

JUNE 2018



Coral Reef Composition and Status within the Coastal Areas of the Proposed Gouyave MPA

KFW



Caribbean Community
Climate Change Centre



Grenada Marine Protected Areas



GRENCODA

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Acknowledgements

This assessment was made possible through funding provided by The German Ministry for Economic Cooperation and Development (BMZ) through an agreement with the the Caribbean Community Climate Change Centre (CCCCC). More specifically, this document is a deliverable of the “Community-based Coastal Ecosystem Management for Climate Adaptation in Selected Areas of Grenada” project which is implemented by the Grenada Community Development Organization (GRENCODA) and its partner agencies; Grenada Fisheries Division, Grenada Forestry Department and the Gouyave Fishermen Cooperative Society Ltd. I would like to thank Olando Harvey, Denzel Adams and Alwyn Gatt of the Fisheries Division for their assistance in collecting the field data and Ken Marks, AGRRA Data Manager for his assistance with preliminary data analysis.

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Executive Summary

This study was commissioned by Grenada Community Development Agency (GRENCODA) as part of a larger project aimed at establishing the preliminary conditions for the establishment of a proposed marine protected area (MPA) with the coastal areas adjacent to the town of Gouyave, Grenada. This study would provide an outline of the current coral reef composition and health with the area proposed for the MPA. The findings of the study will serve as the baseline of the resources within the area that would be utilized to guide the planning and management of the proposed Gouyave MPA.

The Reef Surveys were executed at 5 strategically selected coral reef sites using the Atlantic and Gulf Rapid Reef Assessment (AGRRA) protocol version 5.4. 46 different species of fish from 23 genera and 16 families were documented. Fish abundance and biomass were significantly below Eastern Caribbean for all species and functional groups (i.e. herbivores, piscivores and commercially important species). There were very little motile invertebrates (i.e. urchins, lobsters, conch and sea cucumbers) observed across all sites. A total of 22 species of corals from 15 genera and 9 families were documented during the study. Live coral cover was below the Eastern Caribbean mean of 21.7% all sites except Benago (49%). Cyanobacteria was documented at all survey sites. Crustose coralline Algae (CCA) had a mean percentage cover of 14 ± 3.2 within the study area. The Palmiste 1 and Palmiste 2 had at least 10% of the substrate covered by fleshy macroalgae.

Introduction

The German Ministry for Economic Cooperation and Development (BMZ) is supporting the Caribbean Community (CARICOM) through a €12.9 million Coastal Protection for Climate Change Adaptation in the Small Island States in the Caribbean project over the next 5 years. The Project seeks to pursue the implementation of local adaptation measures for the sustainable improvement of coastal ecosystems relevant for climate change adaptation in 4 CARICOM Countries including Grenada. The design of the Project is based on an agreement made between KfW (the German Development Bank) and the Caribbean Community Climate Change Centre (CCCCC) through the CARICOM Secretariat.

To improve adaptation to climate change, Grenada as a Small Island Developing States (SIDS) was instrumental in the establishment of the Caribbean Challenge Initiative (CCI) and pledged to protect at least 20% of its near-shore marine and coastal environment by 2020. Grenada Community Development Agency (GRENCODA) through implementation of the “Community-based Coastal Ecosystem Management for Climate Adaptation in Selected Areas of Grenada” project plans to enhance ecosystem services provided by coral reefs to reduce the effect of climate change on vulnerable coastal communities on Grenada’s west coast by:

- a. Fostering the creation of an effectively managed MPA on Grenada’s West Coast
- b. Increased Public awareness of, and Community Resilience to the adverse impact of climate change

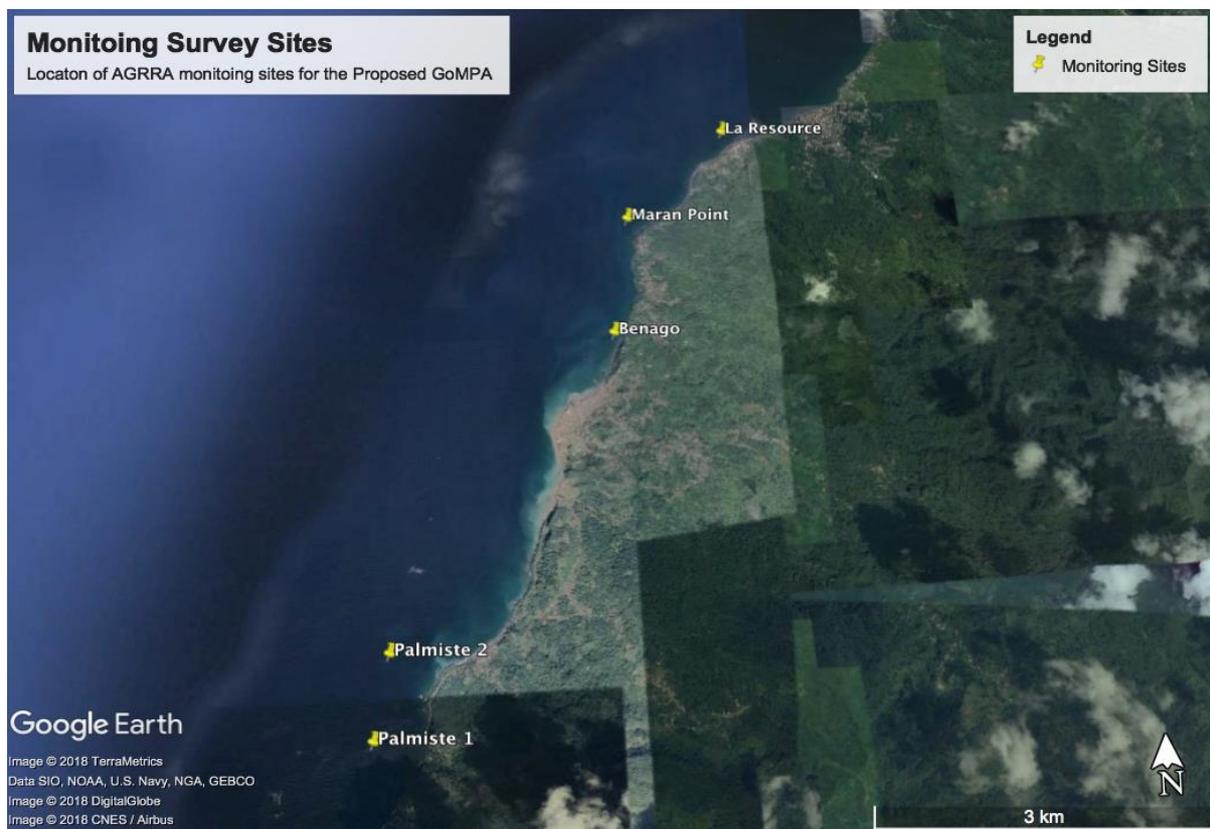
Study Objective

The objective of this study is to establish a baseline of the current coral reef ecosystem health. This baseline would form the benchmark from which all future monitoring at these sites will be compared. In order to allow for consistency with the monitoring methods that is already utilized within the Grenada Marine Protected Areas (GMPA) Program, the Atlantic and Gulf

Rapid Reef Assessment (AGRRA) protocol was selected as the monitoring method for this study. This study would focus on assessing abundance, diversity, density and biomass of key coral reef indicator species of fish, coral and mobile invertebrates at strategically selected sites within the proposed MPA. The findings of this study are intended to guide the design and planning process for the establishment of the proposed Gouyave Marine Protected Area (GoMPA).

Site Selection

The habitat map that was generated for the area was utilized to identify the location of all the major coral reef areas within the study sites. Once the coral reefs were identified, a random spot was identified within five of the coral reef areas. A GIS system was then utilized to generate the GPS coordinates for the identified sites to facilitate navigation to the exact areas.



Map 1: Location of the 5 survey sites within area proposed for the Gouyave MPA

Site Name	GPS Coordinates		Reef Type	Depth Range (m)
	Latitude	Longitude		
Palmiste 1	12° 8' 17.484" N	61° 44' 54.816" W	Bank Barrier	7.0 - 10.1
Palmiste 2	12° 8' 43.548" N	61° 44' 49.92" W	Bank Barrier	9.8 - 14.6
Benago	12° 10' 24.708" N	61° 43' 36.192" W	Fringing	3.0 - 5.8
Maran Point	12° 11' 5.712" N	61° 43' 29.64" W	Fringing	5.2 - 9.1
La Resource	12° 11' 36.888" N	61° 42' 55.584" W	Fringing	6.1 - 10.7

Table 1: GPS Coordinates, reef type and depth range of the 5 survey sites within the area proposed for the Gouyave MPA

Site Description

Five sites were selected based on the marine habitat Maps for the area to allow of a representative sample of the different reef types and to ensure that the sites were distributed across the entire area (See Figure 1 for a map showing the location of the survey sites). Given the location of the area along the Western Coast of Grenada, all of the study sites are considered leeward sites as the dominant winds blow for the North-East. The reef surveyed during this survey falls within two general reef types; that is, bank barrier reef and fringing reef.

Reef Types

Bank Barrier Reef

The two sites within Palmiste Bay (i.e. Palmiste 1 & Palmiste 2) are Bank Barrier Reef systems which are normally characterized by a reef system that is separated from shore by a shallow sandy lagoon. Typically, the bank barrier reef is located at the seaward edge of the continental shelf, beyond which the water is too deep to facilitate the growth of reef forming corals.

Fringing Coral Reef

The other three sites (Benago, Maran Point and La Resource) are Fringing Reef systems. Fringing reefs typically grow close to shore and lack a lagoon between the reef and the shoreline. Fringing reefs are the most common reef type in the Caribbean.

Methodology

Five (5) coral reef sites were surveyed between April 09th – 26th, 2018 along the major reef complexes within the proposed Gouyave Marine Protected Area using the Atlantic and Gulf Rapid Reef Assessment (AGRRA) protocol Version 5.4 (Lang et al., 2010).

Fish Survey

Ten (10) 30m long fish transects were conducted at each coral reef site on SCUBA. The AGRRA protocol requires recording the size of all indicator fish species observed within a 2m wide x 30m long transect. The 10 transects would be conducted along the similar depth contour at least 5m apart.

Benthic & Motile Invertebrates

Six (6) 10m long Benthic transects were conducted at each coral reef site on SCUBA. The Benthos Protocol requires using the point intercept method for documenting the various categories of substrata (e.g. live coral, rock, rubble etc.) and their condition at 10cm intervals (i.e. 100 points) along the 10m long transect. The benthos protocol also documents indicator species of motile invertebrates (e.g. urchins, lobsters and conch) as well as trash in a 1m wide band along the same transect. A 50cm² quadrat is centered over five of the meter segment markers along the transects and the number of coral recruits within the quadrat is recorded. The 6 transects were conducted along the similar depth contour at least 5m apart.

Coral

Two (2) 10m long coral transects was conducted at each coral reef site on SCUBA. The Coral Protocol requires recording all live stony coral $\geq 4\text{cm}$ in length within a 1m wide (i.e. 50cm on either side of transect line) x 10m long transect. The length, width, height and health (i.e. presence and percentage of bleaching or disease) of each live coral within the transect is recorded. The 6 transects was conducted along the similar depth contour at least 5m apart.

Results

Motile Invertebrates

Benago was the only site where *Diadema antillarum* was recorded with a density of (mean \pm standard deviation) 0.02 ± 0.04 (individuals/m²); the other four sites did not have any diadema along the transects. There were other urchins recorded at all survey sites in densities ranging from 0.02 ± 0.04 at Palmiste 2 to 0.08 ± 0.10 at Benago and Maran Point. Maran Point was the only site where lobsters were observed at a density of 0.02 ± 0.04 . There were no conch or sea cucumbers observed along the transect at any of the survey sites.

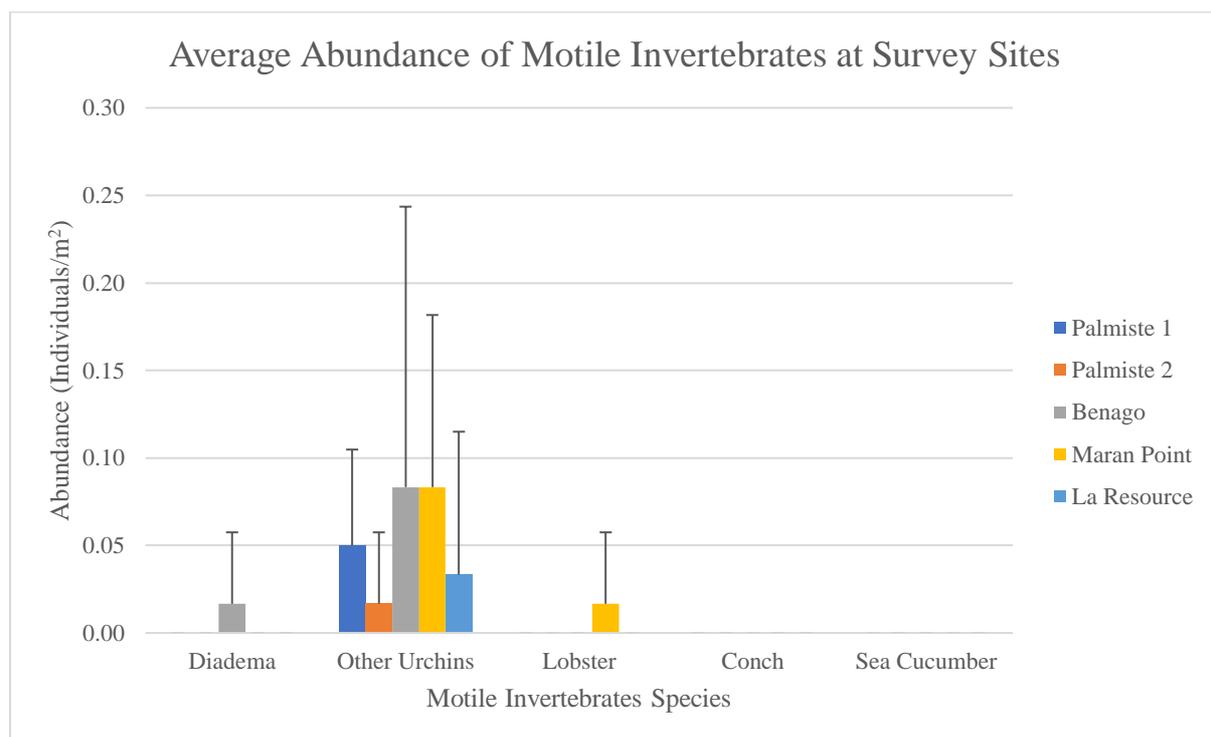


Figure 1: Abundance of motile invertebrates at 5 coral reef sites within the area of the proposed Gouyave MPA. The error bars represents the standard deviation about the mean abundance for each of the indicator species.

Fish

A total of 46 different species of fish from 23 genera and 16 families was documented along the transects at the 5 survey sites. The most abundant fish species observed were Parrotfish (32%), Grunt (18), Surgeonfish (12%), Wrasse (11%), Snapper (9%), Grouper (6%) (See Figure 2). The mean length of commercially important fish species range was grouper 5.3 –

7.5 cm; grunt 2.5 – 5.8 cm; parrotfish 4.0 – 6.7cm; snapper 7.0 – 11.0cm and surgeonfish 3.0 – 6.8cm.

Total fish biomass ranged from 74 ± 116 (grams/100m²) at Benago to 441 ± 362 at Palmiste 1. Herbivore fish biomass ranged from 28 at Maran Point to 197 at Palmiste 1. Invertivore fish biomass ranged from 27 at Benago to 215 at Palmiste 1. Piscivore fish biomass ranged from 12 at Benago to 82 at Palmiste 2. Commercially important fish biomass ranged from 2 at Benago to 104 at Palmiste 1. Diadema (urchin) predating fish biomass ranged from 4 at Benago to 55 at Palmiste 1.

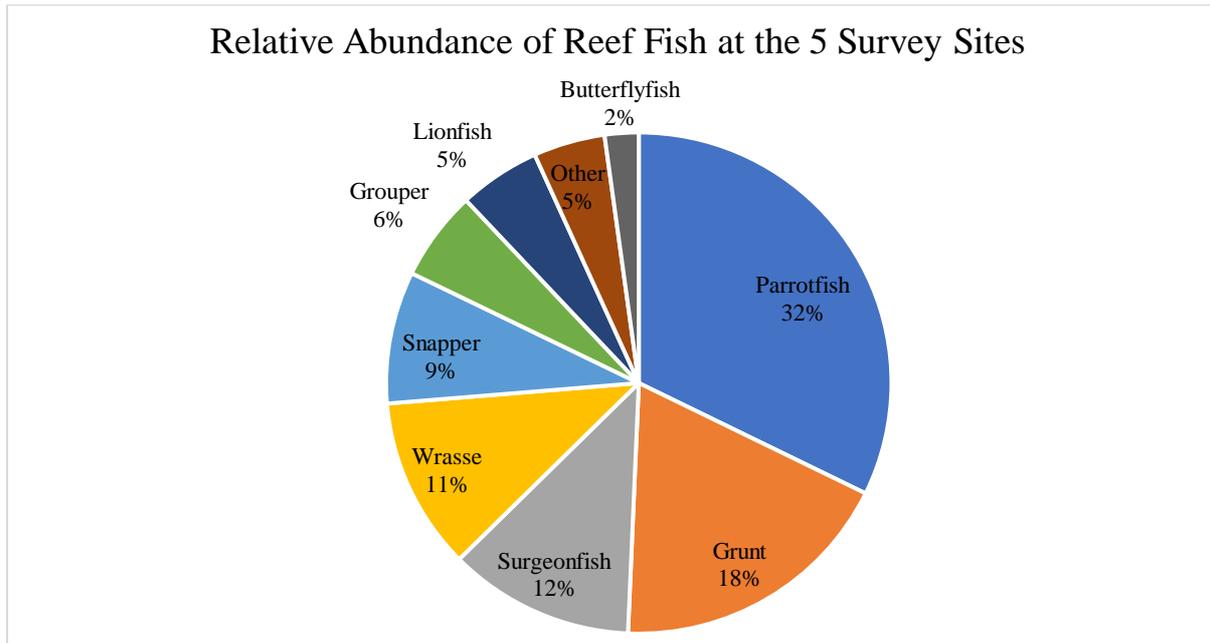


Figure 2: Chart showing the relative abundance of the major reef fish families across the 5 survey sites within the area proposed for the Gouyave MPA.

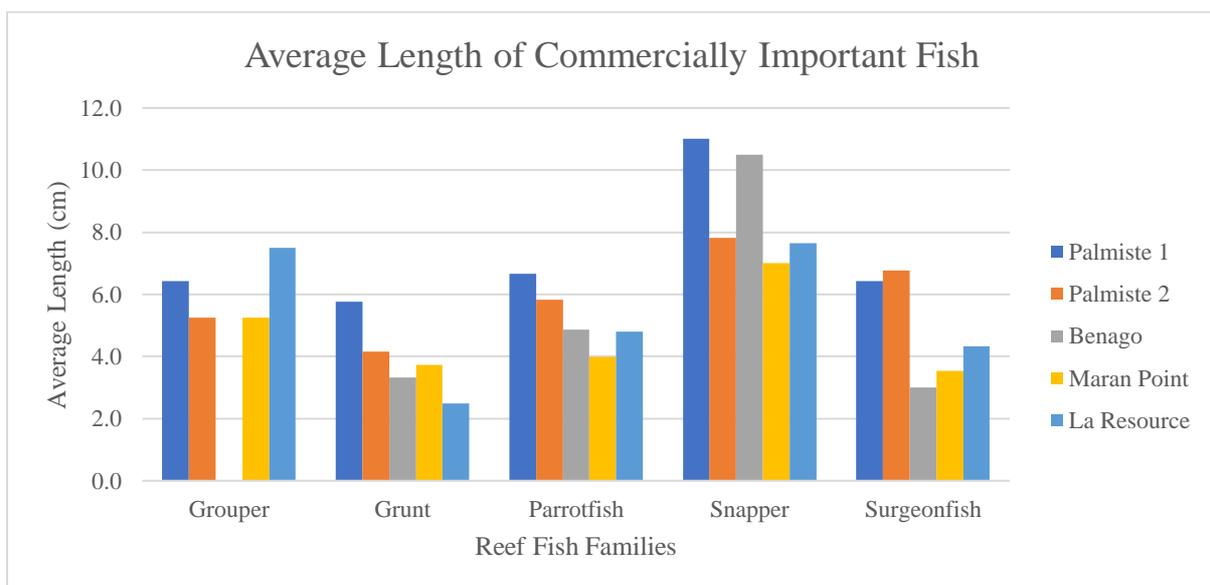


Figure 3: Mean length (cm) of commercially important reef fish families across the 5 survey sites within the area proposed for the Gouyave MPA.

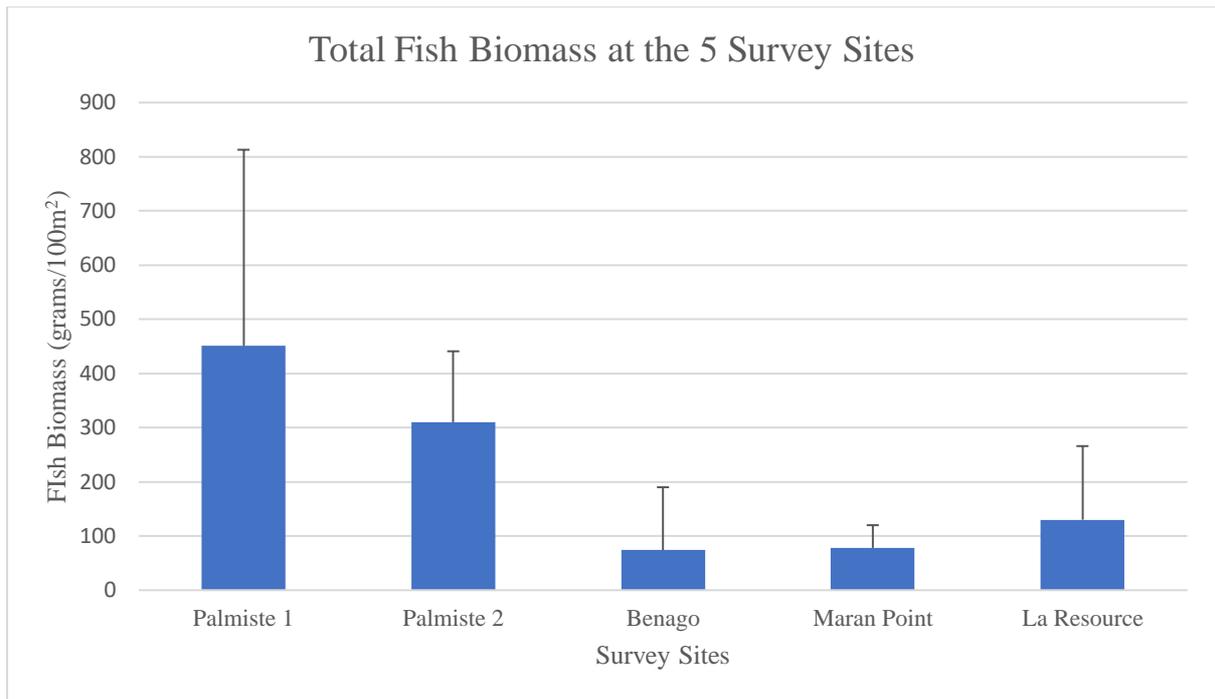


Figure 4: Total biomass (grams/100m²) of reef fish at each of the 5 survey sites within the area proposed for the Gouyave MPA

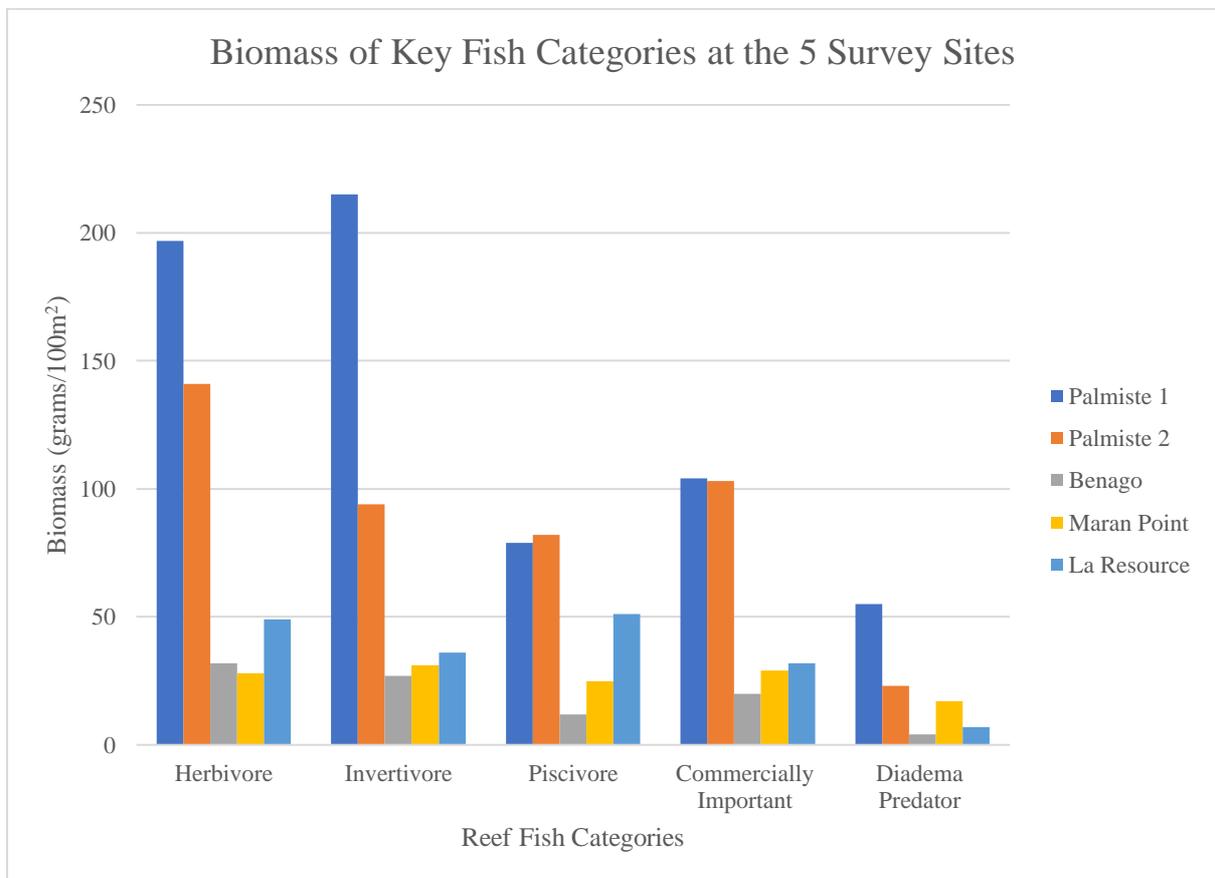


Figure 5: Biomass (grams/100m²) of key reef fish categories across the 5 survey sites within the area proposed for the Gouyave MPA.

Benthic Composition

Although the composition of algae varied drastically across the 5 survey sites, the algae cover at all sites were dominated by the beneficial algae categories (i.e. crustose algae and tuff algae). Tuff algae was the most dominant algae category at all survey sites representing 23%, 18%, 27%, 49% and 42% at Palmiste 1, Palmiste 2, Benago, Maran Point and La Resources respectively. Crustose algae were the second most abundant algae at Benago, La Resources and Maran Point as appose to fleshy macroalgae at Palmiste 1 and Palmiste 2. Fleshy macroalgae represent <1% at Benago, Maran Point and La Resource survey sites. Calcareous macroalgae represented <1% across all survey sites.

All of the survey sites except Palmiste 1 are coral dominated reefs, where the percent coral cover is more than the percent flesh macroalgae cover (See figure X). At Palmiste 1 survey site, fleshy macroalgae cover is 17% ± 6% as oppose to 16% ± 9% live coral cover.

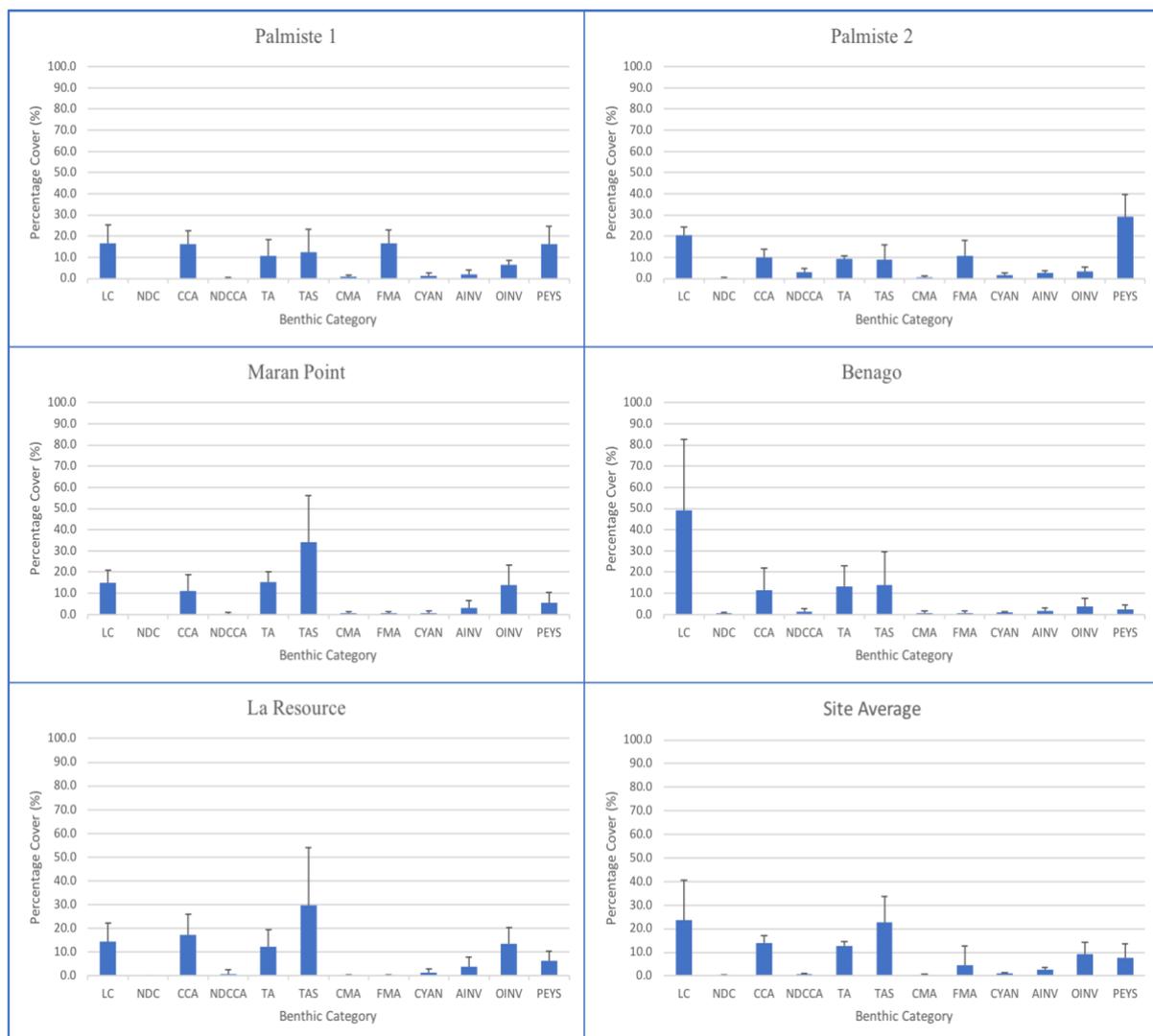


Figure 6: Mean Composition of Benthic Categories within the five individual survey sites along with a summary of all sites within the area proposed for the Gouyave MPA

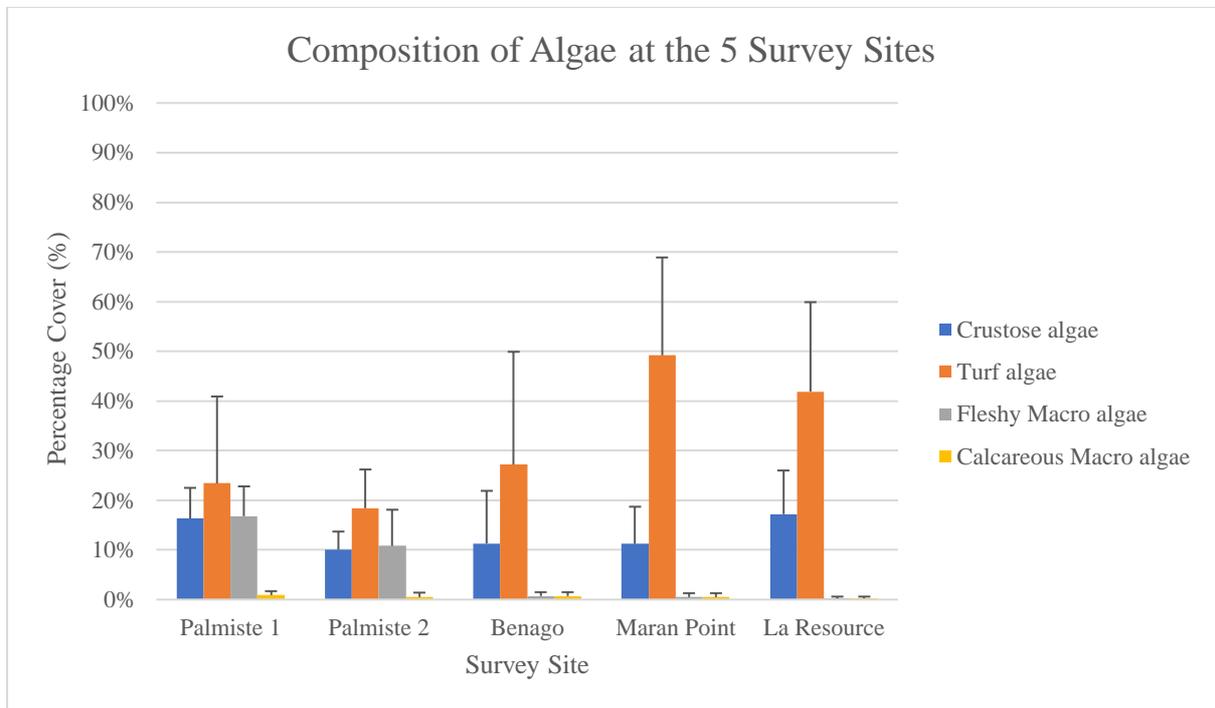


Figure 7: Percentage cover of algae across the 5 survey sites within the area proposed for the Gouyave MPA. Crustose, Tuff and Calcareous macroalgae are positive reef health indicators; while, fleshy macroalgae is an indicator negative reef health.

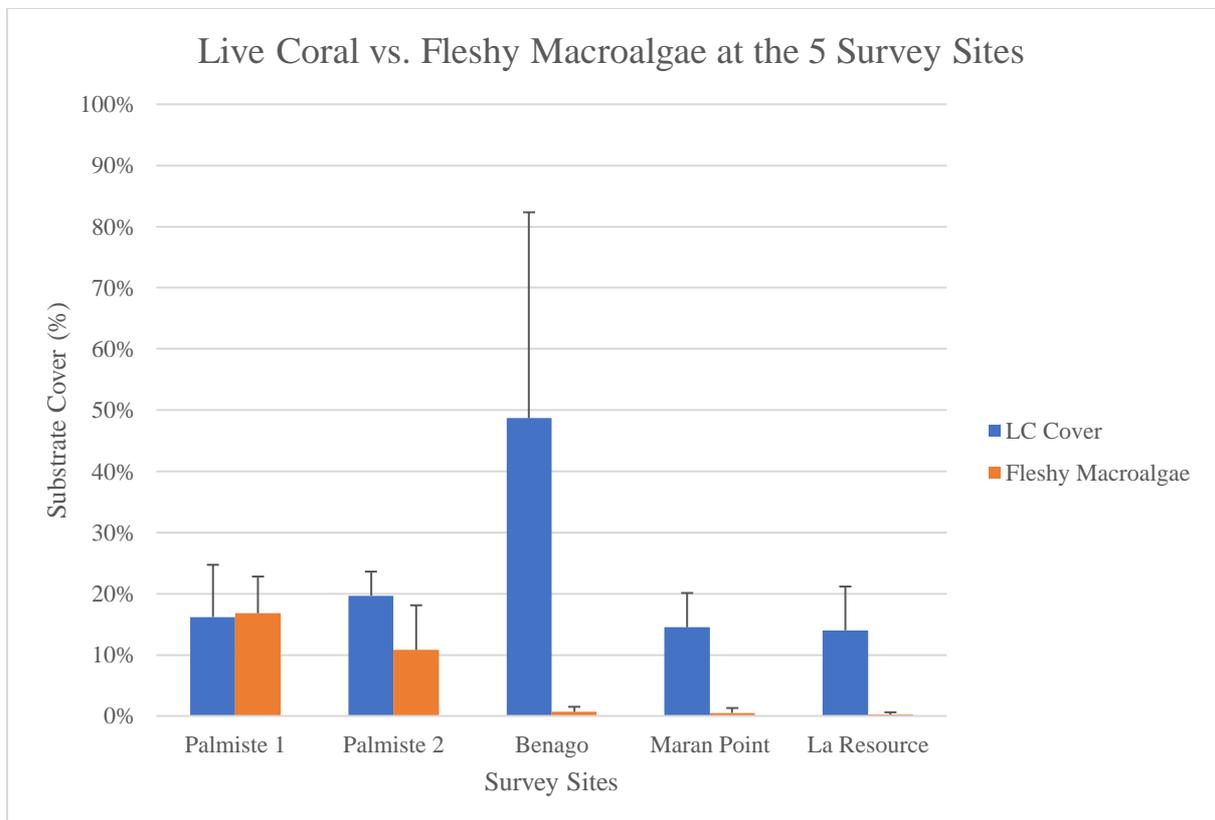


Figure 8: Comparison of percentage cover of fleshy macroalgae cover and live hard coral cover at the 5 survey sites within the area proposed for the Gouyave MPA

Coral

A total of 22 different species of corals from 15 genera and 9 families was observed across the 5 survey sites. A total of 625 colonies of corals were document across the 5 survey sites within the study area (see figure 8 for the distribution across the sites). Coral Density of 4cm corals ranged from 41 (colonies/10m²) at Palmiste 1 to 88 at Palmiste 2. Similarly, the density of 10cm corals ranged from 37 in Palmiste 1 to 84 at Palmiste 2. Coral recruits for survey sites ranged from 0.5 (individuals/m²) at Benago to 9.6 at La Resources (see figure 10).

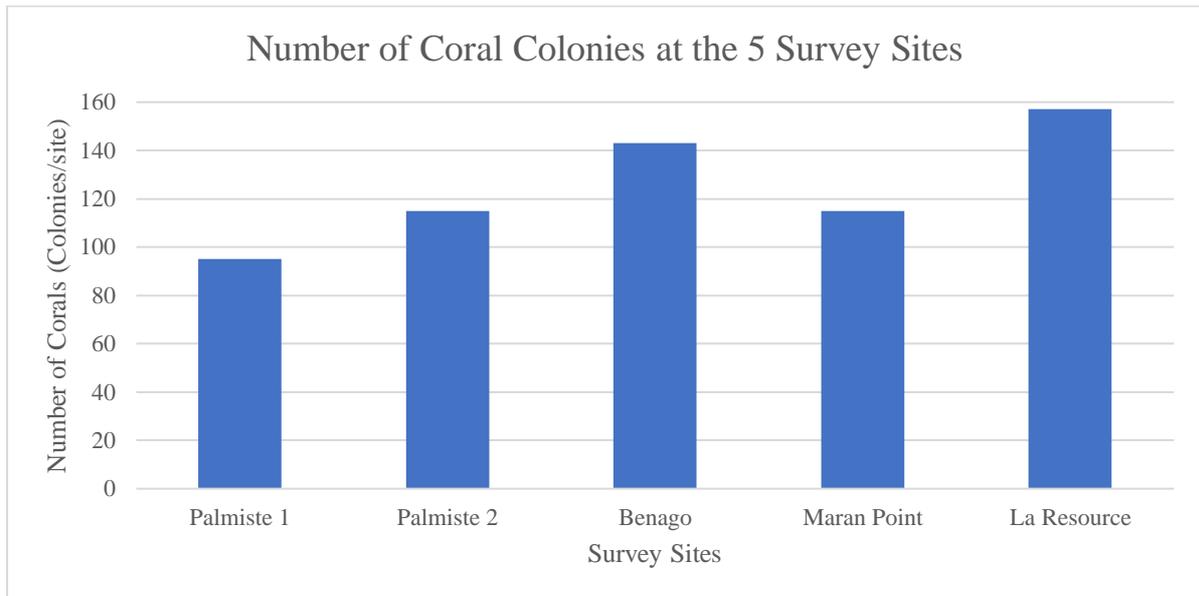


Figure 9: Number of coral colonies observed at each of the 5 survey sites within the area proposed for the Gouyave MPA.

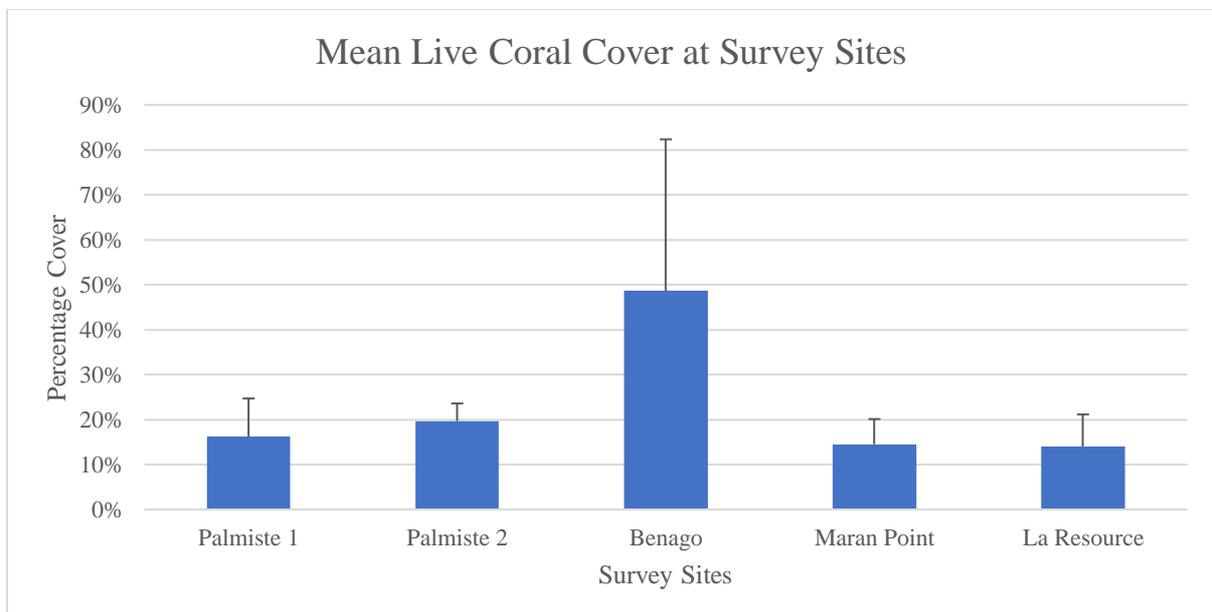


Figure 10: Mean percentage live coral cover at each of the 5 survey sites within the area proposed for the Gouyave MPA.

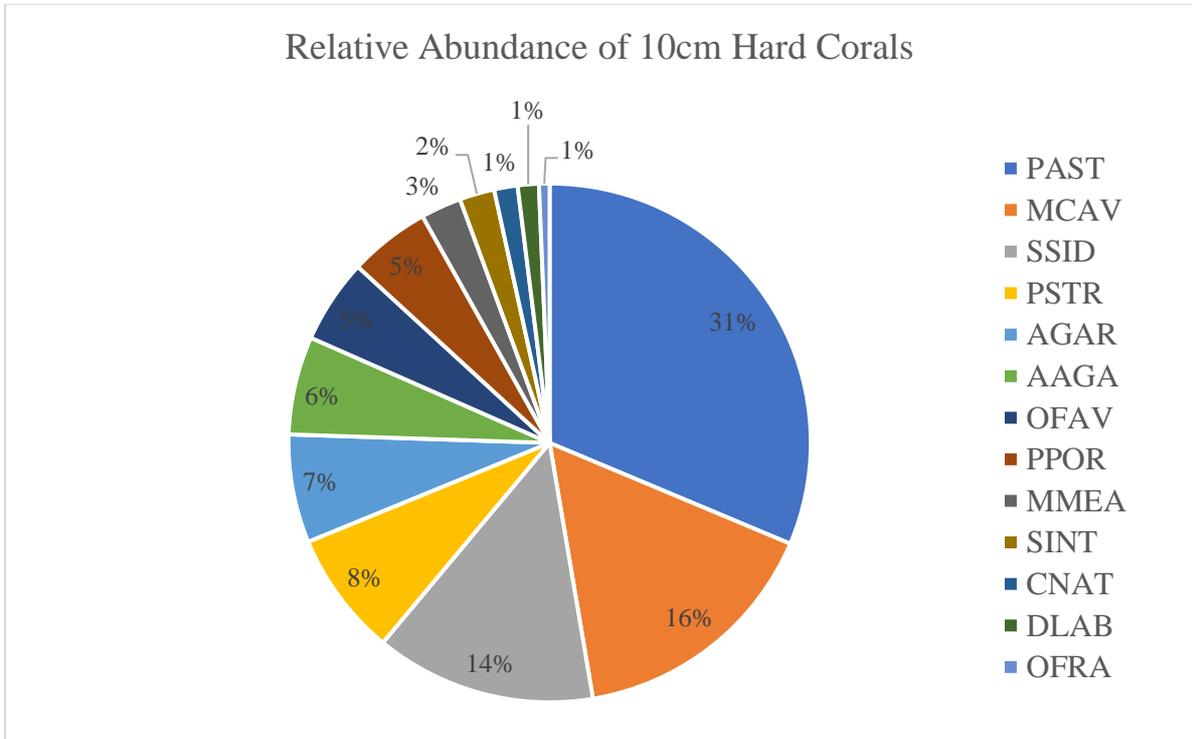


Figure 11: Relative abundance of 10cm coral within the area proposed for the Gouyave MPA. Coral species are as follows: PAST: *Porites astreoides*; MCAV: *Montastraea cavernosa*; SSID: *Siderastrea siderea*; PSTR: *Pseudodiploria strigose*; AGAR: *Agaricia sp.*; AAGA: *Agaricia agaricites*; OFAV: *Orbicella faveolata*; PPOR: *Porites porites*; MMEA: *Meandrina meandrites*; SINT: *Stephanocoenia intersepta*; CNAT: *Colpophyllia natans*; DLAB: *Diploria labyrinthiformis*; PCLI: *Pseudodiploria clivosa*.

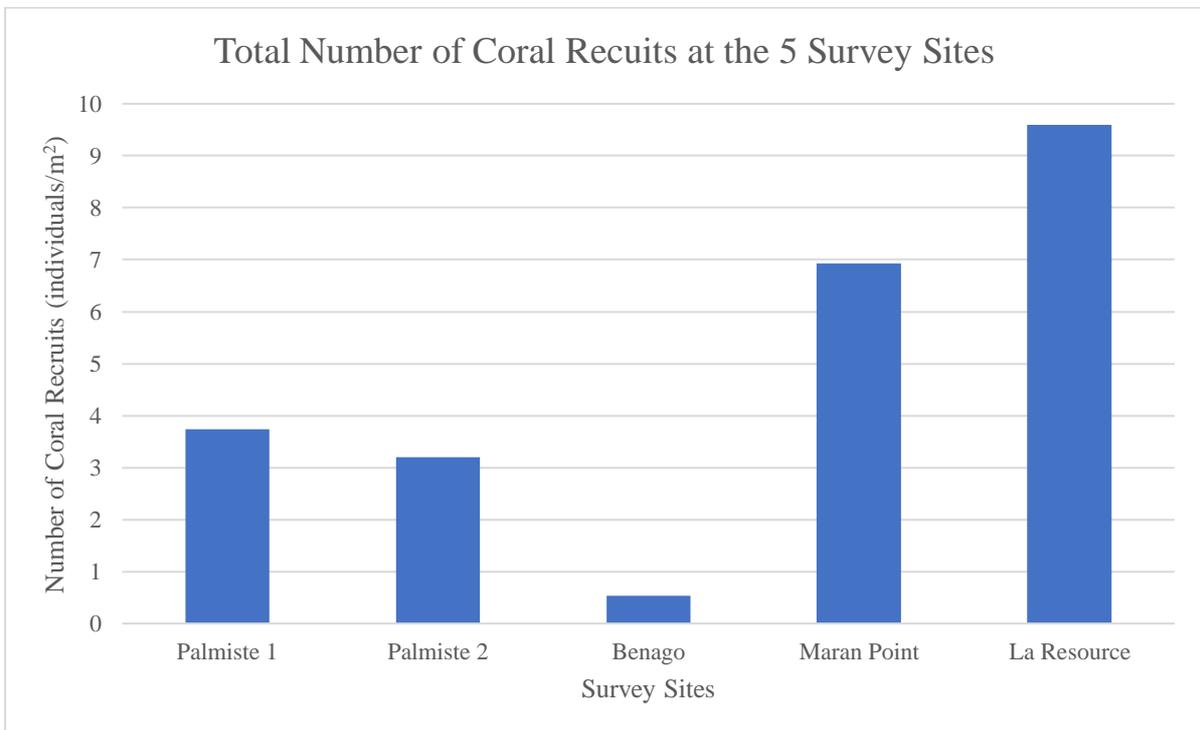


Figure 12: Total number (individuals/m²) of coral recruits observed at each of the 5 survey sites within the area proposed for the Gouyave MPA.

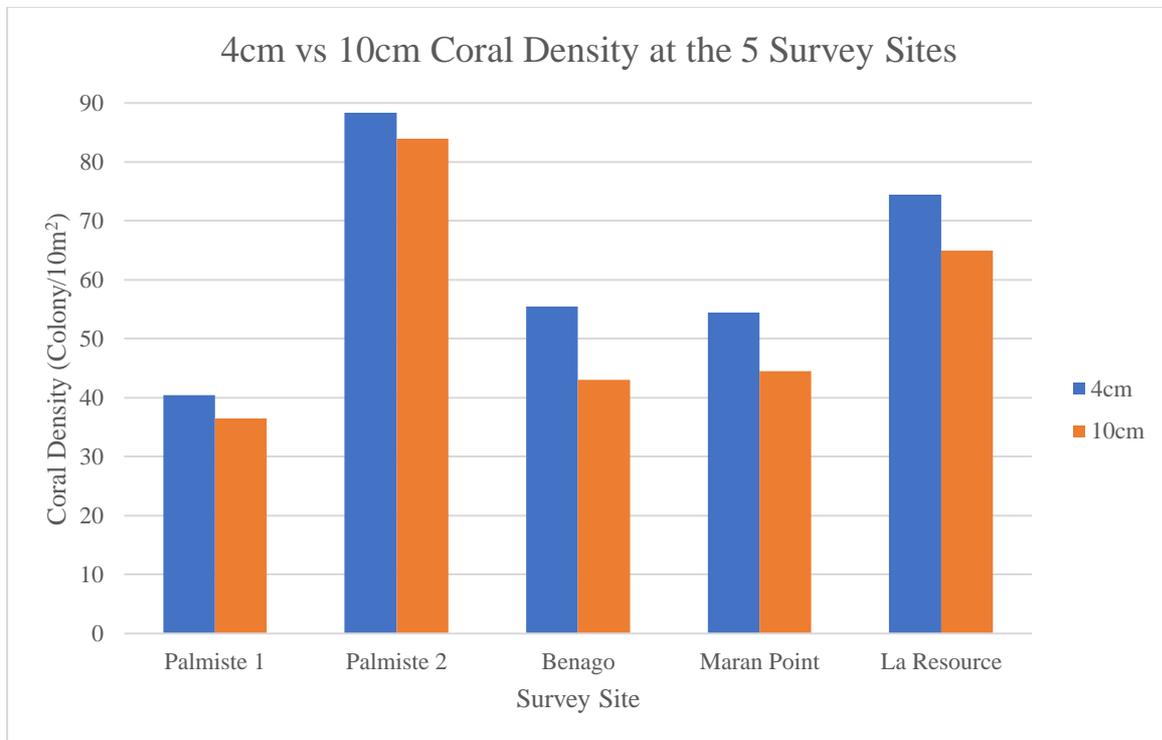


Figure 13: Mean Density (colonies/10m²) of 4cm & 10cm corals across the 5 survey sites within the area proposed for the Gouyave MPA.

Discussion and Recommendations

Motile Invertebrates

The abundance of urchins especially diadema (long spin black sea urchin), was critically low (i.e. <math><0.10</math> individuals/m²) across all sites. Only one site (i.e. Benago) had diadema recorded within the transects at an abundance of 0.02 individuals/m² compared to the Eastern Caribbean average of 1.4 individuals/m². This is an issue of significant concern as urchin play a critically important role as they work in collaboration with herbivorous fish to helping to manage the macro-algal population on the reef. Diadema populations were decimated due to disease during the mid 1980s and have slow to return to some reefs; therefore, other urchins (i.e. *Tripneustes sp.*, *Echinometra sp.*, & *Eucidaris sp.*) has filled the niche that have been left vacant by the diadema. Given the low abundance of urchins of the reefs within the study area, efforts should be made to reduce or eliminate removal of any species of urchins on these reefs so as the enhance stock and ensure that the ecological function they carry-out is fulfilled.

There was also low abundance of the other motile invertebrate indicator species (i.e. spiny lobster, queen conch & sea cucumber). Spiny Lobsters and Queen Conch are selected as indicator species as they are highly prices commodities on both the domestic and exported markets; consequently, there is a potential for overexploitation of these species. Given the low abundance of the three mobile invertebrate indicator species within the surveyed reefs, the extraction of these resources should be prohibited so as to maintain and enhance their abundance.

Reef Fish

Entire Population

46 species of reef fish from 23 genera and 16 families were document across the five study sites. The overall biomass was relatively low at all sites; despites, the relatively high abundance at the sites. This can be attributed to the fact that most of the fish that were observes were <15cm in total length. The fish species diversity was relatively high across all the survey sites. In order to increase fish biomass at these sites measure must be put in place to reduce fishing pressure

Herbivorous fish

The biomass of herbivorous fish (i.e. parrotfish & surgeonfish) was significantly different across the five survey sites ranging from 28 at Maran Point to 197 at Palmiste 1 (g/100m²). Despites the variability across the sites, the highest recorded value at Palmiste 1 (197 g/100m²) is drastically lower that the mean Eastern Caribbean herbivorous fish biomass of 1506 grams/100m². The low fish herbivore biomass across all the sites is having a significant negative impact of the level of macroalgae on the reefs. This is a particular area for concern given the relatively low density of diadema and other urchins on the reefs. These two function groups (i.e. urchins & herbivorous fish) work together to maintain the algal balance of reefs. Measures should be put in place to reduce the fishing pressure on herbivorous fish by instituting a moratorium of these species and/or a size limit.

Commercially Important Fish

The two highest biomass of commercially important reef fish species (i.e. snapper, grouper, grunts, jacks, etc.) of 104 and 103 g/100m²was recorded at Palmiste 1 & Palmiste 2 survey sites respectively. Similar to the herbivore biomass, the biomass of the highest commercially important species if drastically below the 1208 g/100m² mean biomass for commercially important reef fish species in the Eastern Caribbean. The mean length of commercially important fish species within area is 5.6 cm. The low biomass and short length of commercially important reef fish species indicates that the populations of commercially important fish can no longer sustainable sustain a fishery. The capture of the commercially important reef fish of the survey reefs should be discontinued until the biomass and size classes of fish at these sites can once again facilitate sustainable fisheries.

Benthos

Crustose Coralline Algae (CCA) represented a mean percentage cover of 14 ± 3.2 (%) of the benthic substrate across the five study sites. High CCA cover is typically a good feature on coral reefs as they play an important role in facilitating recruitment to the reef. An increase in CCA on the reefs would most likely help to increase coral recruitment across all sites.

Cyanobacteria (CYAN) is a type of blue-green algae that typically indicates that a land-based source of pollution negatively affecting the water quality at that site. This study noted that there was CYAN present at all of the sites at an overall mean percentage cover of 1 ± 0.3 (%) at each site. This is an issue for concern given that the area is being considered for an MPA. Water Quality testing (i.e. nutrient & microbiological) should be conducted to determine exactly what the cause of the water quality issue. A pollution hotspot analysis in the watershed(s) impacting the site should also be conducted to identify the source of the pollution problem.

Fleshy macroalgae represented at least 10% at two of the survey sites (i.e. Palmiste 1 & Palmiste 2). Although macroalgae is a normal constituent on all reefs, the proliferation of macroalgae can result in them outcompeting with corals for reef space and changing the overall structure of the reef from a coral dominated reef to an algae-dominated reef as is the case of the Palmiste 1 site. This phase shift to an algae-dominated reef is an issue of major concern as the algae not only competes with established coral colonies, it also prevents the recruitment of juvenile corals. There are two main factors that affect the proliferation of macroalgae on coral reefs, high nutrient level in the water and abundance/biomass of herbivores on the reef. The more nutrients (i.e. nitrates & phosphates) that's available in the water, the more and faster macroalgae grow; therefore, efforts should be made to reduce the amount of nutrients entering the marine environment from all sources (i.e. river, drains or sewer outfalls). There are two general categories (i.e. croppers & grazers) of herbivores on the reef that consume macroalgae as their primary food source. The croppers consist primarily of the fish species (i.e. parrotfish & surgeonfish) which bite off the bulk of the macroalgae leaving mostly the holdfast. The grazers consist primarily of the urchins which remove the rest of the macroalgae that is cropped by the fish. It is important to note that a healthy reef requires a balance between macroalgae and herbivores as a proliferation in any functional group on the reef could have detrimental results for the reef ecosystem.

Coral

There is approximately 60 different coral species within the AGRRA database; however, only 33 species have been documented in Grenadian waters. Species diversity is relatively low across all sites; given the fact that a total of 22 species from 15 genera and 9 families were documented. Live coral cover is below the Eastern Caribbean mean of 21.7 at all of the survey sites except Benago. Despite the relatively high (49%) live coral cover at the Benago site, the vast majority of the coral at that site was a single species. The low coral diversity can have significant negative implications for the resilience of the reefs. Low species diversity could mean that the corals are less likely to recover following a catastrophic event (i.e. tropical cyclone) or less likely to adapt to the projected impacts of climate change (e.g. elevated sea surface temperature, sea level rise or ocean acidification). Where appropriate, efforts should be made to increase species diversity through coral out-planting from coral nursery.

References

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