A MANAGEMENT PLAN FOR THE MARINE BUFFER ZONE OF THE SARSTOON-TEMASH NATIONAL PARK:

THE SARSTOON-TEMASH MARINE MANAGEMENT AREA (STMMA)

IN THE SOUTHERN COASTAL ZONE OF BELIZE

Prepared for
The Sarstoon Temash Institute for Indigenous Management
SATIIM

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Management Plan for the Sarstoon-Temash Marine Management Area

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1.0 INTRODUCTION

1.1 Background and Context

The Sarstoon-Temash National Park, the southernmost terrestrial protected area of Belize is buffered by an extensive coastal area which feeds into the Gulf of Honduras. The Sarstoon Temash Institute of Indigenous Management (SATIIM) has been appointed by the Government of Belize to co-manage this National Park. The coastal area that is immediately adjacent to the National Park is referred to as the Sarstoon-Temash Marine Management Area. In planning and preparations for the on site management of the Sarstoon-Temash National Park, SATIIM saw the need to offset the influence of terrestrial activities through the identification of a marine buffer zone. While the SATIIM's strategic management initiatives have been focused mostly on terrestrial issues, it has been recognized that equal importance and attention must be placed on initiatives to address the marine management concerns. This is critical in ensuring the viability of the integrity of the national park and its buffering marine resources.

The National Park has an extensive coastal component encompassing the entire coast from the Sarstoon River to just north of the Temash River. In considering buffer zones this also extends as far as the Moho River. The seaward extent of the marine buffer zone is limited by the close alignment of the boundary between Belizean and Guatemalan waters although fishing activities extend beyond Belize's territorial waters. There is hardly any technical or scientific research data available on marine resources, oceanography, sediment transport and fisheries in the area.

Through support from the Oak Foundation a stakeholder meeting was held in Barranco in 2002 to discuss the coastal issues in the surrounding marine environment, the relevant mechanisms to resolve the identified issues in managing a buffer area. Through these discussions, SATIIM developed the concept of creating a community managed marine buffer area to compliment the terrestrial park and ensure land-sea connectivity and comprehensive management. Participants at the workshop included local stakeholders such as fishers and NGOs, various government agencies such as Fisheries and CZMAI, national university and regional projects such as the Mesoamerican Biological Corridors project, the Mesoamerican Barrier Reef System project.

There were several main issues identified through the workshop. These included over-fishing (including extensive gill net setting); the depletion of marine species and habitat damage from shrimp trawling; disruption of the food chain leading to abnormal migrations; different fishing practices and culture between Belizean and Guatemalan fishers, with Guatemalan fishers being more aggressive and prolific; the issue of Guatemalan fishers having access to Belizean fishing licenses; decline in the coastal community of Barranco through out-migration; the difference in regulatory and investment systems between Belize and Guatemala; inadequate enforcement of existing regulations in both countries; poor coordination between relevant monitoring and regulatory agencies; and the lack of tourism development in the area, although identified as high potential.

The major conclusions from these discussions were that there was a high degree of competition over diminishing marine resources, resentment and frustration towards the Guatemalan fishers in what was seen as an unfair advantage and lack of any government or management direction for these issues. Based on this feedback from stakeholders and relevant agencies involved in marine resource management, SATIIM through its co-management role in the immediate region, decided to re-establish a meaningful degree of consensus on the exploitation of the local fisheries through the development of a coastal resource management strategy and a Fisheries Management Plan.

1.2 Purpose and Scope

Following on the principles of sustainable and locally determined resource use and community development, and from the outcomes of the workshop, SATIIM developed a coastal policy statement which focused on the need for management of the area rather than 'formal protection'. The key principle to this strategy is that the management framework should be based on maximized community and stakeholder participation to ensure that such a strategy has the consensus and support of the local community that depend on these resources.

The overall purpose of this management plan is to establish a comprehensive strategy for the management and conservation of fisheries resources in southern waters of Belize between the Moho and Sarstoon Rivers, by establishing a Special Marine Management Area that provides a participatory and dynamic framework and promotes the active stewardship of the coastal marine resources bordering the Sarstoon-Temash National Park. The aim is to achieve this through facilitation by SATIIM with the active inclusion of all stakeholders.

The main objectives of the initiative are to: develop and implement a fisheries and marine management plan in partnership with the relevant government agencies and other key stakeholders, through the application of scientific research and the active engagement of local communities; and to act as a demonstration model for future community and stakeholder based fisheries/coastal management initiatives in the region.

Currently, there are no provisions for Fisheries Management Plans, although the proposed Fisheries Development Authority Bill contained provisions for 'fishery management areas' and the Fisheries Department is planning the development of a National Fisheries Management Plan to guide the management of the Belize Fishing Industry. The proposed provisions included: the designation of zones of activity, closed seasons, specification of species that may or may not be captured, restrictions on the methods of fishing, the number of fishing licenses that can be issued, catch quotas, limitations on access to areas, and the establishment of guidelines and procedures for fishing. These provisions while not formally adopted provide significant opportunity for guidance in addressing the current issues in the Sarstoon-Temash Marine Management Area.

1.3 Management Framework

The management plan shall form a part of the Fisheries Management Plan being developed by the Fisheries Department. Therefore it is critical that the plan be developed in collaboration with the Department to ensure compatibility and endorsement with regards to the objectives and fisheries management strategies. The plan should also complement the Southern Cayes Development Guidelines prepared by CZMAI for the southern coastal region of Belize. The plan shall serve as a model for community management of marine resources for areas that are not under protection but would benefit from sustainable management and use.

1.4 Special Marine Management Area

The area is classified as a Special Marine Management Area, as it is not a designated Marine Protected Area by law and SATIIM intends to sustainably manage the resources in conjunction with support from the local community. This referral to the area as a Special Marine Management Area enables SATIIM to take a comprehensive approach in addressing both fishery management and resource management issues primarily those that are ecosystem and watershed related. In adopting such a strategy the Sarstoon-Temash Marine Management Area will function effectively as a marine buffer zone for the National Park.

2.0 GENERAL INFORMATION

2.1 Location and Boundaries

The Sarstoon-Temash Marine Management Area is located in the southern coastal region of Belize adjacent to the Sarstoon-Temash National Park. It forms a part of the Gulf of Honduras (Figure 1) and is exposed to oceanographic and land based influences from neighboring Guatemala and Honduras. The area of concern is in relation to the Sarstoon-Temash National Park marine buffer zone and extends from Legagu Creek near Barranco to the Sarstoon River, on the border with Guatemala. Its seaward limit is demarcated by the three mile territorial sea limit of Belize as outlined in the Maritime Areas Act 1992 (Appendix 1) (Figure 2). This area covers approximately 40.26 km^2.

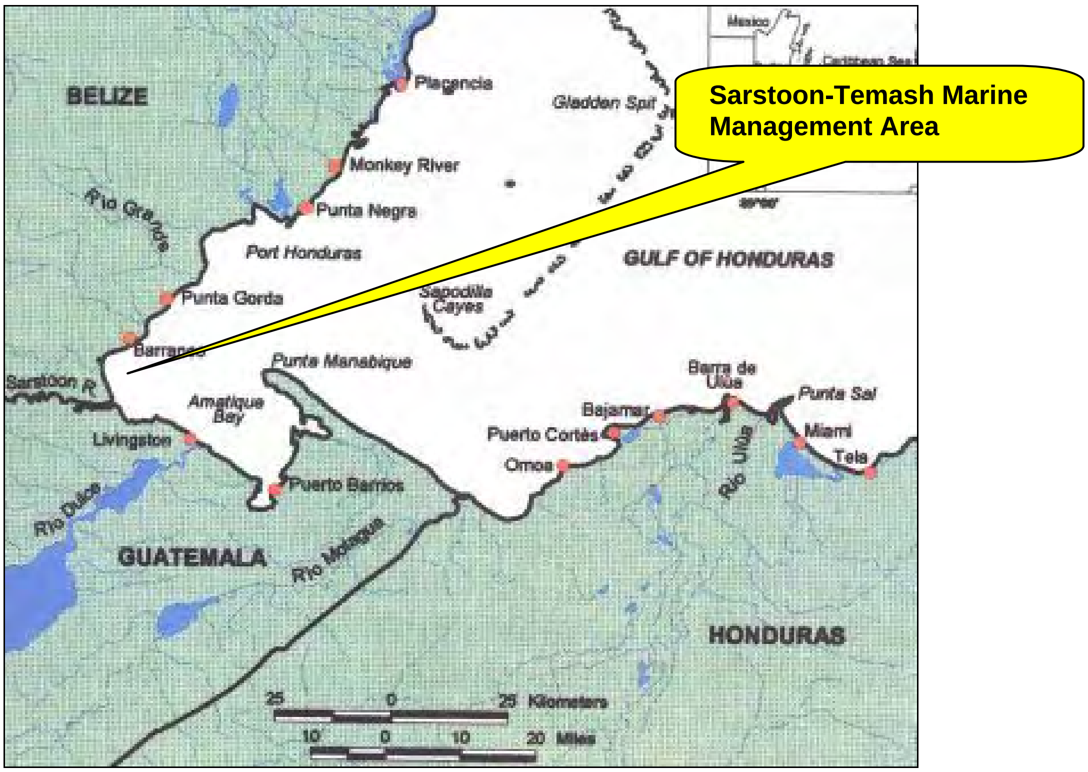


Figure 1

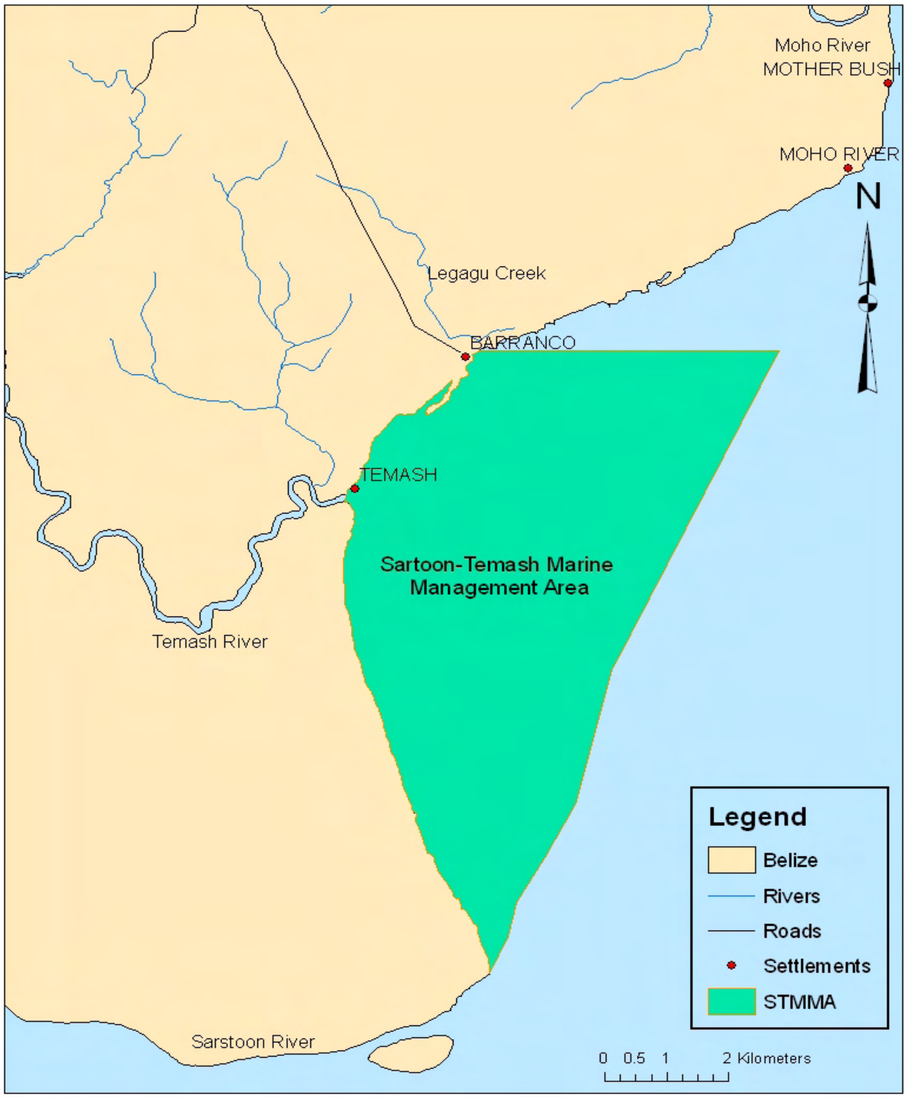


Figure 2

2.2 Access

The area is accessed by boats and other marine vessels from the southern Belizean waters. It is also easily accessed by sea faring vessels, usually fishing interests coming across the Gulf of Honduras from Livingston, Bahia de Amatique and Sarstoon. The area is not regularly patrolled by the Belizean marine authorities, primarily the Belize Defense Force and Fisheries Department. This often results in regular illegal fishing incursions and reports of occurrences of illicit drug activity in the area. Land access to the marine area is non-existent as the terrestrial area falls within the Sarstoon-Temash National Park and is devoid of any major population centers (except for the few tiny fishing settlements on the coast) and development. Hence there are no roads or associated infrastructure to access the coast from the land.

2.3 Public Use

The area is largely used by local fishermen plying their daily livelihood in the area. The area is also accessed by other foreign nationals, mainly Guatemalans who come across to conduct illegal fishing in the area. It is also used as a transit point from Sarstoon to the Temash and on to Punta Gorda by recreational fishers, tour guides and protected area staff from Sarstoon-Temash National Park, Port Honduras Marine Reserve and Punta Gorda. There is no general public recreational use of the area since it lacks beaches or attractions for swimming and snorkeling.

2.4 Sea Tenure

The entire marine area within the identified boundaries of the STMMA is the sovereign waters of Belize and belongs to the Belizean people. As such all the marine area is accessible by any and all of the general Belizean public. In the past there existed controversy over certain maritime areas in southern Belize, with Guatemala claiming portions for their maritime access. This lead the Government of Belize to delimit the majority of the original 12 mile territorial sea limit in 1992 from Sarstoon up to Ranguana Caye to placate Guatemala and improve diplomatic relations. This resulted in Belize's territorial sea shrinking from a 12 mile to 3 mile seaward limit from the mean high water mark in the area identified. (Figure 3)

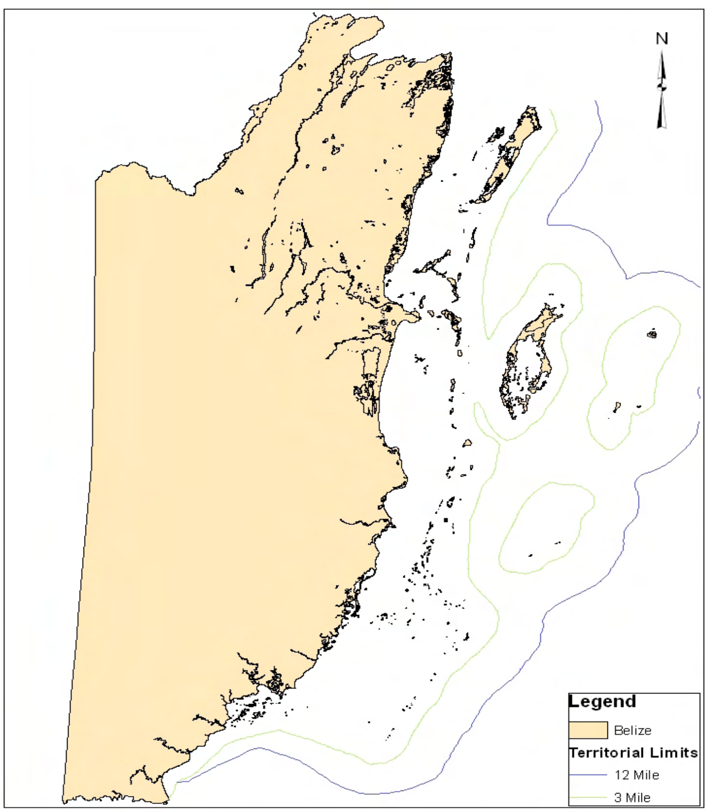


Figure 3

2.5 Maps and Satellite Imagery

Maps of the area show the overall boundary for the Sarstoon-Temash Marine Management Area (STMMA) marine buffer. In addition there are maps that indicate the general marine habitat type and distribution in Belize's southern coastal zone, based on the CZMAI Habitat Map (CZMAI 1998), population sites, major rivers and the area in relation to Sarstoon-Temash National Park. Maps have been obtained from previous reports, particularly the draft Sarstoon-Temash Park Management Plan and others created, such as the STMMA boundary map maps. A satellite image if the area adopted from the Draft Sarstoon-Temash National Park Management Plan (Herrera 2004) is used to illustrate the STMMA in relation to the National Park (Figure 4). Figure 5 illustrates the general marine habitat distribution in the area, showing varying density of seagrass beds.

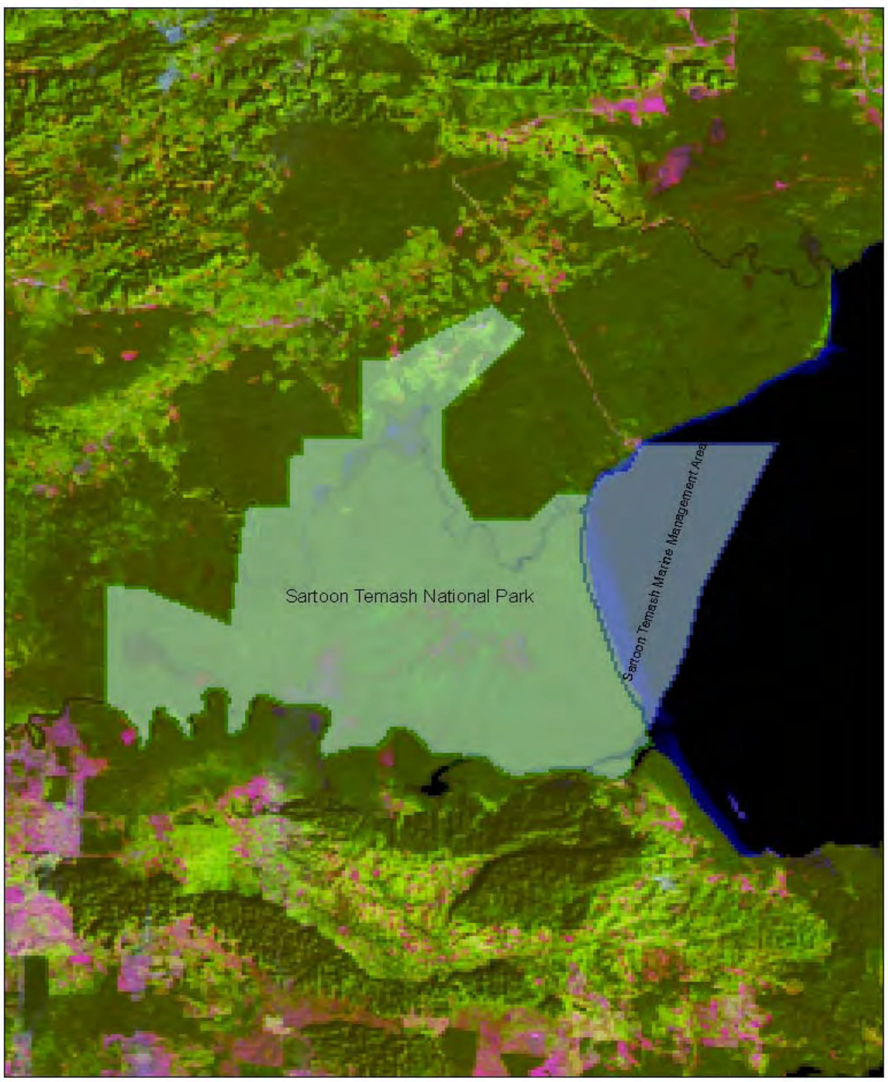
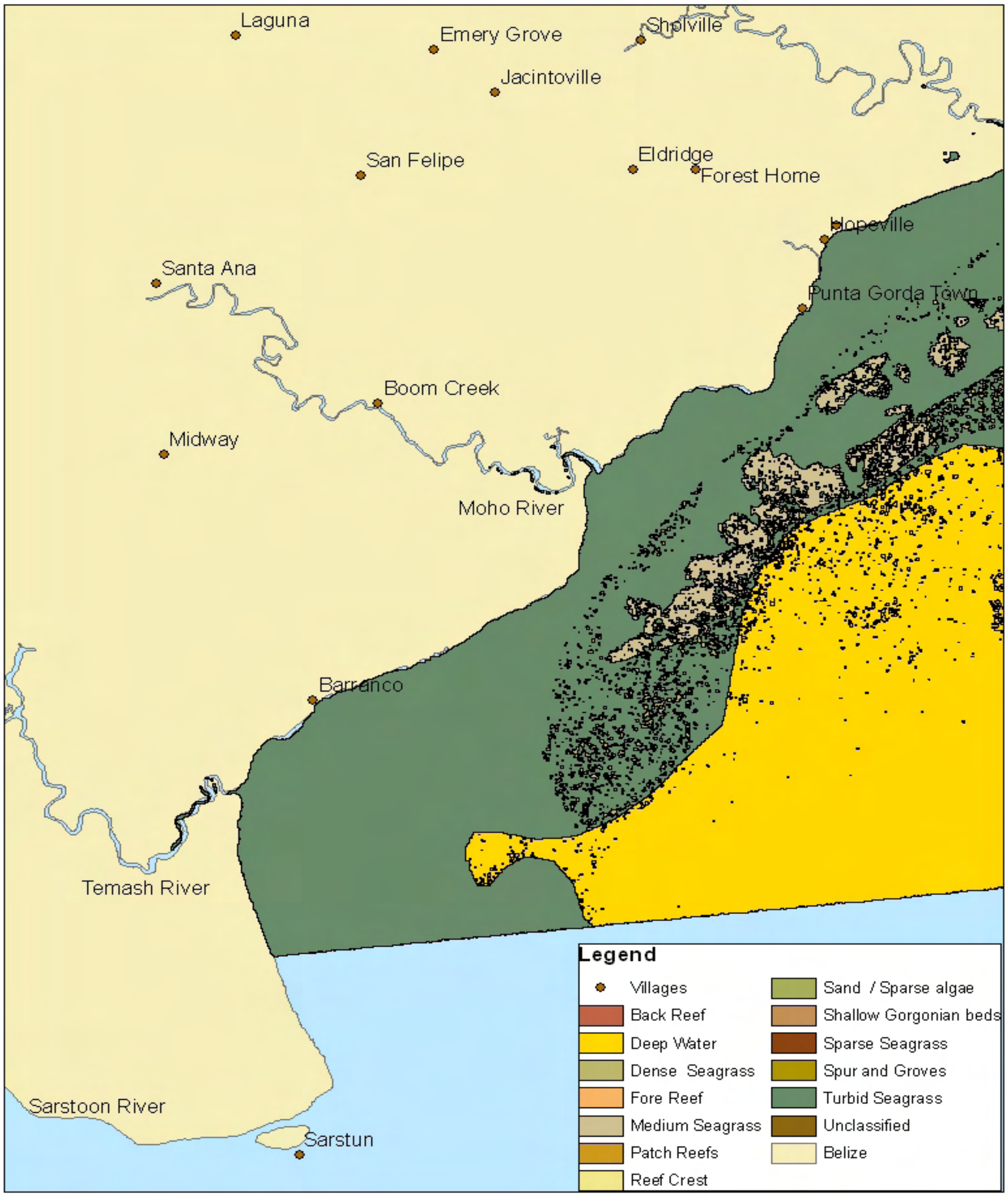


Figure 4



Laguna
Emery Grove
Sholville
Jacintoville
San Felipe
Eldridge
Forest Home
Hopeville
Santa Ana
Punta Gorda Town
Boom Creek
Midway
Moho River
Barranco
Temash River
Sarstoon River
Sarstun
Legend
Villages
Back Reef
Deep Water
Dense Seagrass
Fore Reef
Medium Seagrass
Patch Reefs
Reef Crest
Sand / Sparse algae
Shallow Gorgonian beds
Sparse Seagrass
Spur and Groves
Turbid Seagrass
Unclassified
Belize

Figure 5

3.0 PHYSICAL ENVIRONMENT

3.1 Climate

The climate of Belize is sub-tropical with a wet season from June to January and a dry season from February to May. There is a hurricane season from June to November during which periods of tropical disturbances and/or hurricanes can occur. The relative humidity is generally stable at about 83% but is usually masked by the cooling sea breezes, particularly along the coast. The southern region of Belize has the wettest climate often experiencing the greatest rainfall, particularly the district of Toledo. Rainfall in the south can achieve levels of 3800 mm/y in the mountainous regions (Purdy et al. 1975). This pattern of rainfall also influences the southern coastal region, through direct rainfall and freshwater influences from swollen rivers in the area, particularly the Moho, Temash and Sarstoon.

3.1.1 Air Temperature

Average air temperature ranges between 22°C and 34°C. November to January are traditionally the coolest months with an average of 24°C and May to September are the warmest with an average of 27°C. Sea surface temperatures range from a minimum average of 20°C to maximum average of 31°C. Average sea surface temperatures are generally 29°C.

3.1.2 Wind Speed and Direction

The coast of Belize is exposed to southeast trade winds averaging 5-7 m s^{-1} and these trade winds are at their strongest and most persistent during July. The average wind speed is approximately 3-8 m s^{-1}, with winds greatest in March (6.7 m s^{-1}) and lowest in October (3.6 m s^{-1}). Average wind direction is from the east January to April, and from the northeast during July to December. During May and June the wind blows from the southeast and in November from the northwest. Seasonal "northers" or "cold fronts" may occur between November to March. These weather systems usually cause colder temperatures and storms which can achieve wind speeds of 31 m s^{-1}. These "northers" can last from a few hours to several days, often characterized by gusty winds, whipped seas and heavy rain.

3.2 Oceanography

3.2.1 Tides

Belize has a microtidal range and possesses a semi-diurnal tide, with a diurnal component that increases toward spring tides. In general there are two high tides with a shallow minimum between them, separated by deeper low tides once a day. There is also an annual Neap and Spring tide. The tidal range is minimal, ranging from 0.15 to 0.5 m and average range is approximately 0.3 m, sometimes attaining 0.8 m during "northers" or storm events. Although tidal range is low, the tides have been observed to exert major influence on the coastal waters of Belize. Studies at Carrie Bow Caye indicate that the tidal influences are a major cause of currents in that region (Kjerve 1976).

3.2.2 Currents

There is not much data on current patterns within the Belize submarine shelf. However, a north-northeast current usually occurs outside the main barrier reef while a south-southeast current can be found between the reef and the mainland in the barrier reef lagoon (McCorry et al. 1993). Wind generated currents are often more influential than tidal ones. The coastal waters of Belize are also exposed to the main Caribbean current which flows westward at average velocities between 2.8 and 3.7 km/h. In southern Belize from Glovers Reef Atoll to the Honduran Island of Utilla a circular current pattern exists (Craig 1966). The major currents in the southern inner coastal areas from Punta Gorda to Sarstoon, are influenced by a southerly flow from the north and flows coming off the circular gyre in the Gulf of Honduras. However, much more investigation into the current patterns in the corner of the Gulf, at Sarstoon-Temash Marine Management Area, needs to be done to determine the actual current patterns in that area. This should be a major focus of future assessments or monitoring programs, as it will provide information on trends relating to larval transport and recruiting process for commercial fish species.

3.3 Bathymetry

The inner coastal shelf of Belize varies in depth based on underlying geological features such as drowned rivers, faults, natural channels, etc. The southern coastal area within the Sarstoon-Temash Marine Management Area falls within the Gulf of Honduras and its bathymetry is influenced by the features of the Gulf. There is an extensive north-south depression south of Belize City which descends to depths of more than 60 m near the Sapodilla Cayes. There have been very little studies on the bathymetry of the Belizean coastal shelf. A few studies have given generalized bathymetry of the country's coastal areas, such as Purdy 1974, US Charts and British Admiralty Charts and CZMP Project GIS maps (Gibson et al. 1993). These sources indicate that the shallow inshore waters of southern Belize along the Sarstoon-Temash Marine Management Area are less than 10 m in depth. These waters deepen towards the Gulf of Honduras up to 20-30 m (Figure 6).

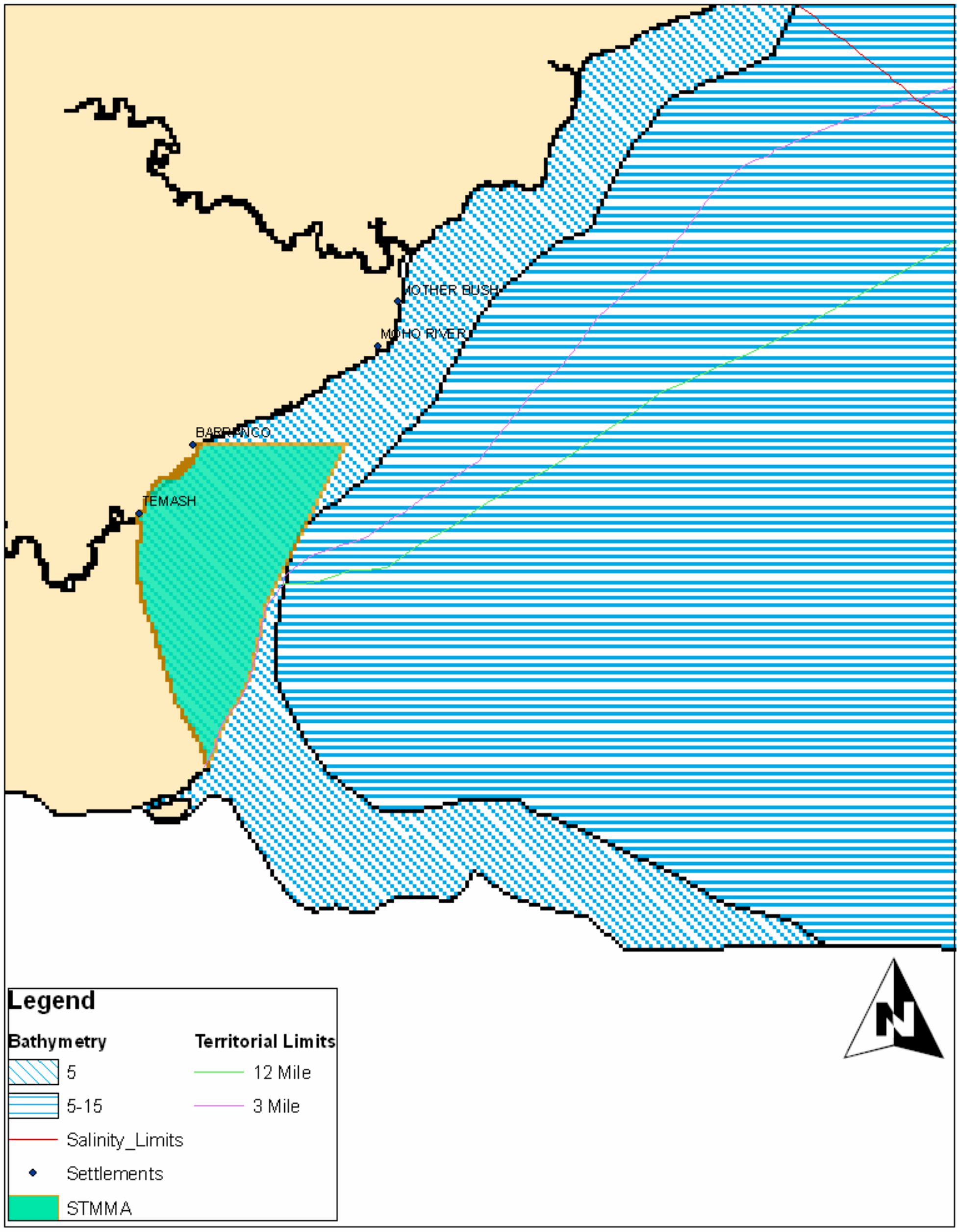


Figure 6

Bathymetric data was collected through a Rapid Ecological Assessment (REA) of the marine resources within the Sarstoon-Temash Marine Management Area. The REA was conducted along the shallow inner coastal waters within the three mile territorial limit. Based on the data collected on the bathymetry of the area, the mean depth was 4.9 m. Depth ranged from 2 m to 7 m at the 17 sites that were assessed (Figure 7), within the boundaries of the marine buffer area. The majority of sites had a depth of 4 m.

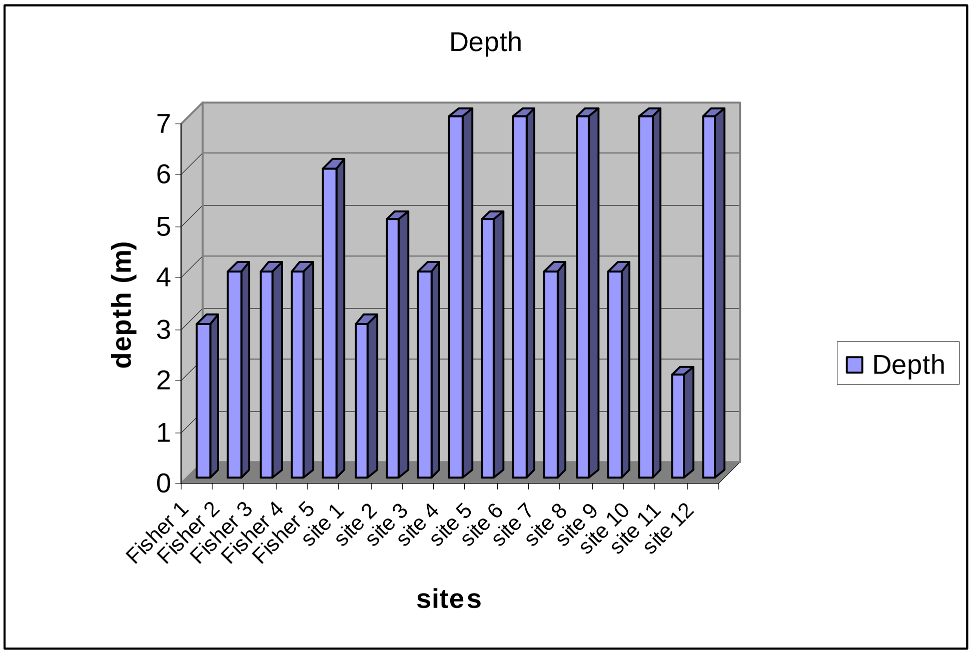


Figure 7

3.4 Underlying Geology

The southern coast of Belize has estuarine, deltaic, shoreface and palimpsest siliciclastic sediments (clays, quartzose sands and rare gravels) that are being intricately mixed with modern carbonates. Waves and longshore currents are the principle agents of marine sediment transport; tides are insignificant. Estuarine and turbid marine environments host an infauna dominated by bivalves and decapod crustaceans. Persistent longshore currents usually restrict deltaic plumes of turbid water to areas close to shore (Clinton 2002). The Holocene marine facies have been characterized for the coastal area of Belize using sediment composition cross sections to illustrate the geological composition of the marine sediments (Purdy and Gischler 2003). This analysis indicates that in the Gulf of Honduras at the mouth of the Temash River, the sediments are primarily terrigenous (land) based comprised of quartz. Seaward at a depth of approximately 10 m, the geology of the seabed is primarily comprised of an upper layer of carbonate mud, followed by terrigenous mud. There are also small sections of coralline algae, corals, forams, halimeda and molluscs. At about 20 m seaward from the mouth of the Temash, the sediments consist of a topmost layer of carbonate mud followed by terrigenous mud, a thin section of molluscs with all this overlying quartz deposits.

3.5 Water Quality

There is not much scientific data available on the water quality of the waters in the marine buffer area. Previous studies did not extend beyond the Port Honduras Marine Reserve or the Sapodilla Cayes Marine Reserve. These areas are dominated by coral reefs while the Sarstoon-Temash Marine Management Area is characteristic of an estuarine-lagoonal environment. SATIIM conducted a very brief Rapid Ecological Assessment (REA) with the aid of the Fisheries Department staff. The REA investigated the basic physical oceanography of the area focusing on parameters such as temperature, salinity, dissolved oxygen, turbidity, Ph and chlorophyll (Appendix 2). This data is the extent of the available information on water quality in the area. Sampling for nutrients, metals and pesticides was not possible given the time and budget limitations.

A total of seventeen sites were surveyed, 5 of which were identified by the fishers of the area as key sites that are used and exploited on a daily basis. The fisher sites are identified as F1 to F5 or Fisher 1 through 5. The remaining sites are numbered sites 1 to 12 (Figure 8). Each parameter was sampled at 1 m depth intervals to note the vertical trend, while individual sites provided an indication of the horizontal trend. The average for each parameter was determined per site and this information presented in summary form to identify trends across sites.

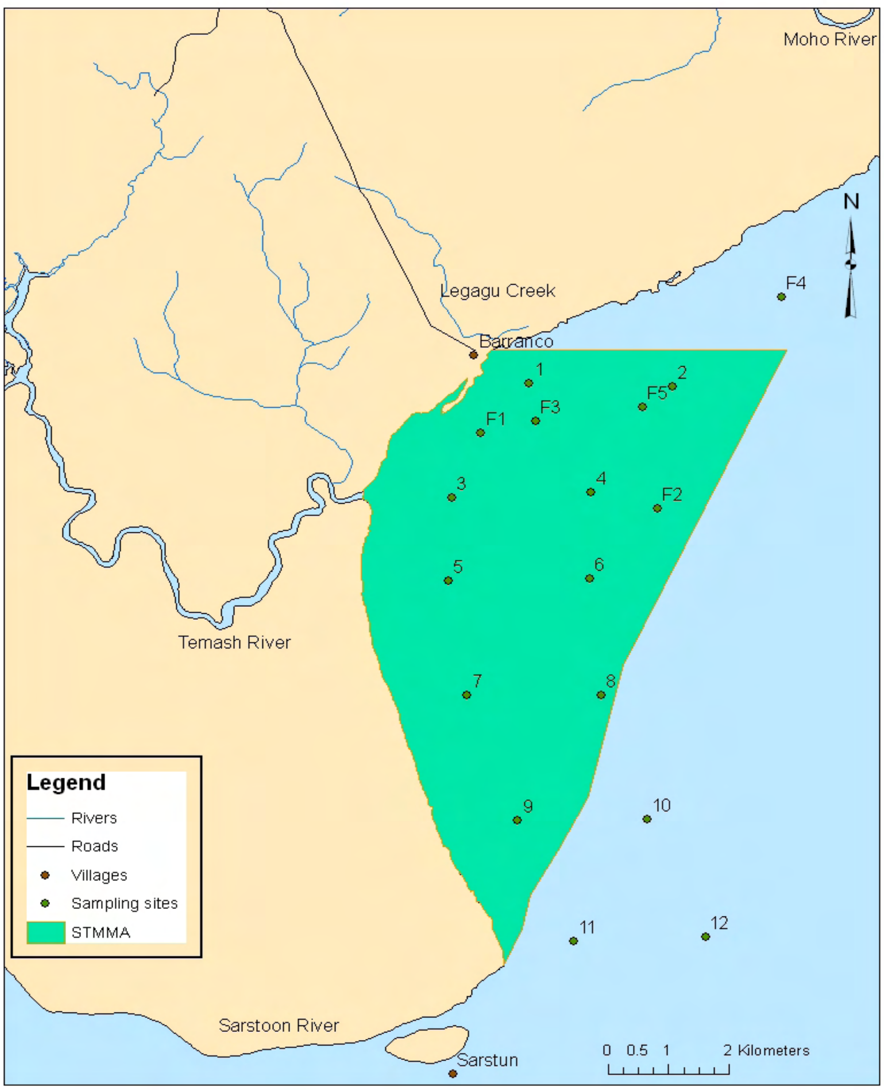


Figure 8

3.5.1 *Sea Temperature*

There was very little variation in sea temperature at the sites within the STMMA. The temperatures at each site varied very little with depth and also showed minimal variation across sites (Figure 9, bars indicate standard deviation). The water temperature varied between 29-31ºC, with an average water temperature of 30.3±0.4 ºC.

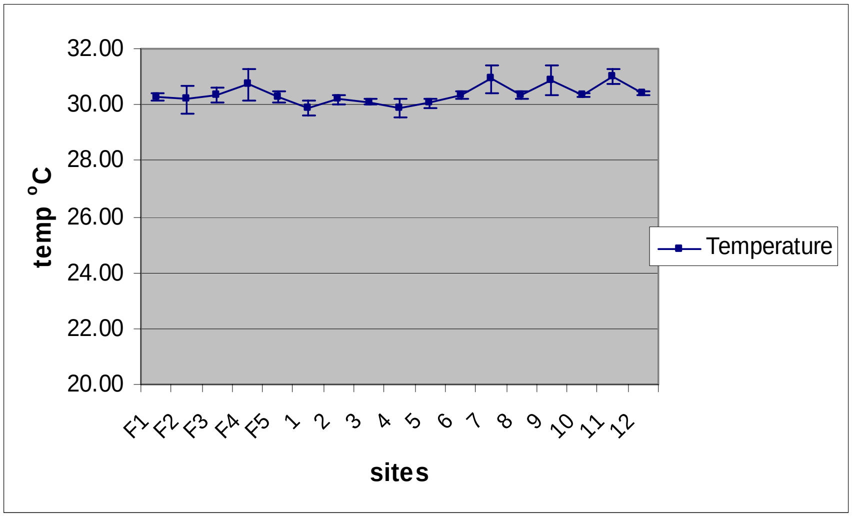


Figure 9

3.5.2 *Salinity*

The STMMA receives estuarine influences from three major rivers in the area, two of which fall within the Sarstoon-Temash National Park. These are the Moho, Temash and Sarstoon rivers. These rivers routinely transport sediments and fresh water which impact the marine waters in the marine buffer area. Based on the extensive riverine influences in the area, the salinity of the waters are markedly lower than that of marine sea water, which usually has a range of 34-37 $^{o}/_{oo}$. The mean salinity of the area was 25.5±2.6 $^{o}/_{oo}$, with salinity ranging from 23 to 28 $^{o}/_{oo}$ (Figure 10). Sites with the lowest salinity were generally adjacent or nearest to the deltas of the Sarstoon and Temash.

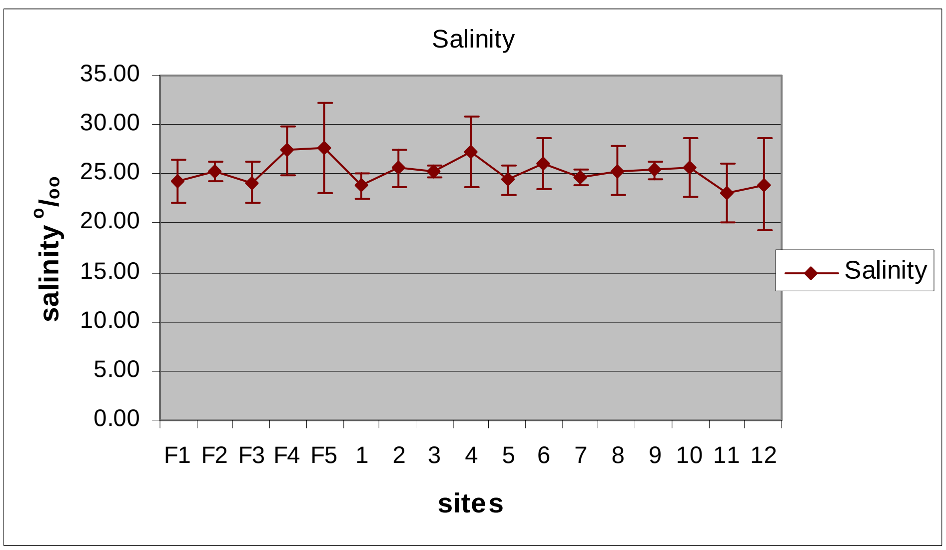


Figure 10

3.5.3 Dissolved Oxygen

The mean dissolved oxygen of the waters in the STMMA indicates that these waters are healthy, 6.8±0.7 mg/l. The dissolved oxygen ranged from 5.8 to 7.7 mg/l (Figure 11), which falls above the normal range for coastal waters (5-6 mg/l). Only two sites 1 and 12 had mean dissolved oxygen below 6 mg/l, all other sites were above (Figure 11). Site F5 and site 4 both showed a high fluctuation in dissolved oxygen with depth. At both these sites, the dissolved oxygen at the bottom depth was just below 5 mg/l (Appendix 3). This indicates that there may be a lot of decomposition occurring at this site which utilized the available oxygen rapidly. At these sites where dissolved oxygen reduced with depth, the values were still within the normal range and can be attributed to natural fluctuations rather than external impacting factors.

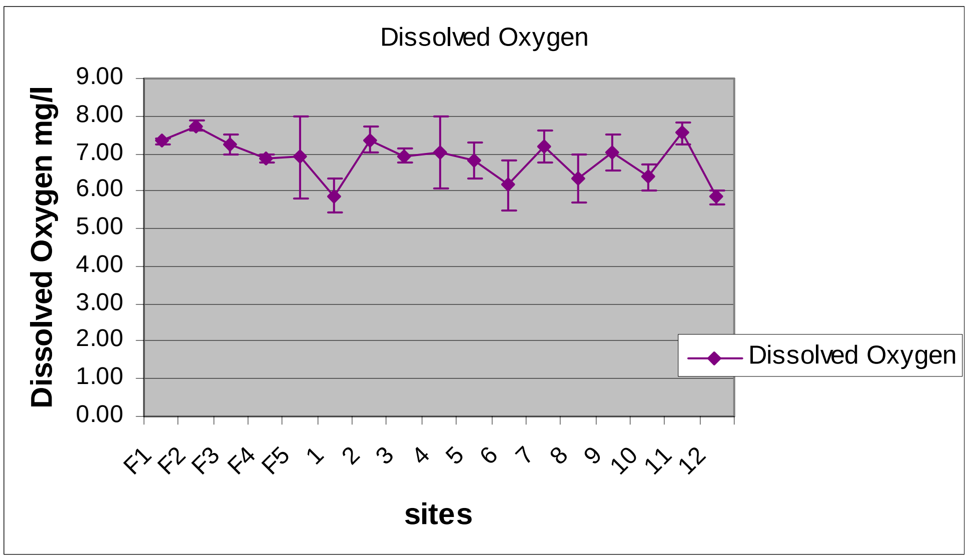


Figure 11

3.5.4 Turbidity

The majority of sites showed good water quality with low levels of total suspended solids, indicated by mean turbidity values (NTU) between 2.9±0.6 – 7.9±2.3 NTU (Figure 12). Two sites, 5 and 12, showed higher turbidity values with site 12 possessing a fairly high mean turbidity of 38.2±44.2 (Figure 12). At site 12 the turbidity was as much at 69.4 NTU at depth (7 m), while at site 5 the turbidity was 41 NTU at depth (5m) (Appendix 3). Both sites were located opposite the mouths of major rivers, site 5 at Temash and site 12 at Sarstoon. The trend noted at both sites indicates that there is a significant level of terrigenous sediments entering the marine environment from the Temash and Sarstoon rivers, contributing to the high levels of suspended solids observed. The sediments gradually settle on the substrate over time and are kept re-suspended above the bottom through wave action and currents.

Elevated sediment concentrations can negatively affect seagrass beds. Seagrass communities are generally characterized by low ambient sediment levels and increases in turbidity can adversely affect seagrasses by lowering the ambient light levels (Walker *et al.* 1999). Turbidity causes a reduction in light availability by: increasing the level of suspended sediments, which then leads to increased water column turbidity; secondly the pulsed increases in suspended sediments cause a dramatic reduction in water column light penetration. Both these factors reduce the photosynthetic capability of the seagrass communities (Shepherd *et al.* 1989; Walker and McComb 1992; Abal and Dennison 1996).

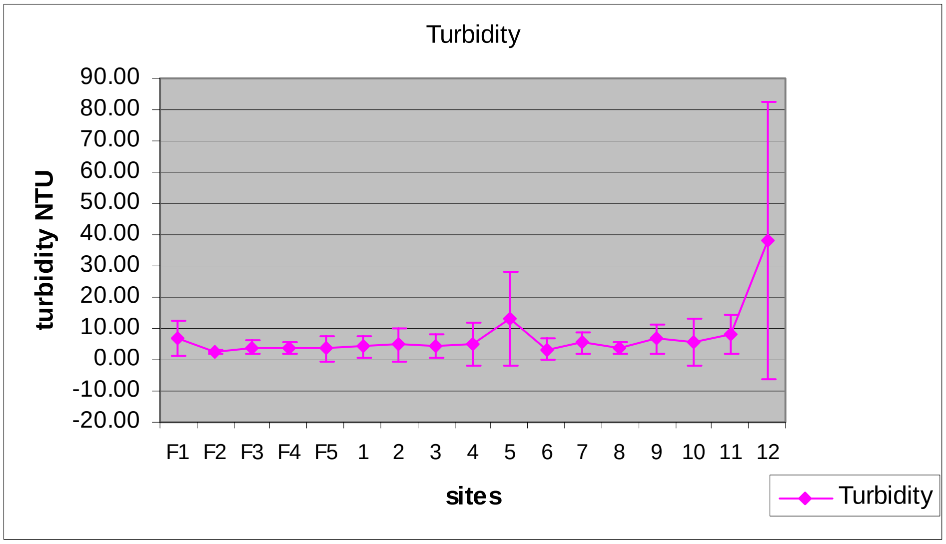


Figure 12

3.5.5 Ph

The Ph of the marine waters was normal with a range of 7.8 – 8.0 (Figure 13), falling within the normal range for sea water (7.5 – 8.5). The mean Ph was found to be 7.9±0.2. Two sites showed a large variation in Ph between the surface value and that at depth. These were site 10 and F3 (Figure 13), with low values of 6.4 and 7.3 respectively. The low Ph at the surface may have been caused by input of contaminants from the sampling boat and was not indicated in the vertical profile of the site.

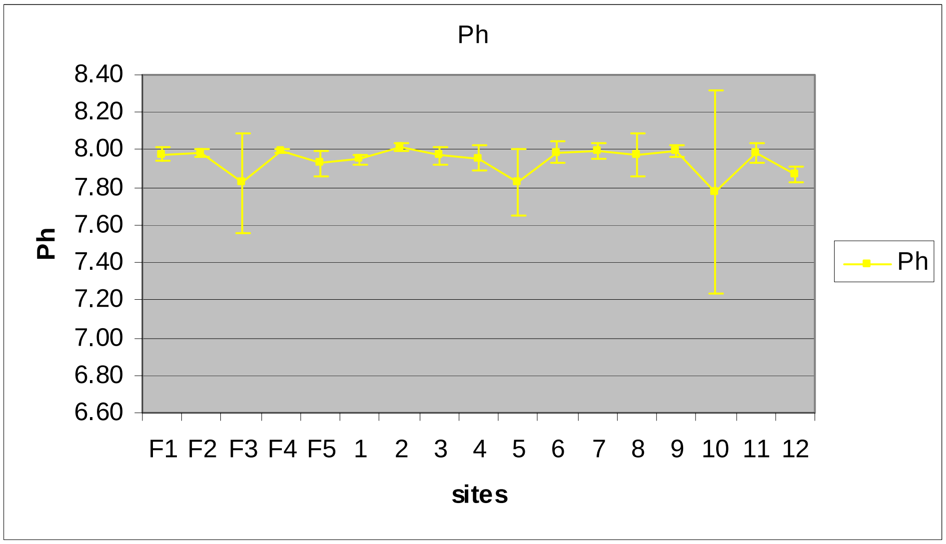


Figure 13

3.5.6 Chlorophyll

Chlorophyll is a measure of the photosynthetic algae in the water column, largely phytoplankton. This measurement gives an indication of the productivity of marine waters, ranging from oligotrophic (little or no productivity) to eutrophic (high productivity). The chlorophyll concentration of the water in the STMMA varied widely from 0.3 to 14.2 µg/l, with site 12 showing the highest chlorophyll value (Figure 14). The mean chlorophyll concentration across all sites was 2.4±3.8 µg/l (S.E.). The chlorophyll values at each site generally increase with depth (Appendix 3).

These levels of chlorophyll are characteristic for coastal lagoonal areas and seagrass beds, which dominate the Sarstoon-Temash Marine Management Area. Elevated chlorophyll levels indicate high numbers of phytoplankton and free floating macroalgae which can shade seagrass beds resulting in declined seagrass abundance and distribution. High levels of water column productivity, identified by high chlorophyll concentrations, can also contribute high amounts of easily decomposed organic matter to sediments, which create detritus and a source of food for various marine organisms thus supporting marine food webs. This may be a factor at site 12, which had the highest chlorophyll a value and void of seagrass communities.

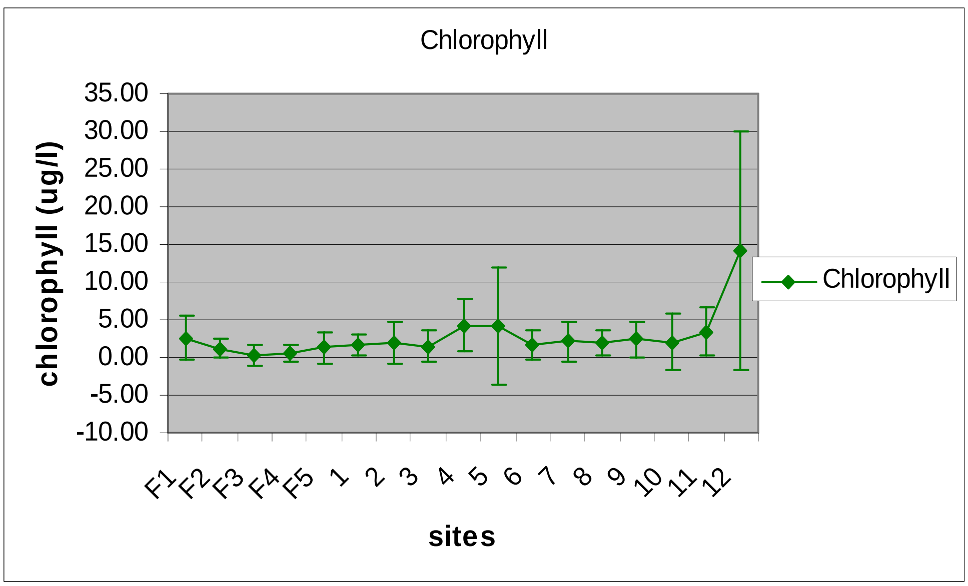


Figure 14

4.0 BIOLOGICAL ENVIRONMENT

4.1 Marine Ecosystems

The Sarstoon-Temash Marine Management Area is dominated by sea grass ecosystems due to its lagoonal and estuarine influences. There is a paucity of coral reef ecosystems in the area as a result of the STMMA forming a part of the Gulf of Honduras which forms a basin where several major rivers from Central American exit. Fringing mangrove stands can also be found all along the coastline of the STMMA as identified in the Management Plan for the Sarstoon-Temash National Park (Herrera 2004). According to the CZMAI Marine Habitat Map (Mumby 1998), the area is made up of turbid or sparse seagrass beds between 1-10 m in depth (Figure 15). This refers to the fact that seagrass communities are present in the area, but often the water column is turbid due to riverine discharge, hence the term turbid seagrass.

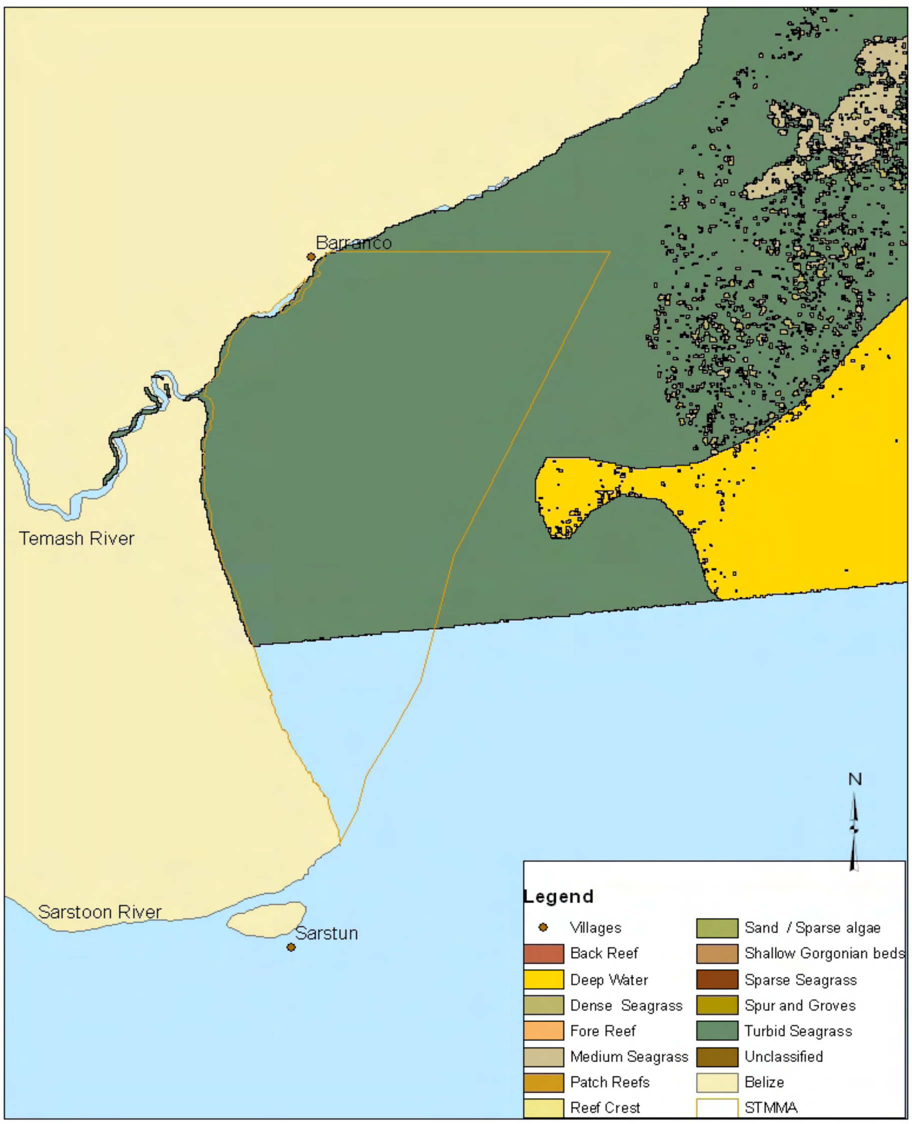


Figure 15

The area was surveyed to determine the distribution and abundance of the seagrass communities. Several parameters on total seagrass cover, seagrass species composition, total algal cover, seagrass leaf blade length, sediment type and total percent cover were determined for 7 sites in the area. Initially 12 sites were identified for assessment, however upon investigation 10 of the 12 sites were unable to be surveyed as the water above the substrate was excessively turbid and prevented any identification of benthic organisms. This high turbidity was due to the fact that during the time of the survey (October 2004) the area was impacted by periods of heavy rain and swollen rivers entering the area at Temash and Sarstoon, carrying high loads of terrigenous sediment from upstream. The community volunteers, fishers from the area who assisted with the survey, identified 5 additional sites that are commonly used by the fishing community, F1 to F5. These were incorporated into the surveys and the data is presented below. For each site, a total of 9-10 transects were sampled to determine seagrass community structure (Appendix 2).

4.1.1 Seagrass Cover

The data was collected using 8-10, 30 m transects per site, with 0.5 m quadrats at every 3 m to determine the percent cover of seagrass, algae and other benthic parameters (See Appendix 2 for detailed methodology). On analysis of the data collected from the surveys, the percent cover of seagrass varied from site to site. Site 1, situated opposite Barranco, had the highest seagrass cover of 31.5%±2.5 (S.E.). There was no seagrass at site 2, while sites F1 through F4 had fairly similar seagrass cover (Figure 16). Site F5 had the lowest seagrass cover of 2.6%±0.7 (S.E.). The seagrass cover for the entire area was classified as sparse seagrass cover based on the percent cover (<50%).

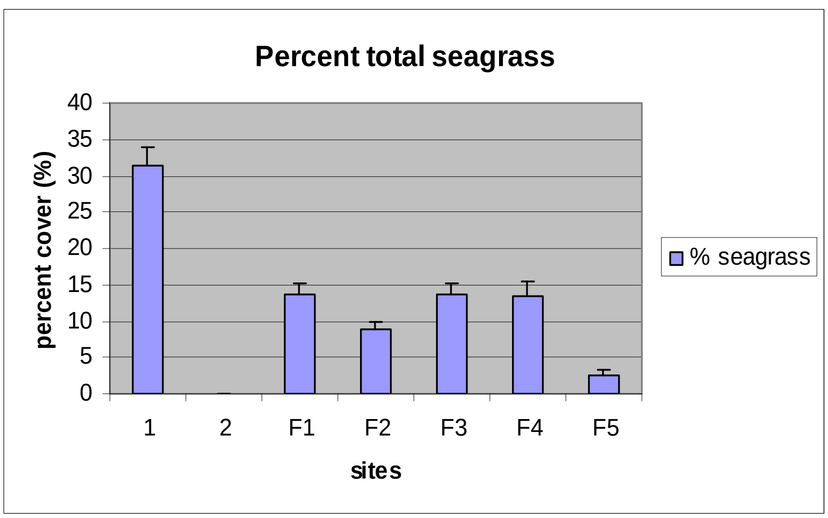


Figure 16

4.1.3 Seagrass species composition

The seagrass ecosystem in the area was dominated by the marine halophyte, *Thalassia testudinum* or turtle grass. The species composition data from transects indicated that of the seven sites, only one site was comprised of more than 1 species of seagrass. Site F1 showed the occurrence of *Thalassia testudinum* and a minimal abundance of *Syringodium filiforme* (manatee grass) (Figure 17).

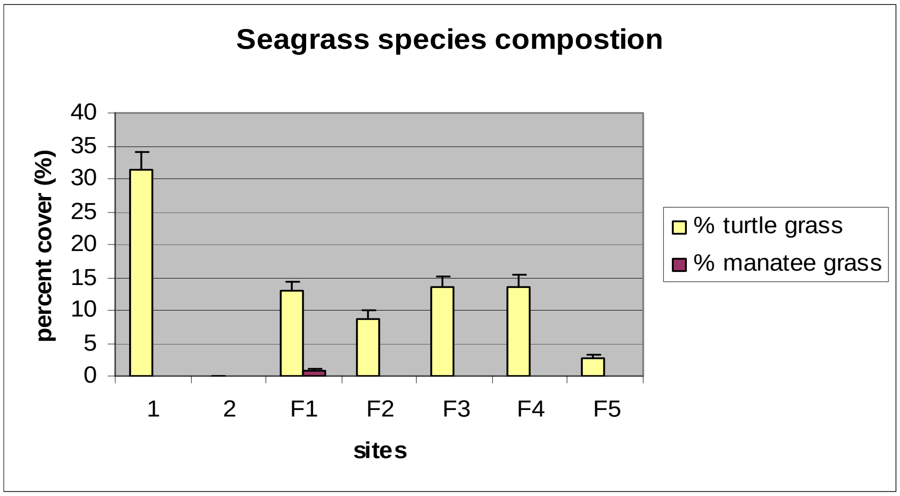


Figure 17

4.1.3 Algal cover

The algal cover varied across the sites in the STMMA. Sites 1 and 2 had the lowest algal cover from the seven sites surveyed, 27-29% (Figure 18). Site F5 showed the highest algal cover of 61.7%±2.7 (S.E.). This algal cover was comprised of non-epiphytic or benthic algae that were found on the substrate within the quadrats.

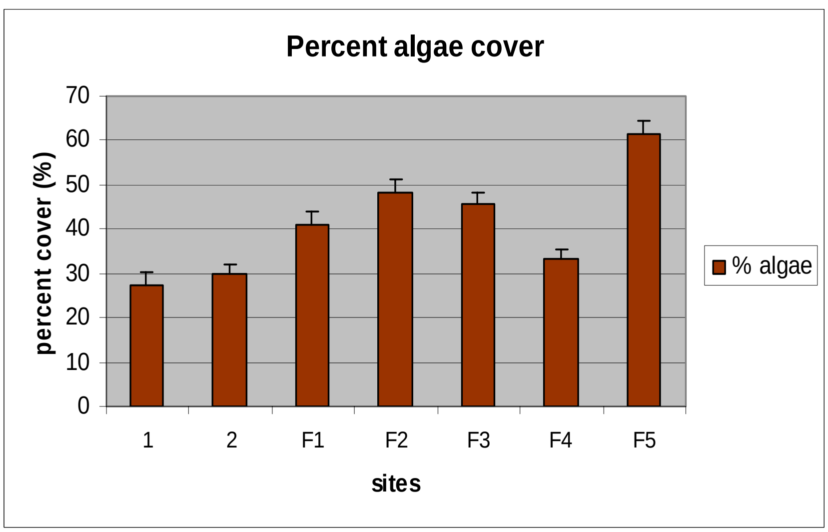


Figure 18

4.1.4 Seagrass leaf blade length

The average leaf blade length of the seagrass beds in the STMMA, ranged from 16-21 cm in length (Figure 19). Site F4 had the longest blades of 20.7±0.5 cm. The average leaf blade length indicates that these seagrass beds were exposed to moderate disturbance and most likely exhibited sparse seagrass density. This is indicative of an estuarine or lagoonal seagrass environment which is constantly exposed to significant freshwater influences.

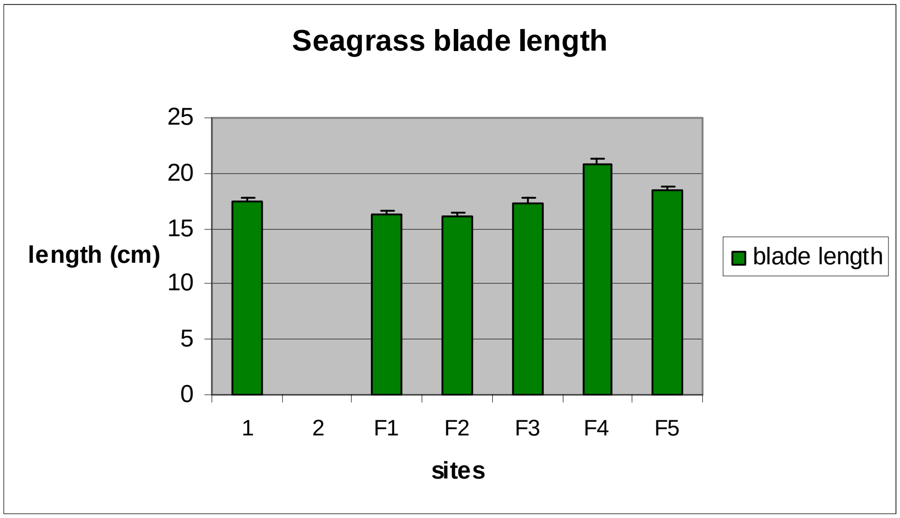


Figure 19

4.1.5 Epiphyte Cover

Seagrass communities are generally divided into four zones based on the organisms inhabiting the ecosystem. These zones are: infauna (organisms which burrow and dwell in the sediments), epiphytes (organisms that dwell on the seagrass stems and leaves), epifauna (large invertebrates such as conch, starfish, sea urchins, etc) and nekton (organisms which inhabit the water column above the seagrass beds, such as fish and jellyfish). The epiphyte cover of the seagrass beds varied among the sites surveyed, ranging from 17-33% (Figure 20). This level of epiphyte cover indicates that the seagrass beds are at a moderate level of health and of fairly good quality. The greater the epiphyte cover, the less healthy and poorer quality of the seagrass beds.

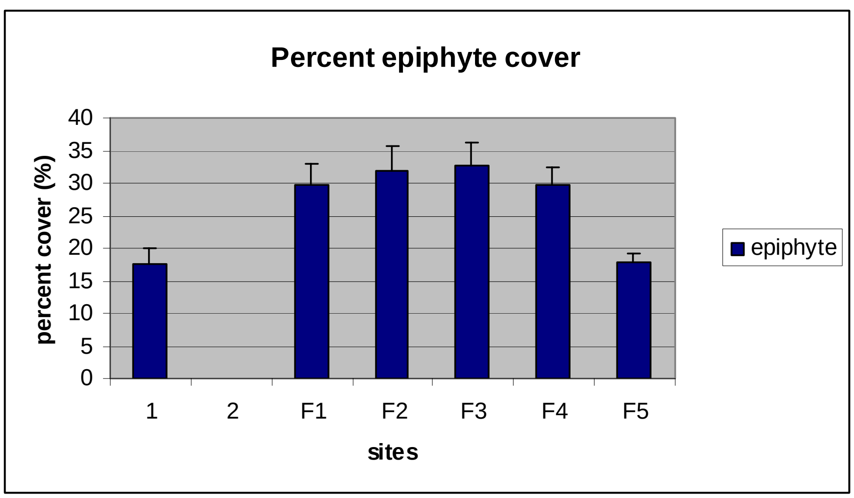


Figure 20