (orange arrow pointing up).

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[8] See NATURA local fishermen survey report December 2019 attached as Annexure 2 hereto

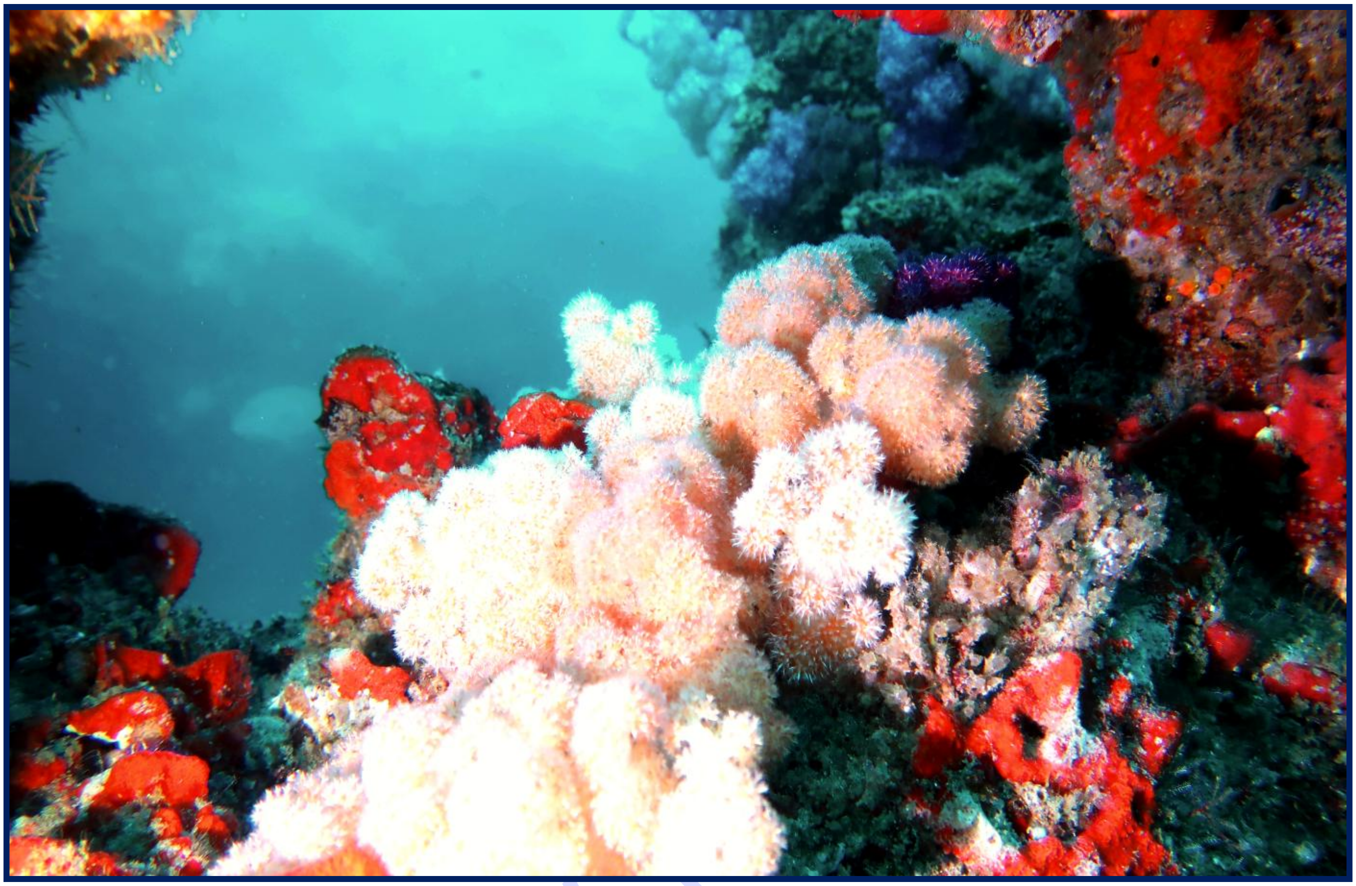

Figure 15. – An example of coral reef formations - Ponta Pomene. Go to the Video Attachments file and click on the box in the left margin called **Video 5** and then click on open to see Pomene reef live

Baixo Zambia

Baixo Zambia reef forms part of a group of moderate structurally complex reefs located 6.5 km from the shore (see location in figure 6), with depths between 7 to 24 m. The reefs are oriented 030 / 210 degrees north south, spanning 1.8 km in length and, approximately, 700 m in width. As with the other reef formations, higher complexity was found on the edges (drop offs to the east) of the reef, and on the inshore side a flat surface with sparse coral colonies (figure 16). These reefs show the most signs of fishing pressure and over-fishing. Many fishing lines, pieces of rope and nets were found amongst the corals. A small motorized boat (~ 4 m long) with three fishermen and one skipper was observed spear fishing at Zambia reef (figure 17). And, a second larger boat (~ 8 m long) with five occupants was spotted late in the afternoon probably shark fishing along the drop off side of the reef. Although this last group was not interviewed, the fishermen were seen throwing small portions of red meat (chumming) the water just before the sunset, e one of our divers was followed closely by a shark on the way back to the expedition rib during this event.

Figure 16. – An example of coral reef formations - Baixo Zambia. Go to the Video Attachments file and double click on **Video 6** to see Baixo Zambia live

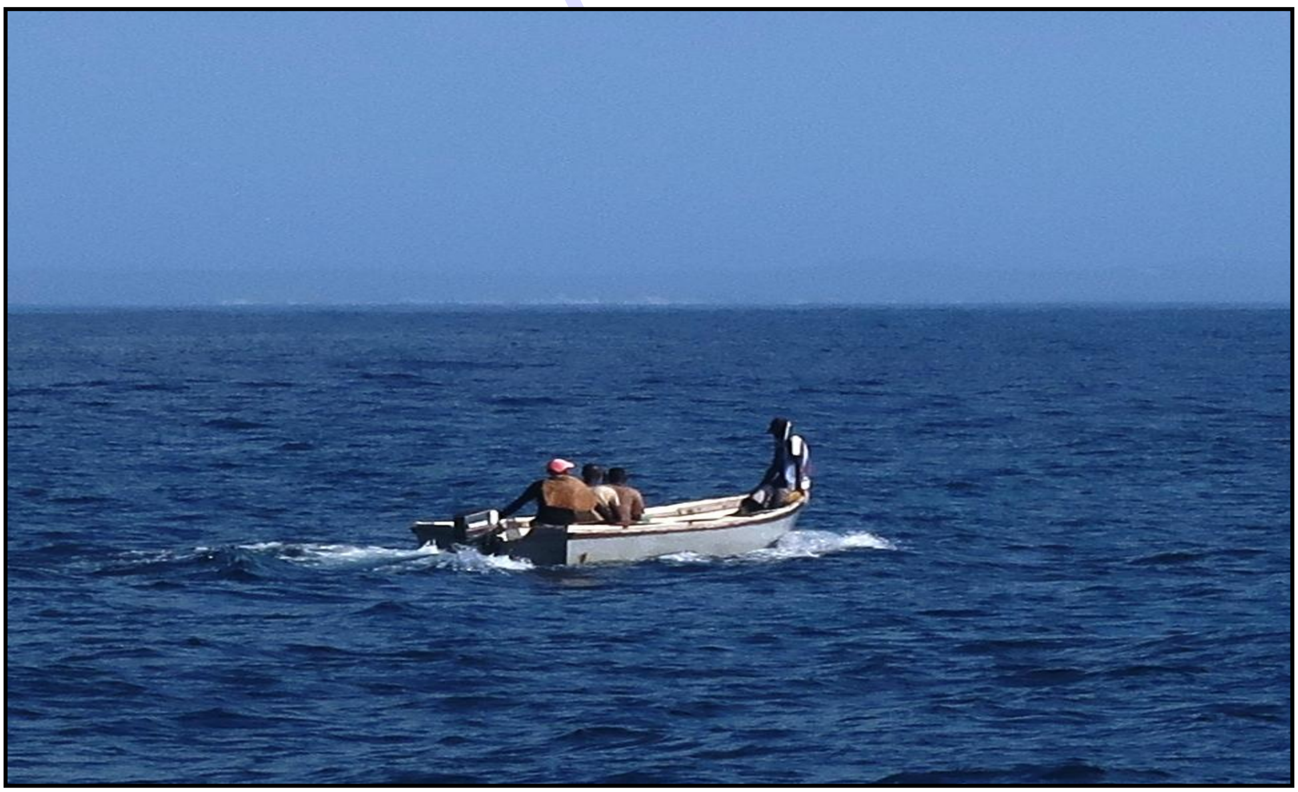

Figure 17. – Boat with spear fishermen observed at Baixo Zambia reef.

Baixo Africa

The Baixo Africa is possibly the reef formation in this area which is the most difficult to access because of distance from safe and probable boat launching points, either 45 km north (São Sebastião Cape) or 12km south (Pomene). The reefs are also grouped in a north south formation, where the north formation is roughly distributed in a horseshoe shape; and, a south group which is more north south aligned is parallel to the shore. Both groups are around 5 km distant from the shore and have depths ranging from 7m to 24 m. Despite having a lower structural complexity when compared to the other reefs surveyed, these reefs are host to significantly increased populations and diversity of fishes and coral compared to the other reefs. One aspect to note is that the seaward face of reefs on the northern group, show high structural complexity (figure 18), while the reefs of the south group show a flatter profile, with lower coral cover and more broken colonies. Signs of sedimentation and the presence of thin epilithic algal matrix may present difficulties for the settlement of new coral recruits in this southern section. A specific characteristic of this section of reefs was the fearless behaviour of the fish. Most fish did not show any sign of fear in the presence of divers and kept to their common behavior (i.e., feeding, fighting, cleaning) even when divers were very close, in the case of smaller or large bodied fish (e.g., groupers). This is a strong sign of low deleterious direct human activities, especially spear fishing and use of nets.

Figure 18. – An example of reef formations - Baixo Africa. (Go to Video Attachments and in the box in the left margin click on Video 7 and then click on open to see Baixo Africa live

Reef Fish Assemblages

A total of 209 different taxa were observed along all sampled sites, with Baixo Zambia showing the largest volume of species (n=136), followed by Baixo Silva and Baixo Africa (n=132), finally Pomene (n=132). Mean species density was similar among sampled sites (figure 19), except for Pomene that was significantly higher than Baixo Zambia (ANOVA, $F\text{-}value_{3,108} = 3.14$, $p = 0.03$). Also, mean abundance of fishes was similar for all reef formations (ANOVA, $F\text{-}value_{3,108} = 3.14$, $p = 0.03$), despite Pomene had the largest mean density of fish (3.7 ± 8.9, mean ± sd), followed by Baixo Africa (3.6 ± 7.7), Baixo Zambia (3.6 ± 8.8), and Baixo Silva (2.8 ± 4.7).

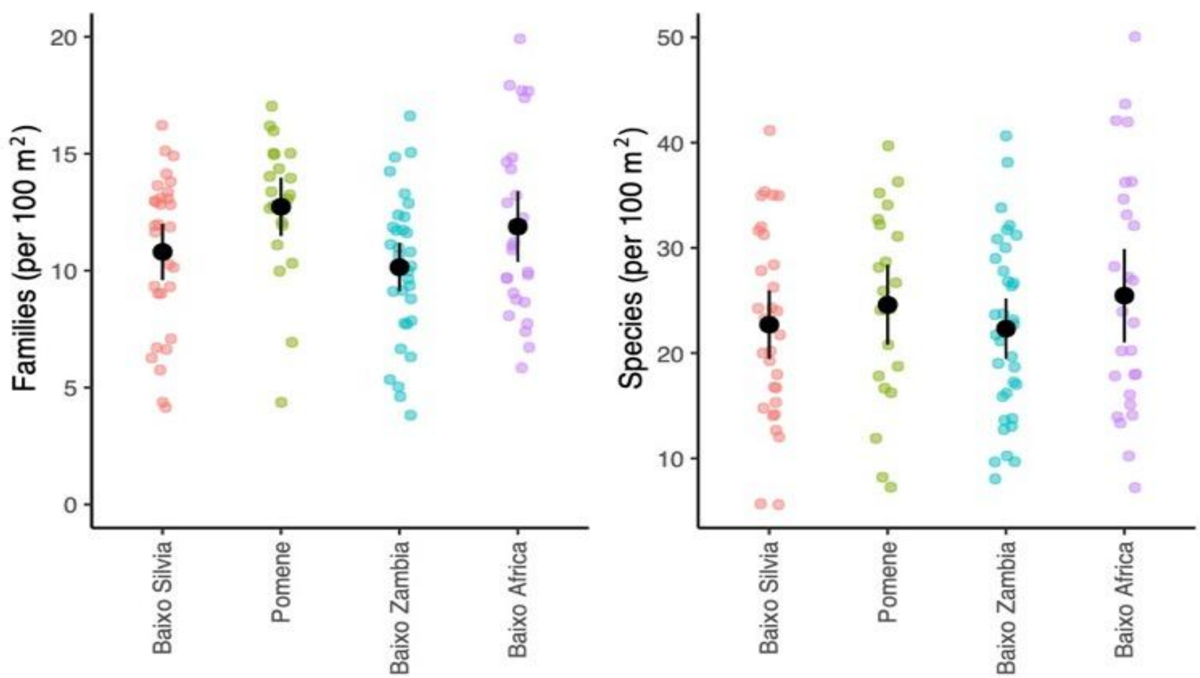

Figure 19. – Number of fish families and species (per 100 m²) according to study site. Colored dots indicate samples, black dots and vertical bars represent the mean and standard error of the mean, consecutively.

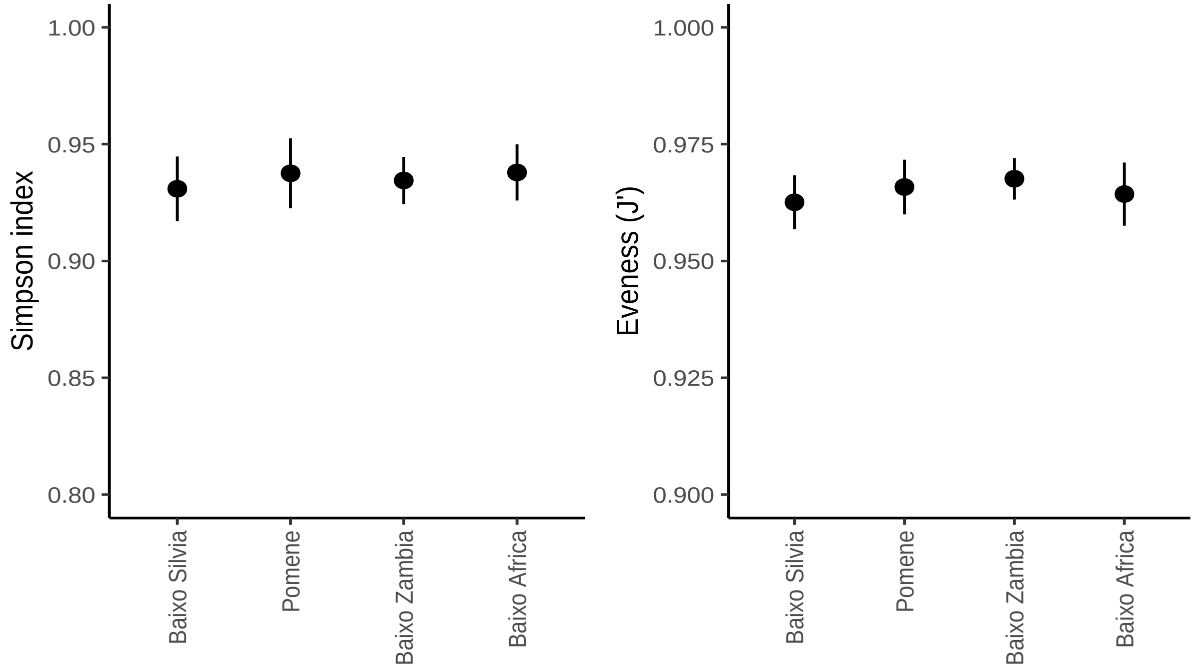

Figure 20. – Reef fish species diversity (Simpson index 1-D) and evenness (Pielou J') on four reef areas along Inhambane Province coast. Colored dots indicate observations at transect level, black dots and vertical bars represent the mean and standard error of the mean.

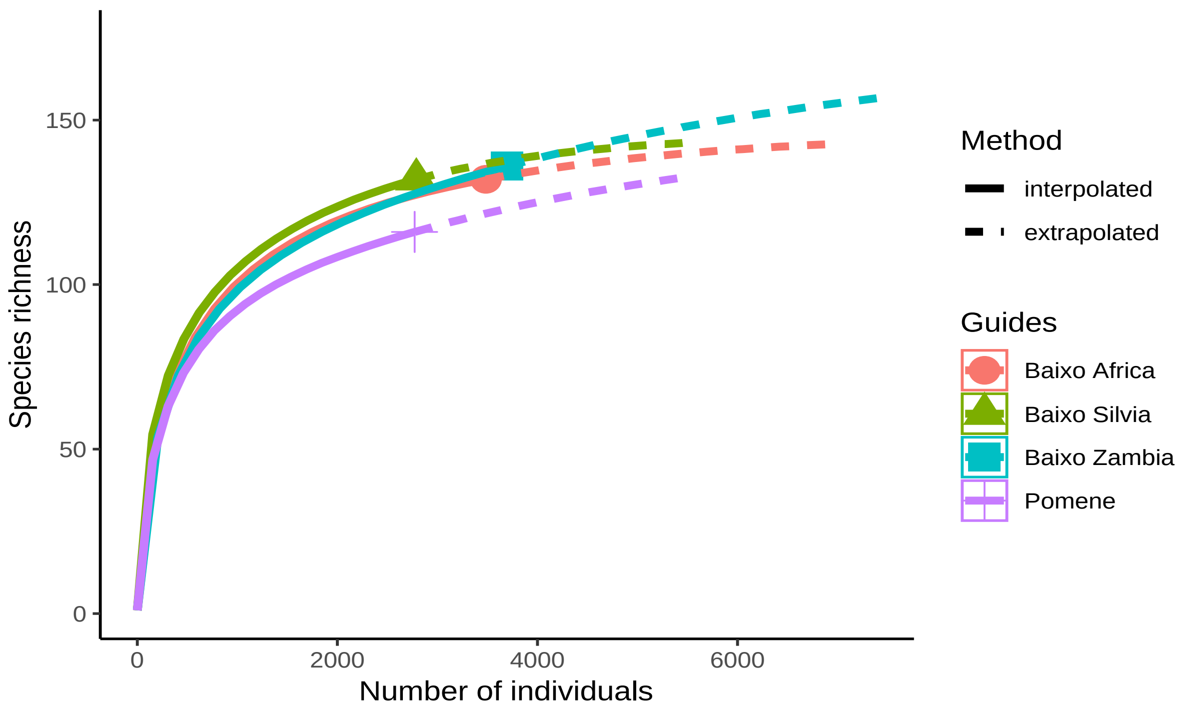

Figure 21. – Rarefaction curves based on species identity and cumulative abundance from four sampled reefs.

Diversity and spread of reef fish species were very close among sampled reefs (figure 20) and showed no significative difference (ANOVA, $F\text{-}value_{3,108} = 0.25$, $p = 0.8$), which is reinforced by the rarefaction curves that projected similar number of species irrespective of differences in sampling effort (figure 21). Most of the species found were not exclusive for each site (Table 1s in supplementary material), with Baixo Zambia and Baixo Africa holding higher similarities in species composition (figure 22), despite the large amount of overlap observed in ordination analysis (figure 23).

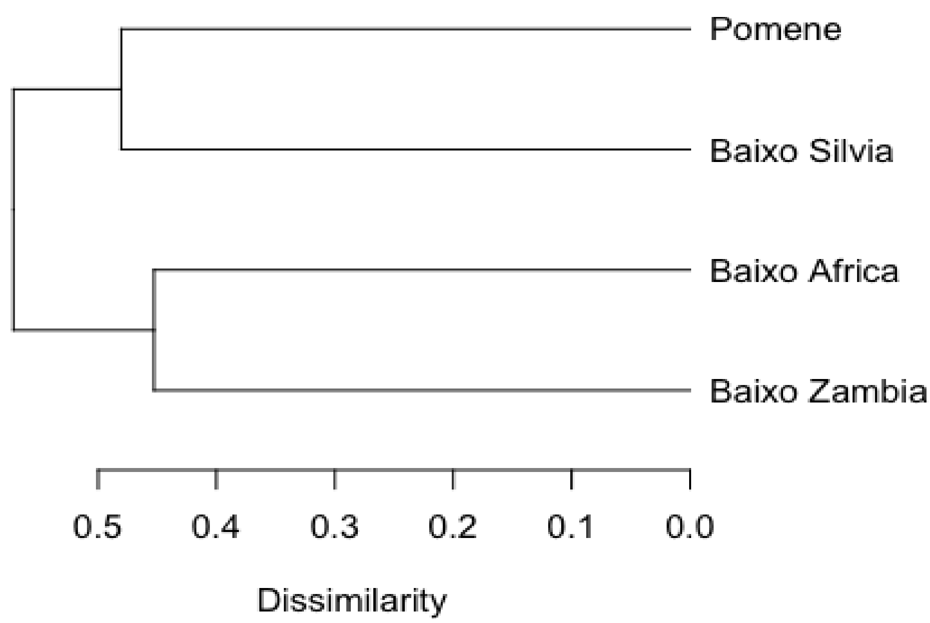

Figure 22. – Dendrogram of dissimilarities among reef sites based on reef fish species composition.

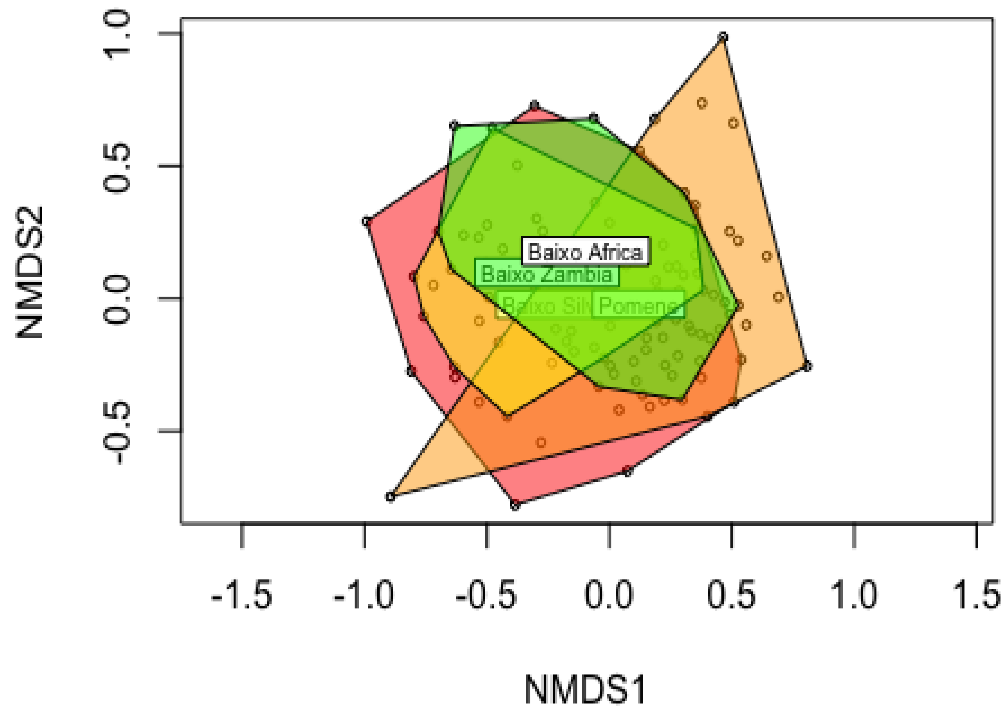

Figure 23. – Ordination plot (nMDS) of reef fish assemblage from four reefs along Inhambane Province coast. Dots indicate transect level samples, and polygons delimitate each reef assemblage multivariate space.

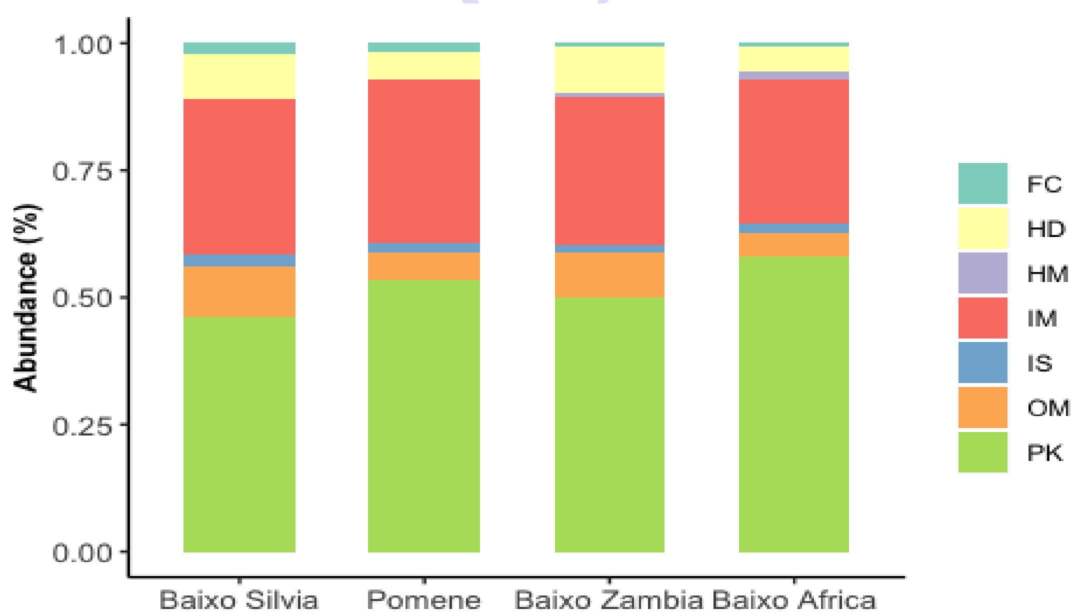

Figure 24. – Relative abundance of reef fish trophic groups observed on four reef areas along Inhambane Province coast. FC – piscivore, HD – herbivore-detritivore, HM – macroalgal feeder, IM – mobile invertebrate feeder, IS – sessile invertebrate feeder, OM – omnivorous, PK - planktivorous.

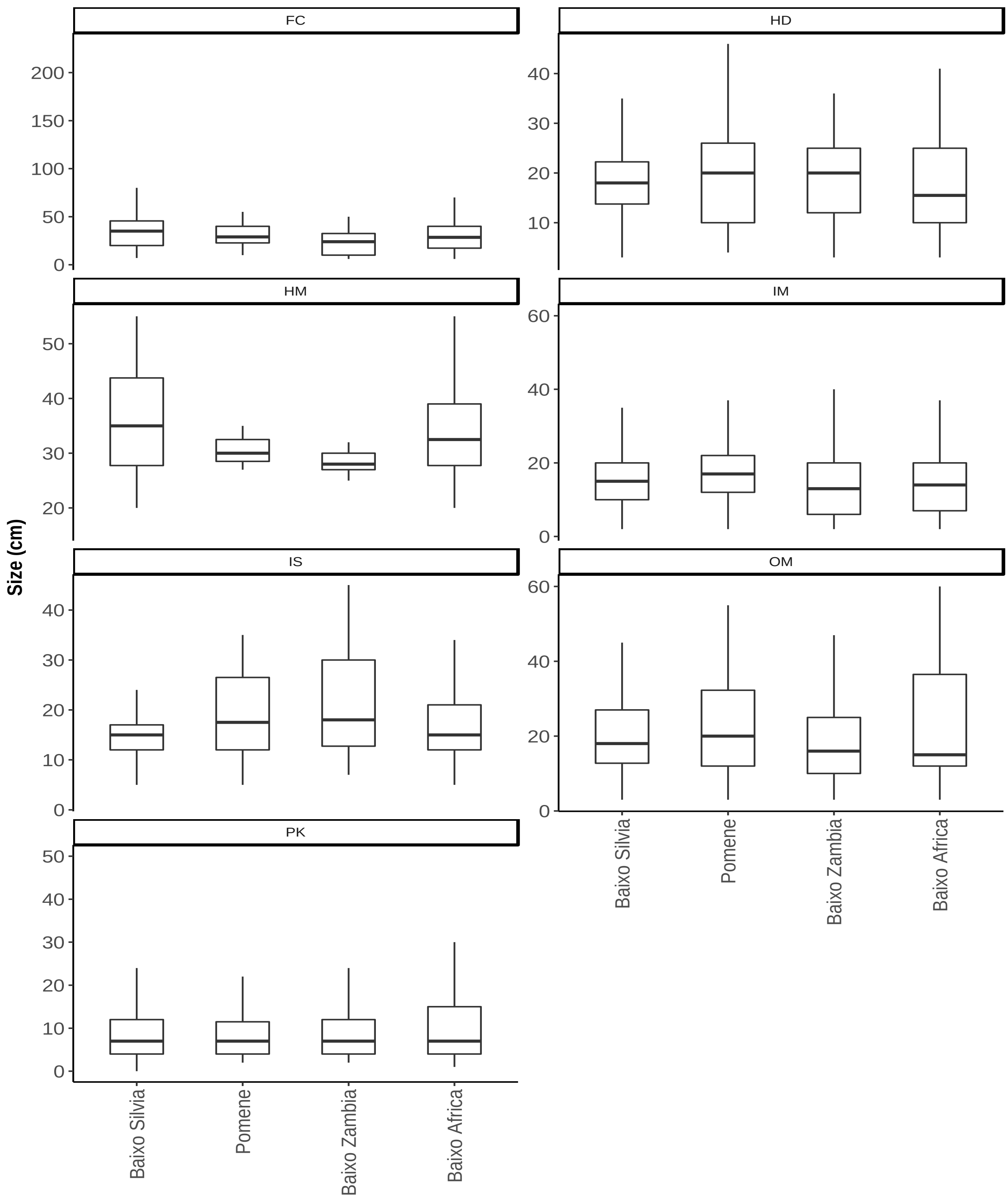

Figure 25. – Estimate size of reef fishes observed on four reef areas along Inhambane Province coast according to trophic groups. FC – piscivore, HD – herbivore-detritivore, HM – macroalgal feeder, IM – mobile invertebrate feeder, IS – sessile invertebrate feeder, OM – omnivorous, PK - planktivorous. Dots represent individual values, and boxes define the interquartile range, with whiskers limiting the 95% quantile interval.

Table 3. – Species richness according to trophic groups and locality along four reef areas along the SSLH to Pomene coast.

Reef site	Trophic group						
	FC	HD	HM	IM	IS	OM	PK
Baixo Silva	7	8	2	15	5	10	20
Pomene	5	7	1	17	3	6	25
Baixo Zambia	2	10	2	20	2	9	37
Baixo Africa	1	8	5	18	3	8	28

FC – piscivore, HD – herbivore-detritivore, HM – macroalgal feeder, IM – mobile invertebrate feeder, IS – sessile invertebrate feeder, OM – omnivorous, PK - planktivorous.

Reef fish trophic structure had higher contribution of planktivorous (n=110) and invertivorous species (n=70), and remaining trophic groups contributed with 40% of species total (table 3). In general, the relative abundance of each trophic group was similar among all sites (figure 24). In general, mean size of individuals from the same trophic group did not differ between reef formations (Figure 25). However, the size of macroalgal feeders was larger at Baixo Africa and Baixo Silva (Figure 25), and the opposite pattern was observed for sessile invertebrate feeders. Piscivore species had the largest mean (36.8 ± 34.8 cm, mean ± SD) and variation (range = 6 – 230 cm) in observed sizes.

Some examples of fish species can be seen around the rim of the drop-offs to the east and along the "flat tops" of the reefs can be seen in Figures 23, 25 and Figure 26.

Several planktivores (e.g., large unicorn-fish from *Naso* genus, and fusiliers from *Caesio* genus), carnivores (e.g. snappers, Lutjanidae family) and piscivore (e.g. jacks, Carangidae family) species were commonly found forming in large shoals (> 100 individuals) within the domains of surveyed reefs, especially at Pomene where reefs are deeper.

Figure 23 – A multispecies shoal of grunters (*Lutjanus* spp.) spotted at Baixo Africa.

Figure 25 – Examples of plate coral formations and resident reef fish species at Baixo Zambia.

Figure 26: Example of a cleaning station with planktivorous fishes (bright orange fishes - *Nemanthias carberryi*) at Baixo Zambia

Figure 27: A white barred sweet lips (*Plectorhynchus playfairi*) at Pomene.

Benthic Cover

A total of 26 species from five phylum of macroinvertebrates were identified along all sampled sites, with Echinodermata and Mollusca being the most frequent (figure 28). On average, Pomene host the highest diversity (figure 29), although the overall number of species was higher at Baixo Silva (n=18), followed by Baixo Zambia (n=16), Pomene (n=15), and Baixo Africa (n=12). On general, species abundance within each transect (covering an area of $50m^2$) was similar for all groups, as showed by the high evenness values (figure 29), except for Baixo Africa. The low evenness values observed at Baixo Africa (figure 29) were as a result of large numbers of the anemone *Heteractis magnifica* found in this site. The most common species of macroinvertebrates observed was the anemone *H. magnifica*, the sea star *Linckia* sp., the sea urchin *Echinothrix calamaris* and the bivalve *Hyotissa* sp..

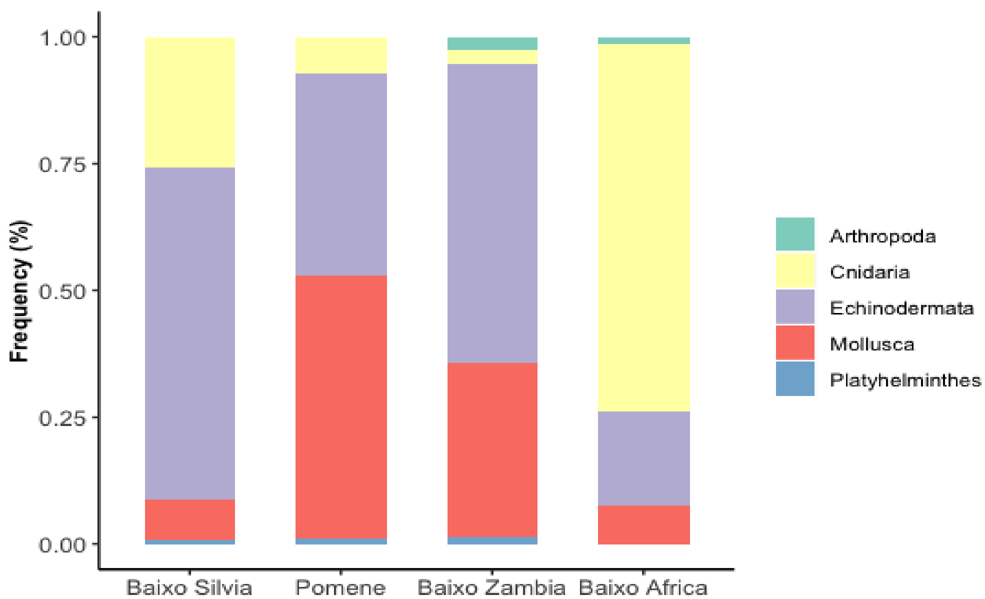

Figure 28. – Relative frequency of invertebrate phyla on four reef areas along Inhambane Province coast.

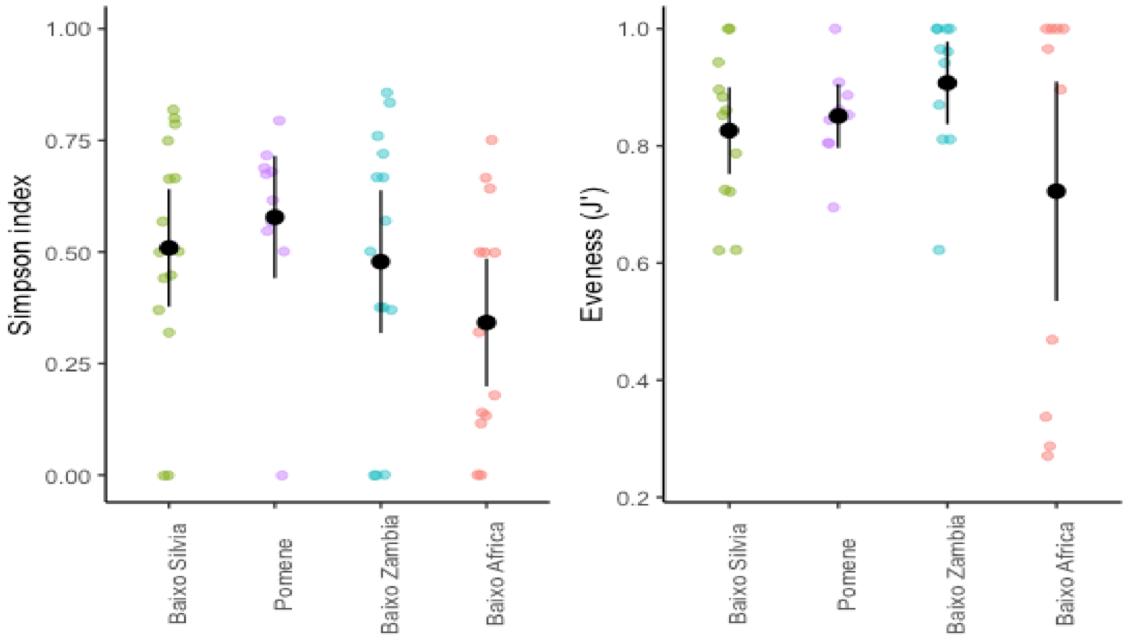

Figure 29. – Benthic cover taxa diversity (Simpson index 1-D) and evenness (Pielou J') on four reef areas along Inhambane Province coast. Colored dots indicate observations at transect level, black dots and vertical bars represent the mean and standard error of the mean.

At least 47 species of Scleractinia, three Zoantharia and nine Alcyonacea were identified along the four reef formations (table 4s). It is important to highlight that these represent only the most common species observed that could be clearly identified by images, and that the actual diversity of reef building corals is higher at all sites.

Megafauna

The register of megafauna taxa was not one of the main objectives of this expedition, but their presence forms an important part of the evaluation of the area relevant information was recorded. Humpback whales (*Megaptera novaeangliae*) (figure 30) were observed on a daily basis, at a distance or close to the research boat. Individuals from the first species were spotted alone, in pairs or 'trios', but more frequently alone. Bottlenose dolphins (*Tursiops truncatus*) were also observed every day during navigation or when anchored at Pomene. At Baixo Zambia and between Baixo Silva and Pomene we observed a few loggerhead turtles (*Caretta caretta*) mating (figure 31), and these species were also spotted a couple of times during fishing counts, resting on reef structures. Besides loggerheads, two individuals of the hawksbill turtle (*Eretmochelys* *imbricata*) were observed underwater, feeding and resting (figure 32) at Baixo Zambia and Baixo Silva reefs.

Figure 30. – Humpback whales (*Megaptera novaeangliae*) observed during the expedition. The top picture shows a small group doing a display of pectoral fin slap which is used for communication.

Figure 31. – Loggerhead turtles (*Caretta caretta*) mating (Pomene).

Figure 32. – Hawksbill turtle (*Eretmochelys imbricata*).[9]

Figure 33. – Unidentified Dasyatidae ray species[10] (left) and a giant manta ray (*Mobula birostris*) (right).

Chondrichthyes species were not abundant but observed on all reviewed reefs. Grey reef shark (*Carcharhinus amblyrhynchos*), whitetip reef shark (*Triaenodon obesus*) and blacktip reef shark (*Carcharhinus melanopterus*) were observed at Pomene, Baixo Silva and Baixo Zambia,

[9] Courtesy of bluesafari.com

[10] Courtesy Rob Harding

respectively. One individual of giant manta ray (*Mobula birostris*) was observed at Baixo Africa, and another two species of rays the blue-spotted ray (*Taeniura lymma*) and a large unidentified *Dasyatidae* (figure 33) were registered at Baixo Zambia.

Protecting endangered Turtle Species and Habitats

Leatherback turtles (*Dermochelys coriacea*) breed in southern Mozambique at Ponta do Ouro/Maputo Special Reserve and just across the border in the newly expanded Isimagaliso Marine Protected Area (10, 700km^2) in South Africa. Post-breeding, a subset of these critically endangered species migrate to foraging areas up to the Sofala Bank in the Mozambique Channel (Robinson *et al.* 2016). Between Pomene and San Sebastião (indicated in chart in figure 34), the Leatherback turtles and Loggerheads (*Caretta caretta*) swim along the coral structures parallel to the coastline and within the 200m isobath limits in large numbers.

Figure 34 – Loggerhead turtle (*Caretta caretta*).[11]

In figure 35 the Leatherback migration routes along the Mozambican coast are shown. The red and yellow lines indicate the migration route of turtles, the black arrows point to the São Sebastião-Pomene area. The presence of Hawksbill turtles (*Eretmochelys imbricata)* together with the other two species confirmed and sighted, has been registered in São Sebastião

[11] Courtesy nwf.org

(monitoria, marcação e conservação de tartarugas marinhas em Moçambique - relatórios anuais 2016/17 and 2017/2018, Centro Terra Viva), meaning that these species are also present along the coastal line between the Pomene and San Sebastião Light House, the area under reviewed in this report. The same reports also show that all these species are nesting on São Sebastião. Images of Loggerheads and Hawksbill turtles, mating and foraging between these two regions (figures 31 and 32) is shown above.

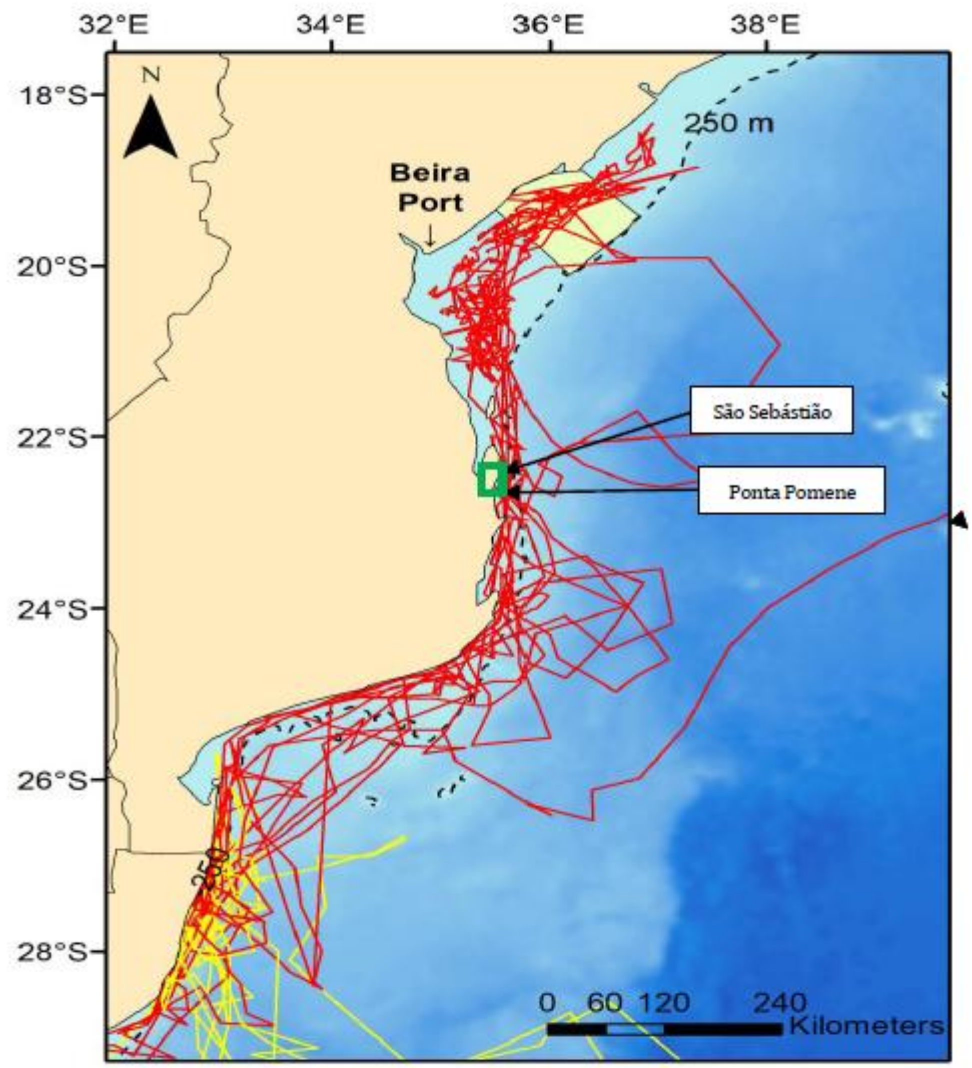

Figure 35. – Turtle migration shown in red and yellow: South Africa to Mozambique (Natal coast to Sofala Bank) relative to the expedition area (in green)[12].

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[12] Courtesy of Turtle studies done byNathan Robinson

Although the aforementioned reports (Centro Terra Viva) don't cover the whole coastal area between Pomene and São Sebastião, the data collected by the expedition, the identified routes for Loggerheads and Leatherbacks and the fact that this coastline is a continuation of the same habitat found off São Sebastião it is certain that the region covered by the expedition is not only a migration corridor but also a nesting and foraging area for turtles. The coral reef structures reported on in this expedition report may play a crucial role as resting, mating and foraging grounds for all these turtle species along this section of the coast.

Strong protection measures have been implemented in RMPPO[13] and VCWS[14] São Sebastião area to protect nesting turtles and their nests, significantly reducing mortality. It is highly recommended that similar protection measures are implemented from Pomene to the VCWS border south of São Sebastião.

In the case of turtles migrating from the south, once they depart nesting beaches, they have no protection at sea along the coastline outside Marine Reserves and Parks. Expanding the marine protection area from Bazaruto NP/ VCWS all the way down the coast to Pomene up to the 200 m isobath line is crucial to providing a further protected habitat frequented by these species of turtles, with no-disturbance zones that offer refuge to these species, thus preserving their natural habitats and the essential coral reef structures which are their feeding grounds and therefore regulating practices outside MPAs specifically to limit destructive fishing predatory fishing practices and regulation of catches.

This report does not deal with the crucial role of the Sofala Bank further north, a world-renowned marine biodiversity hotspot, in terms of protecting vulnerable habitats and securing foraging and spawning grounds for various critically endangered marine species, including sea turtles. Therefore, it's strongly recommended and urgent to address the status of the Sofala Bank before irreversible damage occurs and the habitat and existence of key marine species is lost.

13 RMPPO - Reserva Marinha Parcial da Ponta do Ouro
14 Vilanculos Coastal Wildlife Sanctuary

6. DISCUSSION

In general, the reef fish assemblages of surveyed reefs were similar considering the mean size of individuals, density and species composition, although Baixo Silva had the most variation values. The trophic composition also reflected species composition similarity and was dominated by planktivorous fish species which is expected for areas under the influence of currents (Hobson, 1991). The particulate material and plankton carried by prevailing currents, mainly tidal driven, is the reason for the presence of large filter feeding species such as the giant manta rays, whale sharks and others, which are more common south of Inhambane Province (Rohner et al., 2013). This high productivity and abundance of small-sized planktivorous fish sustain large-bodied fishes observed within sampled reefs. The constant presence of large shoals of fishes (e.g. surgeonfish, fusiliers, snappers, jacks and unicorn fishes), either large and small-bodied is also a clear indication of local productivity, and health conditions of reef communities. Despite, sharks being observed at almost all dives, their presence was not frequent and only small sized individuals were spotted. The observation of fishermen throwing chunks of red meat into the sea at Baixo Zambia is a probable sign of a directed fishing practice targeting sharks. The presence of top predators in the reef environment is critical for resilience of these ecosystems (Roff et al., 2016), and fishing activities can easily decimate local shark populations in a short time period (Heupel et al., 2009). This is a point that should be a major concern and considered in future conservation actions.

Individuals from the Epinephelidae family (i.e., Groupers (Rock Cod)) were observed at all reefs at considerable shallow depths when compared to reefs where they are the focus of direct artisanal fishing activities. Large Groupers and large Carangidae (i.e., Jacks) are usually found deeper, (avoiding traditional method fishing pressure) and are easy access to divers in shallow areas (Lindfield et al., 2016). Although all surveyed reefs are considered shallow (up to 30 m deep), the presence of large specimens at these depths is an indicator of low human influence. However, the presence of fishing lines, ropes and net pieces in these locations, besides fishermen at Baixo Silva, Baixo Zambia and Pomene reefs are clear signs of increasing fishing pressure. As indicated previously, Baixo Africa reefs are probably less accessible, and because of that, the noted presence of large Groupers at shallow depths (< 10 m) as well as other fish species did not show escape or hiding behavior when approached by divers. Despite the south group of Baixo Africa reefs being composed by flat, low relief structures with low coral cover, the composition of fish assemblages was similar, maybe indicating connectivity with the northern more complex 'food richer' reef group.

The results for benthic cover are still being analyzed, the data presented here is related to the low mobility and sessile non-coralline organisms observed at the surveyed reefs, and a general list of the most abundant species from the subclass Hexacorallia and Octocorallia. Based on the data indicated in this preliminary report, is clear that the high similarity in composition observed for reef fishes is not followed by invertebrate fauna. Sea urchins were abundant in Baixo Silva, while soft coral was the main group found at transects in Baixo Africa, but there was a large variation associated with indicators of the last. The low representativeness of large crustaceans (e.g., lobsters) and large shelled mollusks is notable, but this should not be interpreted directly as a result of extraction pressure. Most of the components of these invertebrates have cryptical or nocturnal behavior (Glynn and Enochs, 2011), being underestimates in diurnal surveys. The opposite situation (i.e., high abundance observed during the day) also indicates absence of natural predators or high local productivity. However, the data presented here is not enough to draw final conclusions about the general 'health' of mobile invertebrate reef communities or influence of human exploitation.

Despite no quantitative analysis of the benthic cover having been finalized yet, the slope of all reefs holds relatively high diversity and abundance of coral species. In general, the coral fauna in the surveyed area is composed of several common and widely distributed species, including species of the genera *Acropora*, *Pocillopora*, and *Porites*, which can be found throughout the whole Indo-Pacific region, and a few rare and uncommon species, such as *Gyrosmillia interrupta* and *Horastrea indica*, both restricted to the Western Indian Ocean. *H. indica* is currently classified as vulnerable by the IUCN Red List (Sheppard et al., 2008).

Both coral species diversity and cover are important proxies to the health of the local environment, since they are positively correlated to reef fish diversity and abundance (Komyakova et al., 2013, 2018). The tridimensional environment created by corals, especially those with branching growth forms such as *Acropora*, generates structural complexity that provides shelter for several species of fishes and invertebrates (Nanami et al. 2013, Darling et al., 2017, Rogers et al., 2018), which constitute the basis of coral reef communities. When reef formations are damaged, the environment loses diversity and complexity, with potentially negative impacts on reef biodiversity (Graham and Nash, 2013, Komyakova et al., 2018). The surveyed area holds large numbers of branching and plate corals, mainly fast-growing species from the genus *Acropora*, consisting of higher structural complexity. These species are potentially very important to maintain the biodiversity of these reef formations. Nevertheless, despite the importance of branching species on enhancing structural complexity – consequently, local biodiversity – recent studies have shown that coral species diversity is also a relevant factor to maintain reef fish diversity (Komyakova et al., 2013, 2018). In general, this first assessment indicates that the coral assemblages of Baixo Silva and Baixo Zambia have larger areas with higher coral cover and structural complexity, with high abundance of *Acropora* and *Pocillopora* (figure 12). Overall, Baixo Africa and Pomene had lesser areas of reef slope, the former having a high complexity area concentrated in the north group of its formations, while reef formations at Pomene were very complex in structure due to a rocky basin.

Considering the zooxanthellate corals (i.e., those who build coral reefs), most of the surveyed reefs had no signs of completely bleached colonies, few observations of recently dead or partially dead colonies, were mostly observed at Pomene. The average water temperature (~22°C) observed was bellow extreme limits (>30°C) that would induce bleaching by overheating, indicating that other causes may have caused the death of these isolated corals in these few colonies. Most of these corals were only partially dead, and were small and isolated, which should not be considered as a sign of poor reef conditions or presence of chronical stressors. A few entire dead colonies were observed in Pomene, which might be a result of predation by the crown-of-thorns starfish, which were rarely seen in surveyed reefs. There were also few signs of diseases affecting zooxanthellate corals, with several observations of the species *Astreopora myriophthalma* and *Porites* spp. being affected. The team's observations in total, add up to a high number of observations of small colonies with a low number of observed recently dead colonies at all reef formations. This suggests that all these reef formations are in a fairly healthy state and can thrive if protected. Therefore the concept of introducing protection measures into this area is a very important part of ensuring the ongoing recovery and improving health of all of these reef structures, and will make a serious contribution to the health and ability of the marine life along this section of coastline to grow and sustain healthy coral, invertebrate and fish species populations. In the last decades, coral reefs worldwide have been suffering from several natural and anthropogenic stressors, such as overfishing, pollution, hurricanes, and climate change (Halpern et al., 2008, Hoegh-Guldberg and Bruno, 2010,). In the Western Indian Ocean (WIO), extreme climate events have been responsible for intense bleaching of coral reefs in several sites, from Kenya to Mozambique (Schleyer et al., 1999, Motta et al., 2000, Gudka et al., 2019). In Mozambique, coral reefs have suffered declines on cover during the massive bleaching event of 1998 (Schleyer et al., 1999, Motta et al., 2000) and 2016, when Mozambique seemed to have been less affected than other regions in WIO (Gudka et al., 2019). However, the reef formations at Baixo Silva, Pomene, Baixo Zambia and Baixo Africa were not included in these studies and there is virtually no data on these reef formations. Knowing the critical importance of coral reef formations and coral species diversity, conservation efforts should focus on monitoring and protecting understudied reef structures. Due to the scarce previous knowledge about the surveyed reefs south from Cape San Sebastian to Baixo Silva, the data obtained here represents baseline information for future monitoring activities in the region, besides an indicator of the general condition of those reefs which now require conservation actions.

Further quantitative analysis considering the coral cover and species diversity will help to strengthen the discussion about the differences in composition and give a more accurate picture about the health state of all studied formations, but the general preliminary conclusions are that the coral assemblage from these reefs is diverse and do not show the effects of large scale negative impacts and presence of stressors currently experienced elsewhere.

Dr Cesar Cordeiro **Dr Katia Capel** **Mr Marcos Lucena**

January 2020

7. ACKNOWLEDGEMENTS

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Supplementary Information

Table 1s. – Species found at each of the four reef formations surveyed along the coast between SSLH and Baixo Silva Pomene.

		Reef formation			
Family	**Taxon**	**Baixo Silva**	**Pomene**	**Baixo Zambia**	**Baixo Africa**
Acanthuridae	*Acanthurus blochii*	-	X	-	X
Acanthuridae	*Acanthurus dussumieri*	X	X	X	X
Acanthuridae	*Acanthurus leucocheilus*	-	-	X	-
Acanthuridae	*Acanthurus leucosternon*	X	X	X	X
Acanthuridae	*Acanthurus lineatus*	-	X	X	-
Acanthuridae	*Acanthurus mata*	X	X	X	X
Acanthuridae	*Acanthurus nigrofuscus*	X	X	X	X
Acanthuridae	*Acanthurus sp*	X	X	X	X
Acanthuridae	*Acanthurus tennentii*	X	X	X	X
Acanthuridae	*Acanthurus thompsoni*	X	X	X	X
Acanthuridae	*Acanthurus xanthopterus*	-	X	-	-
Acanthuridae	*Ctenochaetus striatus*	X	X	X	X
Acanthuridae	*Ctenochaetus strigosus*	X	X	X	X
Acanthuridae	*Naso brachycentron*	-	-	-	X
Acanthuridae	*Naso brevirostris*	X	X	X	X
Acanthuridae	*Naso elegans*	X	X	X	X
Acanthuridae	*Naso hexacanthus*	X	-	X	X
Acanthuridae	*Naso tuberosus*	X	-	-	-
Acanthuridae	*Naso unicornis*	X	-	X	X
Acanthuridae	*Paracanthurus hepatus*	-	-	X	-
Acanthuridae	*Zebrasoma gemmatum*	X	-	-	-
Acanthuridae	*Zebrasoma scopas*	X	X	X	X
Apogonidae	*Cheilodipterus macrodon*	-	X	-	-
Apogonidae	*Ostorhinchus angustatus*	-	-	X	X
Apogonidae	*Ostorhinchus cookii*	-	-	X	-

Family	Taxon	Baixo Silva	Pomene	Baixo Zambia	Baixo Africa
Aulostomidae	*Aulostomus chinensis*	X	X	X	-
Balistidae	*Balistapus undulatus*	X	X	X	X
Balistidae	*Balistoides conspicillum*	X	X	X	X
Balistidae	*Melichthys indicus*	-	X	-	-
Balistidae	*Melichthys niger*	-	-	X	X
Balistidae	*Odonus niger*	X	X	X	X
Balistidae	*Pseudobalistes flavimarginatus*	-	-	X	-
Balistidae	*Sufflamen bursa*	-	X	X	X
Balistidae	*Sufflamen chrysopterum*	X	X	X	X
Balistidae	*Sufflamen fraenatum*	X	-	X	X
Blenniidae	*Aspidontus dussumieri*	-	-	X	-
Blenniidae	*Exallias brevis*	-	-	X	-
Blenniidae	*Plagiotremus tapeinosoma*	-	-	X	X
Caesionidae	*Caesio caerulaurea*	X	X	X	X
Caesionidae	*Caesio lunaris*	X	-	-	-
Caesionidae	*Caesio xanthonota*	X	-	X	X
Caesionidae	*Pterocaesio marri*	-	X	-	-
Caesionidae	*Pterocaesio tile*	X	-	-	X
Carangidae	*Caranx melampygus*	-	X	X	X
Carangidae	*Caranx sexfasciatus*	X	X	-	-
Carangidae	*Caranx sp.*	-	-	X	-
Carcharhinidae	*Carcharhinus amblyrhynchos*	-	X	-	-
Carcharhinidae	*Carcharhinus melanopterus*	-	-	X	-
Carcharhinidae	*Triaenodon obesus*	X	-	-	-
Chaetodontidae	*Chaetodon auriga*	X	X	X	X
Chaetodontidae	*Chaetodon bennetti*	-	-	-	X
Chaetodontidae	*Chaetodon blackburnii*	-	X	-	-
Chaetodontidae	*Chaetodon guttatissimus*	X	X	X	X
Chaetodontidae	*Chaetodon interruptus*	X	-	X	X
Chaetodontidae	*Chaetodon kleinii*	X	X	X	X

Family	Taxon	Baixo Silva	Pomene	Baixo Zambia	Baixo Africa
Chaetodontidae	*Chaetodon lineolatus*	-	-	X	-
Chaetodontidae	*Chaetodon lunula*	X	X	-	X
Chaetodontidae	*Chaetodon madagaskariensis*	X	X	X	X
Chaetodontidae	*Chaetodon mertensii*	X	-	-	-
Chaetodontidae	*Chaetodon meyeri*	X	X	X	X
Chaetodontidae	*Chaetodon trifascialis*	X	X	X	X
Chaetodontidae	*Chaetodon trifasciatus*	X	-	-	X
Chaetodontidae	*Chaetodon unimaculatus*	X	-	-	-
Chaetodontidae	*Chaetodon vagabundus*	-	X	-	X
Chaetodontidae	*Chaetodon zanzibarensis*	X	X	X	X
Chaetodontidae	*Forcipiger flavissimus*	X	X	X	X
Chaetodontidae	*Hemitaurichthys zoster*	X	X	X	X
Chaetodontidae	*Heniochus acuminatus*	X	X	X	X
Chaetodontidae	*Heniochus diphreutes*	-	-	-	X
Cirrhitidae	*Cirrhitichthys oxycephalus*	X	X	X	X
Cirrhitidae	*Paracirrhites arcatus*	X	X	X	X
Cirrhitidae	*Paracirrhites forsteri*	X	X	X	X
Diodontidae	*Diodon hystrix*	X	X	-	-
Echeneidae	*Echeneis naucrates*	X	-	-	-
Ephippidae	*Platax orbicularis*	-	-	X	-
Epinephelidae	*Cephalopholis miniata*	X	X	-	X
Epinephelidae	*Grammistes sexlineatus*	-	X	-	-
Epinephelidae	*Plectropomus pessuliferus*	-	-	-	X
Epinephelidae	*Plectropomus punctatus*	X	-	-	-
Epinephelidae	*Variola louti*	X	-	-	X
Fistulariidae	*Fistularia commersonii*	-	-	-	X
Gobiidae	*Gobiidae sp.*	-	-	X	-
Gobiidae	*Valenciennea strigata*	-	X	X	-
Haemulidae	*Diagramma centurio*	-	-	X	-
Haemulidae	*Diagramma pictum*	X	X	X	X

Family	Taxon	Baixo Silva	Baxio Pomene	Baixo Zambia	Baixo Africa
Haemulidae	*Plectorhinchus chubbi*	X	X	-	-
Haemulidae	*Plectorhinchus flavomaculatus*	X	X	-	X
Haemulidae	*Plectorhinchus gaterinus*	-	-	-	X
Haemulidae	*Plectorhinchus gibbosus*	-	X	-	-
Haemulidae	*Plectorhinchus playfairi*	X	X	X	X
Haemulidae	*Plectorhinchus schotaf*	X	X	-	-
Haemulidae	*Plectorhinchus vittatus*	-	-	-	X
Holocentridae	*Myripristis kuntee*	X	X	X	X
Holocentridae	*Sargocentron caudimaculatum*	X	X	X	X
Holocentridae	*Sargocentron diadema*	X	X	X	X
Kyphosidae	*Kyphosus cinerascens*	-	-	-	X
Kyphosidae	*Kyphosus sp*	-	X	-	X
Labridae	*Anampses lineatus*	-	-	X	-
Labridae	*Anampses meleagris*	X	X	X	X
Labridae	*Bodianus axillaris*	X	X	X	X
Labridae	*Bodianus bilunulatus*	X	-	X	X
Labridae	*Bodianus diana*	X	X	X	X
Labridae	*Bodianus sp.*	X	X	-	-
Labridae	*Chlorurus strongylocephalus*	-	X	-	-
Labridae	*Coris aygula*	-	-	X	-
Labridae	*Coris caudimacula*	X	X	X	X
Labridae	*Coris cuvieri*	X	-	X	-
Labridae	*Coris formosa*	-	X	-	-
Labridae	*Coris gaimard*	X	-	X	-
Labridae	*Coris sp.*	-	-	-	X
Labridae	*Gomphosus caeruleus*	X	X	X	X
Labridae	*Halichoeres cosmetus*	X	X	X	X
Labridae	*Halichoeres hortulanus*	X	X	X	X
Labridae	*Halichoeres iridis*	-	-	X	-
Labridae	*Halichoeres nebulosus*	X	X	X	X

Family	Taxon	Baixo Silva	Pomene	Baixo Zambia	Baixo Africa
Labridae	*Halichoeres sp.*	X	-	-	X
Labridae	*Hemigymnus fasciatus*	X	X	X	X
Labridae	*Labrichthys unilineatus*	-	-	X	-
Labridae	*Labroides bicolor*	X	X	X	X
Labridae	*Labroides dimidiatus*	X	X	X	X
Labridae	*Macropharyngodon bipartitus*	X	-	X	X
Labridae	*Macropharyngodon cyanoguttatus*	-	-	-	X
Labridae	*Macropharyngodon sp*	-	-	X	-
Labridae	*Pseudocheilinus hexataenia*	X	X	X	X
Labridae	*Stethojulis albovittata*	X	-	-	-
Labridae	*Thalassoma amblycephalum*	X	X	X	X
Labridae	*Thalassoma hebraicum*	X	X	X	X
Labridae	*Thalassoma lunare*	X	X	X	X
Lethrinidae	*Monotaxis grandoculis*	-	-	-	X
Lutjanidae	*Aphareus furca*	X	-	-	-
Lutjanidae	*Aprion virescens*	X	-	-	X
Lutjanidae	*Lutjanus argentimaculatus*	-	-	X	-
Lutjanidae	*Lutjanus bohar*	X	-	-	X
Lutjanidae	*Lutjanus fulviflamma*	X	X	X	X
Lutjanidae	*Lutjanus gibbus*	-	X	-	-
Lutjanidae	*Lutjanus kasmira*	X	X	X	X
Lutjanidae	*Lutjanus lutjanus*	X	X	-	-
Lutjanidae	*Lutjanus notatus*	X	-	-	-
Malacanthidae	*Malacanthus latovittatus*	-	-	X	X
Microdesmidae	*Gunnellichthys curiosus*	X	X	X	-
Microdesmidae	*Nemateleotris magnifica*	X	-	X	X
Microdesmidae	*Ptereleotris evides*	-	-	X	X
Microdesmidae	*Ptereleotris heteroptera*	-	-	X	-
Monacanthidae	*Aluterus scriptus*	-	-	X	X
Monacanthidae	*Amanses scopas*	X	X	X	X

Family	Taxon	Baixo Silva	Pomene	Baixo Zambia	Baixo Africa
Monacanthidae	*Cantherhines dumerilii*	-	-	-	X
Monacanthidae	*Cantherhines fronticinctus*	X	X	-	-
Monacanthidae	*Pervagor janthinosoma*	-	-	-	X
Mullidae	*Mulloidichthys flavolineatus*	-	X	-	-
Mullidae	*Mulloidichthys vanicolensis*	X	X	-	-
Mullidae	*Parupeneus barberinus*	-	-	X	X
Mullidae	*Parupeneus cyclostomus*	X	X	X	X
Mullidae	*Parupeneus indicus*	X	X	X	X
Mullidae	*Parupeneus macronemus*	X	X	X	X
Mullidae	*Parupeneus pleurostigma*	X	X	-	-
Mullidae	*Parupeneus trifasciatus*	X	-	X	X
Muraenidae	*Gymnothorax eurostus*	X	-	-	-
Muraenidae	*Gymnothorax favagineus*	X	-	X	-
Muraenidae	*Gymnothorax sp.*	-	-	X	-
Oplegnathidae	*Oplegnathus robinsoni*	X	X	X	X
Ostraciidae	*Lactoria cornuta*	-	-	X	-
Ostraciidae	*Ostracion cubicus*	-	-	-	X
Ostraciidae	*Ostracion meleagris*	X	X	X	X
Pemphridae	*Pempheris schwenkii*	-	X	-	-
Pinguipedidae	*Parapercis hexophtalma*	X	-	X	X
Pomacanthidae	*Apolemichthys trimaculatus*	X	X	X	X
Pomacanthidae	*Centropyge acanthops*	-	-	X	X
Pomacanthidae	*Centropyge multispinis*	X	X	X	X
Pomacanthidae	*Pomacanthus imperator*	X	X	X	X
Pomacanthidae	*Pomacanthus rhomboides*	X	-	-	-
Pomacanthidae	*Pomacanthus semicirculatus*	X	X	X	X
Pomacanthidae	*Pygoplites diacanthus*	-	X	-	X
Pomacentridae	*Abudefduf natalensis*	X	X	X	X
Pomacentridae	*Abudefduf sparoides*	X	-	-	-
Pomacentridae	*Abudefduf vaigiensis*	X	-	X	-

Family	Taxon	Baixo Silva	Pomene	Baixo Zambia	Baixo Africa
Pomacentridae	*Amphiprion akallopisos*	X	X	-	X
Pomacentridae	*Amphiprion allardi*	X	X	X	X
Pomacentridae	*Chromis fieldi*	X	X	X	X
Pomacentridae	*Chromis nigrura*	X	-	-	-
Pomacentridae	*Chromis viridis*	X	-	-	-
Pomacentridae	*Chromis weberi*	X	X	X	X
Pomacentridae	*Chrysiptera unimaculata*	-	-	X	-
Pomacentridae	*Dascyllus carneus*	-	-	X	X
Pomacentridae	*Dascyllus trimaculatus*	X	X	X	X
Pomacentridae	*Neopomacentrus azysron*	X	X	X	X
Pomacentridae	*Neopomacentrus cyanomos*	-	X	-	-
Pomacentridae	*Neopomacentrus fuliginosus*	-	X	-	-
Pomacentridae	*Plectroglyphidodon dickii*	-	-	X	X
Pomacentridae	*Pomacentrus caeruleus*	X	-	X	X
Priacanthidae	*Heteropriacanthus cruentatus*	X	X	X	X
Scaridae	*Chlorurus sordidus*	X	-	-	X
Scaridae	*Scarus ghobban*	-	X	-	-
Scaridae	*Scarus rubroviolaceus*	X	X	X	X
Scaridae	*Scarus scaber*	-	-	X	-
Scaridae	*Scarus viridifucatus*	X	-	X	-
Scorpaenidae	*Scorpaenopsis sp.*	-	-	X	X
Scorpaenidae	*Sebastapistes cyanostigma*	-	-	X	-
Serranidae	*Cephalopholis nigripinnis*	X	X	X	X
Serranidae	*Epinephelus fasciatus*	-	-	X	X
Serranidae	*Epinephelus spilotoceps*	-	-	-	X
Serranidae	*Pseudanthias squamipinnis*	X	X	X	X
Siganidae	*Siganus sutor*	X	X	X	X
Sparidae	*Polyamblyodon gibbosum*	-	-	X	X
Synodontidae	*Synodus sp.*	X	-	-	-
Synodontidae	*Synodus variegatus*	X	-	-	-

Family	Taxon	Baixo Silva	Pomene	Baixo Zambia	Baixo Africa
Tetraodontidae	*Arothron meleagris*	X	X	X	X
Tetraodontidae	*Arothron nigropunctatus*	-	-	X	-
Tetraodontidae	*Canthigaster solandri*	-	X	-	-
Tetraodontidae	*Canthigaster valentini*	X	X	X	X
Zanclidae	*Zanclus cornutus*	X	X	X	X

Table 2s. – Size, relative abundance and frequency of reef fish species found at four reef areas between SSLH and Baixo Silva Pomene, according to family and trophic group classifications. (SE = standard error, FC – piscivore, HD – herbivore-detritivore, HM – macroalgal feeder, IM – mobile invertebrate feeder, IS – sessile invertebrate feeder, OM – omnivorous, PK – planktivorous).

Family	Taxon	Size		Relative abundance (%)	Frequency (%)	Trophic groups
		Mean	SE			
Acanthuridae	*Acanthurus blochii*	21.17	7.19	0.17	5.36	HD
Acanthuridae	*Acanthurus dussumieri*	32.94	5.10	0.88	30.36	HD
Acanthuridae	*Acanthurus leucocheilus*	25.50	2.12	0.03	1.79	HD
Acanthuridae	*Acanthurus leucosternon*	20.13	4.43	2.48	80.36	HD
Acanthuridae	*Acanthurus lineatus*	24.50	3.94	0.18	5.36	HD
Acanthuridae	*Acanthurus mata*	32.50	8.27	0.56	14.29	PK
Acanthuridae	*Acanthurus nigrofuscus*	12.89	4.28	1.94	57.14	HD
Acanthuridae	*Acanthurus tennentii*	22.14	5.21	4.24	111.61	HD
Acanthuridae	*Acanthurus thompsoni*	18.75	4.45	0.46	10.71	PK
Acanthuridae	*Acanthurus xanthopterus*	40.00	8.49	0.03	1.79	HD
Acanthuridae	*Ctenochaetus striatus*	14.58	4.19	4.21	101.79	OM
Acanthuridae	*Ctenochaetus strigosus*	15.03	4.61	0.99	26.79	OM
Acanthuridae	*Naso brachycentron*	40.00	-	0.03	0.89	HM
Acanthuridae	*Naso brevirostris*	37.39	8.20	2.19	25.00	OM
Acanthuridae	*Naso elegans*	29.59	5.32	0.84	30.36	HM
Acanthuridae	*Naso hexacanthus*	35.87	9.59	1.85	13.39	PK
Acanthuridae	*Naso tuberosus*	55.00	-	0.03	0.89	HM
Acanthuridae	*Naso unicornis*	44.00	11.53	0.05	2.68	HM
Acanthuridae	*Paracanthurus hepatus*	19.50	5.04	0.29	7.14	HD
Acanthuridae	*Zebrasoma gemmatum*	20.50	0.71	0.03	1.79	HD
Acanthuridae	*Zebrasoma scopas*	15.00	3.05	0.71	30.36	HD

Family	Taxon	Size mean	Size SE	Relative abundance (%)	Frequency (%)	Trophic groups
Apogonidae	*Cheilodipterus macrodon*	22.00	-	0.02	0.89	FC
Apogonidae	*Ostorhinchus angustatus*	5.50	0.71	0.03	1.79	IM
Apogonidae	*Ostorhinchus cookii*	7.00	-	0.02	0.89	IM
Aulostomidae	*Aulostomus chinensis*	40.82	7.64	0.18	9.82	FC
Balistidae	*Balistapus undulatus*	17.67	3.55	0.24	10.71	IM
Balistidae	*Balistoides conspicillum*	30.23	6.07	0.20	11.61	IM
Balistidae	*Melichthys indicus*	9.00	-	0.06	0.89	PK
Balistidae	*Melichthys niger*	21.86	3.67	0.14	6.25	PK
Balistidae	*Odonus niger*	21.78	7.77	5.44	44.64	PK
Balistidae	*Pseudobalistes flavimarginatus*	30.00	-	0.02	0.89	IM
Balistidae	*Sufflamen bursa*	20.59	3.28	0.26	15.18	IM
Balistidae	*Sufflamen chrysopterum*	18.24	3.35	2.08	92.86	IM
Balistidae	*Sufflamen fraenatum*	19.94	3.34	0.32	14.29	IM
Blenniidae	*Aspidontus dussumieri*	7.50	3.54	0.03	1.79	OM
Blenniidae	*Exallias brevis*	7.00	-	0.02	0.89	IS
Blenniidae	*Plagiotremus tapeinosoma*	8.25	1.50	0.08	3.57	IM
Caesionidae	*Caesio caerulaurea*	20.48	4.79	7.67	20.54	PK
Caesionidae	*Caesio lunaris*	18.00	-	0.46	0.89	PK
Caesionidae	*Caesio xanthonota*	24.29	3.25	2.73	6.25	PK
Caesionidae	*Pterocaesio marri*	11.00	-	0.46	0.89	PK
Caesionidae	*Pterocaesio tile*	21.50	4.95	1.22	1.79	PK
Carangidae	*Caranx melampygus*	34.60	7.97	0.68	8.93	FC
Carangidae	*Caranx sexfasciatus*	31.50	11.07	1.90	8.93	IM
Carcharhinidae	*Carcharhinus amblyrhynchos*	150.00	-	0.02	0.89	FC
Carcharhinidae	*Carcharhinus melanopterus*	160.00	-	0.02	0.89	FC
Carcharhinidae	*Triaenodon obesus*	120.00	0.00	0.03	1.79	FC
Chaetodontidae	*Chaetodon auriga*	14.78	1.83	0.59	20.54	IM

Family	Taxon	Size mean	Size SE	Relative abundance (%)	Frequency (%)	Trophic groups
Chaetodontidae	*Chaetodon bennetti*	18.00	-	0.02	0.89	IS
Chaetodontidae	*Chaetodon blackburnii*	9.67	3.39	0.15	5.36	IM
Chaetodontidae	*Chaetodon guttatissimus*	11.15	1.56	0.61	24.11	IS
Chaetodontidae	*Chaetodon interruptus*	12.00	3.63	0.17	7.14	OM
Chaetodontidae	*Chaetodon kleinii*	10.62	2.03	1.31	46.43	PK
Chaetodontidae	*Chaetodon lineolatus*	10.00	-	0.02	0.89	IS
Chaetodontidae	*Chaetodon lunula*	14.73	4.36	0.24	9.82	IS
Chaetodontidae	*Chaetodon madagaskariensis*	12.09	1.93	0.77	31.25	IM
Chaetodontidae	*Chaetodon mertensii*	10.00	-	0.02	0.89	IM
Chaetodontidae	*Chaetodon meyeri*	14.24	2.49	0.32	15.18	IS
Chaetodontidae	*Chaetodon trifascialis*	12.35	1.99	0.56	20.54	IS
Chaetodontidae	*Chaetodon trifasciatus*	12.00	1.63	0.11	3.57	IS
Chaetodontidae	*Chaetodon unimaculatus*	16.00	-	0.06	0.89	IS
Chaetodontidae	*Chaetodon vagabundus*	15.00	0.00	0.08	2.68	IM
Chaetodontidae	*Chaetodon zanzibarensis*	13.20	2.97	0.21	8.93	IS
Chaetodontidae	*Forcipiger flavissimus*	14.58	1.59	0.80	27.68	IM
Chaetodontidae	*Hemitaurichthys zoster*	13.55	2.73	0.21	9.82	PK
Chaetodontidae	*Heniochus acuminatus*	20.12	3.59	0.46	15.18	IM
Chaetodontidae	*Heniochus diphreutes*	27.50	3.54	0.06	1.79	PK
Cirrhitidae	*Cirrhitichthys oxycephalus*	4.94	1.30	1.34	45.54	IM
Cirrhitidae	*Paracirrhites arcatus*	7.00	1.56	1.66	73.21	IM
Cirrhitidae	*Paracirrhites forsteri*	10.86	3.44	0.21	12.50	FC
Diodontidae	*Diodon hystrix*	36.50	2.12	0.03	1.79	IM
Echeneidae	*Echeneis naucrates*	37.50	10.61	0.05	1.79	IM
Ephippidae	*Platax orbicularis*	40.00	-	0.09	0.89	OM
Epinephelidae	*Cephalopholis miniata*	34.50	7.05	0.06	3.57	FC
Epinephelidae	*Grammistes sexlineatus*	13.00	-	0.02	0.89	FC

Family	Taxon	Size mean	Size SE	Relative abundance (%)	Frequency (%)	Trophic groups
Epinephelidae	*Plectropomus pessuliferus*	30.00	-	0.02	0.89	FC
Epinephelidae	*Plectropomus punctatus*	80.00	-	0.02	0.89	FC
Epinephelidae	*Variola louti*	42.50	10.41	0.06	3.57	FC
Fistulariidae	*Fistularia commersonii*	100.00	-	0.02	0.89	FC
Gobiidae	*Valenciennea strigata*	10.00	5.66	0.05	1.79	IM
Haemulidae	*Diagramma centurio*	50.00	-	0.05	0.89	IM
Haemulidae	*Diagramma pictum*	39.73	5.89	0.29	13.39	IM
Haemulidae	*Plectorhinchus chubbi*	41.67	16.07	0.14	2.68	IM
Haemulidae	*Plectorhinchus flavomaculatus*	43.50	2.52	0.09	3.57	IM
Haemulidae	*Plectorhinchus gaterinus*	31.80	4.09	0.11	4.46	IM
Haemulidae	*Plectorhinchus gibbosus*	25.00	-	0.02	0.89	IM
Haemulidae	*Plectorhinchus playfairi*	43.36	7.17	0.49	22.32	IM
Haemulidae	*Plectorhinchus schotaf*	25.00	7.07	0.05	1.79	IM
Haemulidae	*Plectorhinchus vittatus*	40.00	-	0.02	0.89	IM
Holocentridae	*Myripristis kuntee*	21.47	3.57	3.10	52.68	PK
Holocentridae	*Sargocentron caudimaculatum*	21.96	4.05	1.56	46.43	IM
Holocentridae	*Sargocentron diadema*	18.35	3.24	0.73	15.18	IM
Kyphosidae	*Kyphosus cinerascens*	32.40	9.81	0.46	4.46	HM
Labridae	*Anampses lineatus*	22.50	6.36	0.03	1.79	IM
Labridae	*Anampses meleagris*	15.12	5.75	0.43	21.43	IM
Labridae	*Bodianus axillaris*	15.16	3.92	0.58	27.68	IM
Labridae	*Bodianus bilunulatus*	31.67	5.25	0.20	10.71	IM
Labridae	*Bodianus diana*	17.38	3.30	0.88	50.00	IM
Labridae	*Chlorurus strongylocephalus*	50.00	-	0.02	0.89	OM
Labridae	*Coris aygula*	22.00	11.31	0.05	1.79	IM
Labridae	*Coris caudimacula*	11.81	4.71	0.41	23.21	IM
Labridae	*Coris cuvieri*	7.75	4.27	0.06	3.57	IM

Family	Taxon	Size mean	Size SE	Relative abundance (%)	Frequency (%)	Trophic groups
Labridae	*Coris formosa*	18.00	-	0.02	0.89	IM
Labridae	*Coris gaimard*	18.50	9.19	0.03	1.79	IM
Labridae	*Gomphosus caeruleus*	12.53	6.13	0.87	49.11	IM
Labridae	*Halichoeres cosmetus*	9.11	3.16	0.27	16.07	IM
Labridae	*Halichoeres hortulanus*	16.29	5.83	1.52	66.96	IM
Labridae	*Halichoeres iridis*	2.00	-	0.03	0.89	IM
Labridae	*Halichoeres nebulosus*	8.34	4.79	1.34	54.46	IM
Labridae	*Hemigymnus fasciatus*	25.17	9.22	0.27	16.07	IM
Labridae	*Labrichthys unilineatus*	14.00	-	0.02	0.89	IS
Labridae	*Labroides bicolor*	10.50	4.23	0.18	10.71	IM
Labridae	*Labroides dimidiatus*	5.56	1.76	3.55	97.32	IM
Labridae	*Macropharyngodon bipartitus*	5.96	2.26	0.70	24.11	IM
Labridae	*Macropharyngodon cyanoguttatus*	9.00	-	0.03	0.89	IM
Labridae	*Pseudocheilinus hexataenia*	3.69	1.49	0.67	28.57	IM
Labridae	*Stethojulis albovittata*	14.00	2.83	0.03	1.79	IM
Labridae	*Thalassoma amblycephalum*	7.01	4.33	6.15	63.39	PK
Labridae	*Thalassoma hebraicum*	12.80	4.98	3.69	131.25	IM
Labridae	*Thalassoma lunare*	12.00	5.25	0.99	36.61	IM
Lethrinidae	*Monotaxis grandoculis*	25.50	7.78	0.05	1.79	IM
Lutjanidae	*Aphareus furca*	40.00	-	0.14	0.89	FC
Lutjanidae	*Aprion virescens*	61.67	7.64	0.21	2.68	FC
Lutjanidae	*Lutjanus argentimaculatus*	30.00	-	0.02	0.89	FC
Lutjanidae	*Lutjanus bohar*	27.25	12.53	0.06	3.57	FC
Lutjanidae	*Lutjanus fulviflamma*	22.45	4.15	3.20	29.46	IM
Lutjanidae	*Lutjanus gibbus*	38.00	-	0.61	0.89	IM
Lutjanidae	*Lutjanus kasmira*	21.74	3.36	14.88	50.89	IM
Lutjanidae	*Lutjanus lutjanus*	21.43	3.26	1.22	6.25	IM

Family	Taxon	Size mean	Size SE	Relative abundance (%)	Frequency (%)	Trophic groups
Lutjanidae	*Lutjanus notatus*	20.00	-	0.02	0.89	FC
Malacanthidae	*Malacanthus latovittatus*	42.50	3.54	0.03	1.79	IM
Microdesmidae	*Gunnellichthys curiosus*	6.67	3.51	0.05	2.68	PK
Microdesmidae	*Nemateleotris magnifica*	6.08	2.81	0.32	10.71	PK
Microdesmidae	*Ptereleotris evides*	10.00	3.16	0.15	5.36	PK
Microdesmidae	*Ptereleotris heteroptera*	8.00	2.83	0.30	3.57	PK
Monacanthidae	*Aluterus scriptus*	40.50	0.71	0.03	1.79	PK
Monacanthidae	*Amanses scopas*	17.25	3.41	0.12	7.14	IM
Monacanthidae	*Cantherhines dumerilii*	20.00	-	0.02	0.89	IS
Monacanthidae	*Cantherhines fronticinctus*	17.00	4.24	0.03	1.79	IM
Monacanthidae	*Pervagor janthinosoma*	8.33	3.21	0.05	2.68	OM
Mullidae	*Mulloidichthys flavolineatus*	8.00	-	0.15	0.89	IM
Mullidae	*Mulloidichthys vanicolensis*	22.00	5.72	0.76	3.57	IM
Mullidae	*Parupeneus barberinus*	34.00	7.94	0.05	2.68	IM
Mullidae	*Parupeneus cyclostomus*	27.93	8.93	0.38	13.39	FC
Mullidae	*Parupeneus indicus*	37.17	7.84	0.26	10.71	IM
Mullidae	*Parupeneus macronemus*	15.35	6.12	1.70	50.89	IM
Mullidae	*Parupeneus pleurostigma*	21.00	7.07	0.03	1.79	IM
Mullidae	*Parupeneus trifasciatus*	22.86	5.52	0.14	6.25	IM
Muraenidae	*Gymnothorax eurostus*	60.00	-	0.02	0.89	FC
Muraenidae	*Gymnothorax favagineus*	175.00	77.78	0.03	1.79	FC
Oplegnathidae	*Oplegnathus robinsoni*	43.00	13.65	0.23	12.50	OM
Ostraciidae	*Lactoria cornuta*	15.00	-	0.03	0.89	IM
Ostraciidae	*Ostracion cubicus*	37.50	3.54	0.05	1.79	IS
Ostraciidae	*Ostracion meleagris*	19.17	8.30	0.09	5.36	IS
Pemphridae	*Pempheris schwenkii*	10.50	1.00	1.12	3.57	PK
Pinguipedidae	*Parapercis hexophtalma*	10.88	3.72	0.12	7.14	FC

Family	Taxon	Size mean	Size SE	Relative abundance (%)	Frequency (%)	Trophic groups
Pomacanthidae	*Apolemichthys trimaculatus*	17.91	3.29	0.38	19.64	IS
Pomacanthidae	*Centropyge acanthops*	5.40	1.67	0.12	4.46	HD
Pomacanthidae	*Centropyge multispinis*	7.33	2.55	1.63	76.79	HD
Pomacanthidae	*Pomacanthus imperator*	27.92	7.44	0.38	21.43	IS
Pomacanthidae	*Pomacanthus rhomboides*	34.00	-	0.03	0.89	IM
Pomacanthidae	*Pomacanthus semicirculatus*	35.70	4.67	0.30	17.86	IS
Pomacanthidae	*Pygoplites diacanthus*	15.75	4.35	0.06	3.57	IS
Pomacentridae	*Abudefduf sparoides*	12.00	2.83	0.03	1.79	OM
Pomacentridae	*Abudefduf vaigiensis*	9.50	1.00	0.47	3.57	PK
Pomacentridae	*Amphiprion akallopisos*	6.00	1.77	0.20	7.14	PK
Pomacentridae	*Amphiprion allardi*	7.92	3.09	0.27	10.71	PK
Pomacentridae	*Chromis fieldi*	4.73	2.20	24.45	168.75	PK
Pomacentridae	*Chromis nigrura*	3.50	0.71	0.15	1.79	PK
Pomacentridae	*Chromis viridis*	3.00	1.41	0.91	1.79	PK
Pomacentridae	*Chromis weberi*	7.98	2.94	5.57	50.00	PK
Pomacentridae	*Chrysiptera unimaculata*	5.00	-	0.02	0.89	OM
Pomacentridae	*Dascyllus carneus*	5.00	1.53	0.33	6.25	PK
Pomacentridae	*Dascyllus trimaculatus*	7.38	3.48	3.17	53.57	PK
Pomacentridae	*Neopomacentrus azysron*	3.23	0.99	9.43	61.61	PK
Pomacentridae	*Neopomacentrus cyanomos*	12.00	-	0.02	0.89	PK
Pomacentridae	*Neopomacentrus fuliginosus*	6.00	-	0.03	0.89	PK
Pomacentridae	*Plectroglyphidodon dickii*	6.71	3.51	0.41	15.18	OM
Pomacentridae	*Pomacentrus caeruleus*	5.36	2.26	1.02	19.64	PK
Priacanthidae	*Heteropriacanthus cruentatus*	25.47	3.91	0.38	16.96	IM
Scaridae	*Chlorurus sordidus*	26.00	5.29	0.05	2.68	OM
Scaridae	*Scarus ghobban*	26.67	2.89	0.05	2.68	OM
Scaridae	*Scarus rubroviolaceus*	36.17	9.26	1.55	66.96	OM

Family	Taxon	Size mean	Size SE	Relative abundance (%)	Frequency (%)	Trophic groups
Scaridae	*Scarus scaber*	30.00	-	0.02	0.89	OM
Scaridae	*Scarus viridifucatus*	24.00	1.41	0.08	3.57	OM
Scorpaenidae	*Sebastapistes cyanostigma*	6.00	0.00	0.05	1.79	IM
Serranidae	*Cephalopholis nigripinnis*	27.64	5.08	0.23	12.50	IM
Serranidae	*Epinephelus fasciatus*	25.12	8.29	0.12	7.14	FC
Serranidae	*Epinephelus spilotoceps*	35.00	-	0.02	0.89	FC
Serranidae	*Pseudanthias squamipinnis*	5.61	2.39	19.91	90.18	PK
Siganidae	*Siganus sutor*	24.78	4.48	0.58	20.54	HD
Sparidae	*Polyamblyodon gibbosum*	32.83	9.58	0.21	5.36	IM
Synodontidae	*Synodus variegatus*	20.00	-	0.02	0.89	FC
Tetraodontidae	*Arothron meleagris*	17.86	9.68	0.26	12.50	IS
Tetraodontidae	*Arothron nigropunctatus*	27.00	-	0.02	0.89	IS
Tetraodontidae	*Canthigaster solandri*	8.00	1.41	0.03	1.79	OM
Tetraodontidae	*Canthigaster valentini*	6.11	1.66	0.71	33.93	OM
Zanclidae	*Zanclus cornutus*	18.68	3.14	2.67	52.68	OM

Table 3s. – Abundance of macroinvertebrates observed in transections (50 m^2) at four reef areas between SSLH and Baixo Silva Pomene.

Phylum	Taxon	Reef formation			
		Baixo Silva	Pomene	Baixo Zambia	Baixo Africa
Arthropoda	*Odontodactylus scyllarus*	-		2	-
	Panulirus versicolor	-	-	-	2
Cnidaria	*Actinaria* sp. *1*	-	2	-	-
	Actinaria sp. *2*	-	-	-	1
	Heteractis magnifica	32	5	2	114
Echinodermata	*Crinoidea*	5	10	6	4
	Culcita schmideliana	3	-	-	-
	Diadema savignyi	13	4	-	-
	Diadema sp.	-	-	1	1
	Echinothrix calamaris	20	2	12	9
	Fromia indica	5	2	5	2
	Fromia milleporella	2	1	1	-
	Fromia sp. *1*	1	-	1	-
	Fromia sp. *2*	2	-	-	-
	Holothuria cf. nobilis	1	1	2	-
	Linckia guildingi	9	17	13	10
	Linckia laevigata	4	2	2	3
	Linckia sp.	16	-	-	-
Mollusca	*Chomodoris africana*	1	-	-	-
	Chromodoris hamiltoni	2	1	9	-
	Halgerda wasiniensis	-	-	-	1
	Hyotissa sp.	3	40	6	6
	Ovula ovum	-	2	1	-
	Tridacna sp.	4	8	9	5
Platyhelminthes	*Pseudoceros dimidiatus*	-	1	1	-
	Pseudoceros scriptus	1	-	-	-

Table 4s. – Most common cnidarian species found at each of the four reef formations surveyed along the between SSLH and Baixo Silva Pomene.

			Reef formation			
Subclass	**Family**	**Taxon**	**Baixo Silva**	**Pomene**	**Baixo Zambia**	**Baixo Africa**
Hexacorallia	Anthipathidae	*Cirripathes sp.*	X	X	X	X
	Acroporidae	*Acropora branchi*	X	X	X	X
	Acroporidae	*Acropora cf. apressa*	X	-	X	X
	Acroporidae	*Acropora spp.*	X	X	X	X
	Acroporidae	*Acropora digitifera*	-	-	X	X
	Acroporidae	*Alveopora allingi*	X	-	X	X
	Acroporidae	*Alveopora marionensis*	-	-	X	-
	Acroporidae	*Astreopora myriophthalma*	X	X	X	X
	Acroporidae	*Montipora faveolata*	X	-	X	X
	Acroporidae	*Montipora turgescens*	X	X	X	X
	Acroporidae	*Montipora sp.*	-	-	X	X
	Agariciidae	*Gardineroseris planulata*	-	-	X	-
	Agariciidae	*Leptoseris sp.*	-	X	X	X
	Agariciidae	*Pavona explanulata*	-	X	-	X
	Agariciidae	*Pavona duerdeni*	-	-	X	-
	Agariciidae	*Pavona sp.*	-	X	-	-
	Coscinaraeidae	*Coscinaraea columna*	X	X	X	X
	Coscinaraeidae	*Horastrea indica*	X	-	-	X
	Dendrophylliidae	*Tubastraea diaphana*	X	X	-	X
	Dendrophylliidae	*Tubastraea micranthus*	X	X	-	X
	Dendrophylliidae	*Tubastraea coccinea*	X	X	-	X

Subclass	Family	Taxon	Baixo Silva	Pomene	Baixo Zambia	Baixo Africa
	Dendrophylliidae	*Turbinaria mesenterina*	-	X	X	X
	Euphylliidae	*Galaxea fascicularis*	X	X	X	X
	Euphylliidae	*Gyrosmilia interrupta*	-	X	X	-
	Faviidae	*Favia spp.*	X	X	X	X
	Fungiidae	*Lobactis cf. scutaria*	X	-	X	X
	Fungiidae	*Fungia sp.*	-	-	-	X
	Fungiidae	*Leptastrea cf. transversa*	X	-	X	X
	Lobophylliidae	*Acanthastrea echinata*	X	X	X	X
	Lobophylliidae	*Acanthastrea sp.*	X	-	X	-
	Lobophylliidae	*Echinophyllia aspera*	X	X	X	X
	Lobophylliidae	*Lobophyllia sp.*	X	X	X	X
	Merulinidae	*Astrea annuligera*	X	X	X	X
	Merulinidae	*Echinopora sp.*	X	X	X	X
	Merulinidae	*Favites spp.*	X	X	X	X
	Merulinidae	*Goniastrea sp.*	X	X	X	X
	Merulinidae	*Hydnophora sp.*	-	-	X	-
	Merulinidae	*Leptoria sp.*	-	-	-	X
	Merulinidae	*Paramontastraea peresi*	X	X	-	X
	Merulinidae	*Platygra spp.*	-	X	X	X
	Plesiastreidae	*Plesiastrea versipora*	X	X	-	X
	Pocilloporidae	*Pocillopora damicornis*	X	X	-	X
	Pocilloporidae	*Pocillopora verrucosa*	X	X	X	X
	Pocilloporidae	*Stylophora pistillata*	X	X	X	X
	Poritidae	*Goniopora columna*	X	-	X	-

Subclass	**Family**	**Taxon**	**Baixo Silva**	**Pomene**	**Baixo Zambia**	**Baixo Africa**
	Poritidae	*Goniopora sp.*	-	X	X	-
	Poritidae	*Porites spp.*	-	X	X	X
	Sphenopidae	*Palythoa tuberculosa*	X	X	X	X
	Sphenopidae	*Palythoa nelliae*	-	X	-	-
	Zoanthidae	*Zoanthus sansibaricus*	-	X	-	-
Octocorallia	Melithaeidae	*Melithaea rubra*	X	X	-	X
	Acyoniidae	*Cladiella kashmani*	X	X	X	X
	Acyoniidae	*Sinularia dura*	X	X	X	X
	Acyoniidae	*Sinularia spp.*	X	X	X	X
	Alcyoniidae	*Cladiella spp.*	X	X	X	X
	Alcyoniidae	*Lobophytum spp.*	X	X	-	-
	Alcyoniidae	*Sarcophyton sp.*	X	X	-	-
	Nephtheidae	*Dendronephthya sp.*	X	X	X	X
	Xeniidae	*Xenia sp.*	-	X	-	X