

# Gladden Spit and Silk Cayes Marine Reserve



## Management Plan

2011 – 2016



**Gladden Spit and Silk Cayes Marine Reserve – Management Plan  
2011-2016**



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## Gladden Spit and Silk Cayes Marine Reserve – Management Plan 2011-2016



### Gladden Spit and Silk Cayes Marine Reserve

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## Introduction

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### Background and Context

Gladden Spit and Silk Cayes Marine Reserve (GSSCMR) is world-famous for the whale sharks that congregate at the Gladden Spit promontory.

The idyllic sand beaches of the Silk Cayes, the shallow clear waters, vibrant coral reefs and prolific sea grass provide habitats for many marine species. These islands are also an increasingly important tourism destination.

Gladden Spit and Silk Cayes Marine Reserve was originally established in May 2000 following lobbying from Friends of Nature (FoN), a local, community based organization, for the protection of the Gladden Spit spawning aggregation site, the congregating whale sharks, and the tourism value of the Silk Cayes, and was designated as a Marine Reserve (SI 68 of 2000). The regulations for the MPA were legislated three years later (95 of 2003) as was the overlapping, seasonally protected spawning aggregation site.

The primary focus of the Marine Reserve is the spawning aggregation site, located along one of the best developed sections of the Belize Barrier Reef, a unique geological promontory that drops to a depth of 250 m to the east, resulting in the water current conditions required for the highest priority spawning aggregation site in Belize.

For ten days after the full moon of each lunar cycle between March and June, the whale sharks gather, feeding on the spawn produced by thousands of fish that form the Gladden Spit spawning aggregation (SPAG). Many of these are commercially important species that support the traditional fishing industry in Belize.

#### SITE INFORMATION

**Size:** 26,000 acres (10,523 ha)

Conservation Zone 378 acres (153 ha)

General Use Zone 25,622 acres (10,370 ha)

Gladden Spit\* 1,280 acres (518 ha)

**Statutory Instrument:** SI 68 of 2000

Spawning Aggregation Site SI 162 of 2003

**IUCN Category:** IV

**Management Authority:** Fisheries Department

**Co-management Partner:**

Southern Environmental Association (SEA)

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**Location:** Gladden Spit and Silk Cayes Marine Reserve lies offshore, on the Barrier Reef, 36km east of Placencia, the primary point of access for visitors.

**Uses:** Extractive and Non-extractive – fishing, tourism, education and research.

**Biodiversity information:** SEA, WCS (whale sharks, commercial fish species); Heyman (spawning aggregations); Conservation International (MMAS) and various independent researchers.

**Facilities (2009):** Bathroom facilities, picnic tables on Middle Silk Caye.

**Tourism Visitation (2009):** 4,700

**On-site Staff (2009):** 1 head ranger, 2 rangers, supported by the SEA central office staff in Placencia

\*Overlapping spawning aggregation site

## Gladden Spit and Silk Cayes Marine Reserve – Management Plan 2011-2016

To the west, the shallow lagoon is protected behind the barrier reef, and is considered an excellent example of a barrier reef platform. Situated on this platform within the Marine Reserve are the Silk Cayes - three sand cayes (Northern, Middle and South Silk Caye) that change shape with each major tropical storm that sweeps the area, with the core components of forereef (with extensive spur and groove formation), reef-crest, and back-reef all being present. Sea grass beds, important for connectivity and for the maintenance of commercial species such as conch, lie in the shallow back-reef lagoon. These ecosystems support many marine species important for both the commercial fishing and tourism industries as well as eleven species of international concern (critically endangered, endangered or vulnerable – IUCN, 2008) – including the Hawksbill turtle and goliath grouper.

The Marine Reserve has clear zones embedded in the legislation that allow for extractive / non-extractive use, and conservation protection, with use concentrating on sustainable fishing, tourism, research and education. Since the signing of the first co-management agreement in 2001, management has been assisted through collaboration with Friends of Nature (FoN) – now the Southern Environmental Association (SEA). SEA is responsible for day-to-day management of the reserve, including activities such as patrols and fee collections, and has been working more closely with the Fisheries Department in 2008 and 2009 to improve management and scientific monitoring.

The Marine Reserve designation is considered to be equivalent to **Category IV: – A Habitat/Species Management Area**, with active management targeted at conservation through management intervention (NPAPSP, 2005; IUCN, 1994).

## **Purpose and Scope of Plan**

Gladden Spit and Silk Cayes Marine Reserve is one of three protected areas managed by SEA, and a component of the Southern Belize Reef Complex. This five year management plan has been developed to provide guidance to the Southern Environmental Association and Fisheries Department, towards effective management of the Marine Reserve and the associated spawning aggregation site.

Since the establishment of the Marine Reserve, and development of the first management plan in 2003 (Friends of Nature, 2003), the level of use of the protected area and the status of the resources have changed, and the knowledge base has improved substantially from the interim years of research and data collection. The management regime has changed from a volunteer base under Friends of Laughing Bird Caye to the more organized Friends of Nature (FoN), and most recently, through a merger of FoN and TASTE (Toledo Association for Sustainable Tourism and Empowerment) to form the Southern Environmental Association (SEA).

The programmes in this Plan address the current status of the Marine Reserve, and reflect the participatory approach to management being adopted in Belize today. It includes general information on the physical and biological attributes of the reserve, documents the current uses and management problems, defines the goals and objectives of the Marine Reserve, summarizes conservation planning and climate change assessment outputs, outlines specific management programmes, including zoning, sets in place the means for measuring management effectiveness, and recommends an implementation schedule format.

In line with the National Protected Areas Policy and System Plan, this Management Plan has been prepared with the input of the various stakeholders of the protected area through meetings with SEA staff, a series of workshops with key stakeholder components, and interviews with a wide variety of individuals, including fishermen, the tourism sector, management staff and researchers. It seeks to conserve the resources of the reserve while allowing economic benefit through sustainable fishing and tourism. The management programmes are based on the best available data and scientific knowledge, with the integration of conservation planning strategies, and fit within the scope of the current zoning scheme and regulations that govern the protected area, except where recommended management regimes are highlighted for review.

This management plan is designed to guide the management of the Marine Reserve through the next five years, providing a framework for both broad management activities as well as more specific research and monitoring activities. It is recommended that detailed operational plans be developed based on the implementation format, on an annual basis by the Southern Environmental Association, based on the framework provided by this management plan, with an annual review of implementation success, allowing for adaptive management over the five year period.



## **1. Current Status**

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### **1.1 Location**

Gladden Spit and Silk Cayes Marine Reserve is located on the Barrier Reef (UTM 389 135 N, 1819 200 W (16°27'08.04"N, 88°02'25.35"W)), and is part of the Southern Belize Reef Complex, a system-level planning unit. Access is by water – the Marine Reserve is located 36km offshore, east of the village of Placencia, a popular tourist destination, and the primary departure point for tours to the area. Encompassing a total of 10,523 ha, the area is zoned, with demarcation by buoys. Conservation Zone 1 - 153 ha surrounding Middle Silk Caye, is a no take zone, and the main focus of tourism activities. The remainder of the reserve is designated as a General Use Zone, open to regulated fishing activities (Maps 1 and 2).

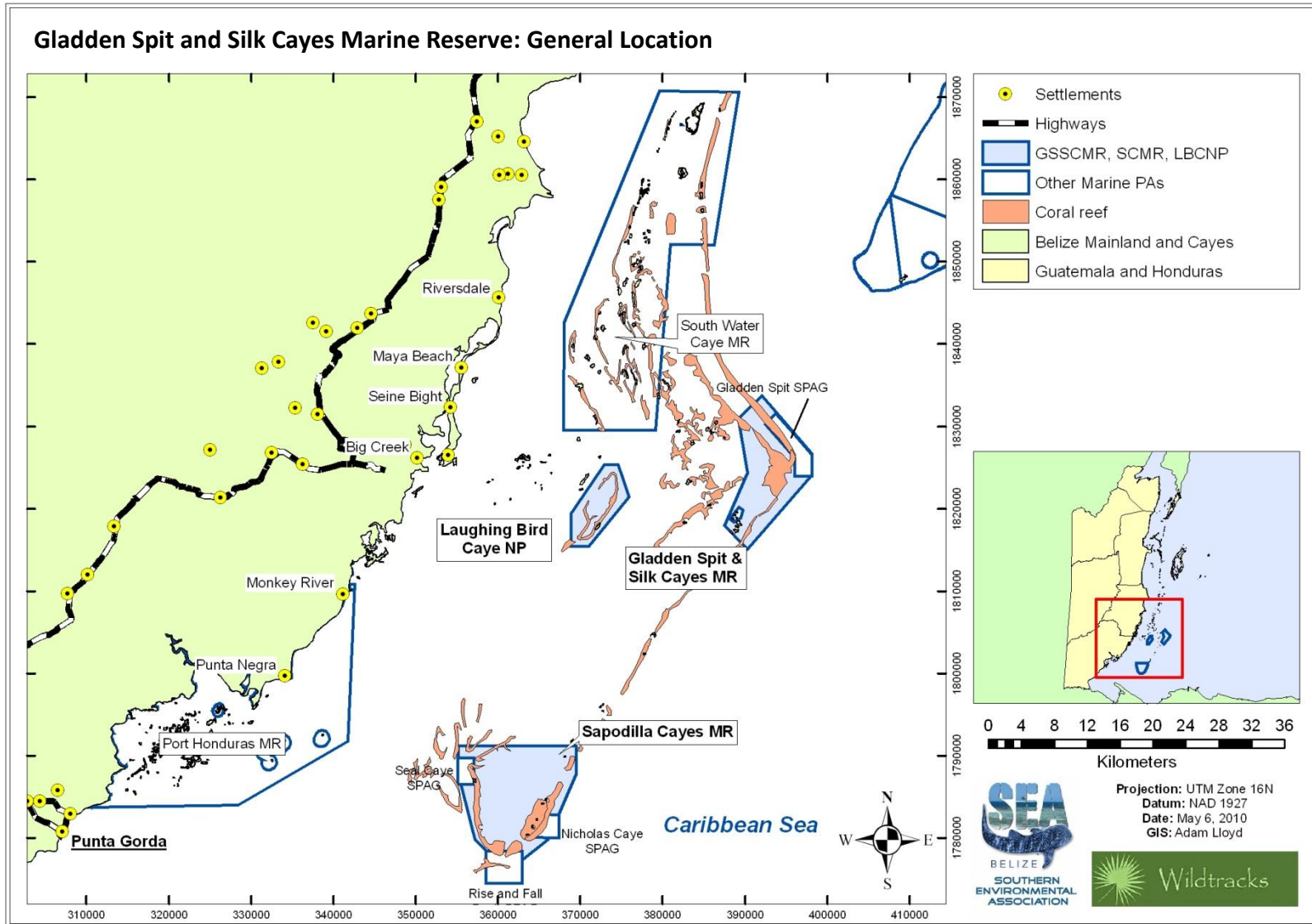
The General Use Zone is utilized by fishermen from central Belize (Hopkins to Monkey River) primarily during the spawning aggregations and opening of lobster and conch seasons. The area is also used by boats from the northern communities - Sarteneja, Chunox and Copper Bank - which fish from sailboats throughout the year, free diving for lobster and conch.

The primary management focus of the Marine Reserve is Gladden Spit, a unique geological promontory that falls sharply into the sea, resulting in currents that attract large spawning aggregations of grouper, snapper and other species, in synchrony with the lunar cycle. This in turn has brought one of the largest predictable congregations of whale sharks known in the region. Whilst designated in its own right as one of Belize's most important spawning aggregation sites, some traditional fishing is permitted by those fishermen who used the area long before it was placed under protection.

The sand beaches and shallow, clear waters of the three Silk Cayes (North, Middle and South), are also important features of the area, attracting heavy day-tourism use, primarily for snorkeling. Kayak tours and a number of sail charters also use the area for overnight stops. South Silk Caye has two bathroom stalls, four picnic tables and a barbecue grill. A second barbecue grill is located on Middle Silk Caye. 2 mooring buoys have been installed near South Silk Caye and are the property of Port Authority, for use by both day and overnight tour boats. There are also additional mooring buoys in the whale shark zone for boats conducting day trips to the spawning aggregation site.

There are no permanent settlements within the Marine Reserve, but a number of communities exist on the mainland to the west on the southern coastal plain - primarily Placencia, Riversdale, Hopkins, Sittee River, Independence, Big Creek and Seine Bight - that utilize the resources of the Marine Reserve.

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**Map 1: Gladden Spit and Silk Cayes Marine Reserve: General Location**

## 1.2 Regional Context

Gladden Spit and Silk Cayes Marine Reserve is part of the Meso-American Reef (MAR), which stretches for more than 600 miles along the coast of Belize, Guatemala, Honduras and Mexico. One of the most diverse ecosystems on earth, the MAR is considered outstanding on a global scale, and a priority for conservation action, stabilizing and protecting coastal landscapes, maintaining coastal water quality, sustaining species of commercial importance, and providing employment in the fishing and tourism industries to more than a million people living in coastal areas (Global Environment Facility, 2001).

Belize has an estimated 1,420 km<sup>2</sup> of reef within its waters - 5.5% of the reefs of the Wider Caribbean (World Resources Institute, 2004). The Barrier Reef was included on a list of 18 richest centers of endemism and was highlighted as one of the most threatened by human impacts (Roberts et al., 2002). In the Wider Caribbean region, recent studies have shown that nearly two-thirds of coral reefs are threatened by human activities (World Resources Institute, 2004), and recently, Belize has been shown to have a percentage live coral cover that is slightly lower than the average for the Caribbean (AGGRA /McField, et al. 2008 (ed. Wilkinson et. al.)). Belize is one of the areas highlighted as having the lowest impacts, with its small population and relatively low coastal development rate. Impacts are increasing - recent quantitative data on fish populations comparing 2002 and 2008 observations in the adjacent South Water Caye Marine Reserve to the north indicate a staggering decline in populations of larger reef fish such as grouper, snapper, and triggerfish (Mumby, 2009<sup>1</sup>), increasing the importance of no-take and managed extraction areas such Gladden Spit and Silk Cayes Marine Reserve within the National Protected Areas System.

The area is highlighted as an ecoregional priority for conservation planning efforts (World Wildlife Fund, 2002), particularly for the role of the spawning aggregations in the maintenance of regional commercial fish stocks – one of the most active and viable in the region (Heyman et. al., 2002). It is also recognized for the global importance of the whale shark congregation and feeding area. The Marine Reserve contains assemblages of regionally important ecosystems of remarkable biodiversity and beauty, as well as of great scientific value, and importance for many species of global conservation concern, among them the critically endangered hawksbill turtle (*Eretmochelys imbricata*) and goliath grouper (*Epinephelus itajara*), and the endangered green and loggerhead turtles (*Chelonia mydas* and *Caretta caretta*). The no-take area, whilst small, also contributes towards the regional viability of important commercial species, including the Queen Conch (*Strombus gigas*) and spiny lobster (*Panulirus argus*).

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<sup>1</sup> Report to the Belize Fisheries Department: Fishing Down the Foodweb (P. Mumby, 2009)

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In 1983, Belize signed the **Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region** (the ‘Cartagena Convention’) with the primary objective of protecting the ecosystems of the marine environment, following recognition of the regional importance of the Mesoamerican Barrier Reef System (MBRS), the majority of which lies within Belizean waters (Table 1).

<b>Table 1: International Conventions and Agreements of Relevance to Gladden Spit and Silk Cayes Marine Reserve</b>	
<b>Convention on Biological Diversity</b> (Rio de Janeiro, 1992) Ratified in 1993	To conserve biological diversity to promote the sustainable use of its components, and encourage equitable sharing of benefits arising from the utilization of natural resources. <b><i>Gladden Spit and Silk Cayes Marine Reserve provides an important and integral part in the national protected areas system, protecting biodiversity and threatened species, as per Belize’s commitment under the CBD.</i></b>
<b>Alliance for the Sustainable Development of Central America (ALIDES)</b> (1994)	Regional alliance supporting sustainable development initiatives. <b><i>Initiatives under the Southern Environmental Association within the stakeholder communities of Gladden Spit and Silk Cayes Marine Reserve are targeted for facilitation of sustainable economic and environmental development, with the support of Fisheries Department</i></b>
<b>Central American Commission for Environment and Development (CCAD)</b> (1989)	Regional organization of Heads of State formed under ALIDES, responsible for the environment of Central America. Initiated Mesoamerican Biological Corridors and Mesoamerican Barrier Reef Systems Programmes. <b><i>Data gathered through monitoring initiatives Gladden Spit and Silk Cayes Marine Reserve have been shared regionally in the past through MBRS.</i></b>
<b>Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region</b> (Cartagena de Indias, Colombia, 1983)	Regional convention with the objective of protecting the marine environment of the Wider Caribbean through promoting sustainable development and preventing pollution. <b><i>Gladden Spit and Silk Cayes Marine Reserve is an important and integral part in the national protected areas system, protecting biodiversity and threatened species, as per Belize’s commitment under this Convention.</i></b>
<b>International Convention for the Protection and Conservation of Sea Turtles for the Western Hemisphere</b> (December 21 <sup>st</sup> , 1997)	To protect and conserve sea turtle species of the Western Hemisphere. <b><i>Gladden Spit and Silk Cayes Marine Reserve protects important feeding area for sea turtles, including the Critically Endangered hawksbill</i></b>
<b>The UN Convention on the Law of the Sea</b> (1982)	The Law of the Sea Convention defines the rights and responsibilities of nations in their use of the world’s oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources.

In June 1997, with the increasing threats to the overall health of the reef system, the Governments of Mexico, Belize, Guatemala and Honduras (the four countries bordering the

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MBRS) committed themselves through the Tulum Declaration to the development of a 15-year Action Plan – the **Mesoamerican Barrier Reef System Project** - for the conservation and sustainable use of this ecosystem. This initiative, adopted by the Heads of State in June 1999, is supported by the **Central American Commission on Environment and Development (CCAD)**, which works to harmonize environmental policies within the region.

Conservation of this Marine Reserve is also a step towards fulfilling Belize's international commitments under the **Convention on Biological Diversity**, signed in 1992, as well as the **International Convention for the Protection and Conservation of Sea Turtles for the Western Hemisphere**, signed in 1997.

As a signatory of the **Convention for the Regulation of International Trade of Endangered Species (CITES)**, Belize is obligated to follow the CITES permitting procedures, with a permit required for every individual export of conch (*Strombus gigas*), validated by Customs Department, in order for Belize to ship this product internationally. The Belize Fisheries Department has developed a sustainable use strategy for this species, in order to maintain its export market.

## 1.3 National Context

### 1.3.1 Legal and Policy Framework

Gladden Spit and Silk Cayes Marine Reserve is a national protected area, established in 2000 (SI 68 of 2000) under the **Fisheries Act** (1948), the SI including two management zones – the General Use Zone and the Conservation Zone. The protected area is currently managed by the Southern Environmental Association and Belize Fisheries Department, through a co-management letter of arrangement.

Belize has an impressive record of establishing protected areas, with a total of 83 marine and terrestrial reserves, spawning aggregation sites, crown reserve cayes supporting important bird colonies, archaeological reserves, and recognized private reserves. Almost 2,000,000 acres – is designated for conservation (including sustainable resource use) – either as national or private protected areas.

The national objectives for conservation revolve around the protection, conservation and rational use of Belize's natural resources within the context of sustainable human development.

These goals are supported by the National Protected Areas Policy and System Plan (NPAPSP, 2006), which was developed following a full review of the national protected areas system in 2005.

#### GLADDEN SPIT AND SILK CAYES MARINE RESERVE

##### From..SI 68 of 2000

**ALL THAT PORTION** of the Caribbean Sea comprising the General Use Zone and the Conservation Zone and more fully described as follows:-

Commencing at a point BND-NW, lying more than 0.5 miles southeast of Gladden Caye, and having scaled UTM coordinates 389 229 East 1 830 932 North;

thence in a general southeasterly direction to a point BNDM, having scaled UTM coordinates 390 330 East 1824 363 North;

thence in a general southwesterly direction to a point, BND-SW, having scaled UTM coordinates 387 507 East 1 817 964 North;

thence on a bearing of 1350 (true bearing) for 2.50 miles to a point one-half mile outside of the steep reef drop-off at a point BND-SE, having scaled UTM coordinates 390 332 East 1815 123 North;

thence bearing 410 (true bearing) parallel to the reef to a point BND-ES, having scaled UTM coordinates 398 167 East 1824 130 North;

thence bearing 00 (true bearing) to a point BND-EN, having scaled UTM coordinates 398 197 East 1 826 714 North;

thence bearing 3190 (true bearing) parallel to the reef to a point, BND-NE, one-half mile from the steep reef drop-off, and having scaled UTM coordinates 392 095 East 1833 735 North;

thence bearing 2250 (true bearing) for a distance of 2.50 miles, back to the point of origin.

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The Policy was accepted by Cabinet in January 2006, and centers around the following policy statement:

*The Government of Belize shall promote the sustainable use of Belize’s protected areas by educating and encouraging resource users and the general public to properly conserve the biological diversity contained in these areas in order to maintain and enhance the quality of life for all. This shall be achieved by facilitating the participation of local communities and other stakeholders in decision-making and the equitable distribution of benefits derived from them, through adequate institutional and human capacity building and collaborative research and development.*

Gladden Spit and Silk Cayes Marine Reserve is an important component of Belize’s strategies for conservation of the marine environment. Whilst the entire Barrier Reef and associated coral reef structures do not have full protected status within Belize, there are 13 marine protected areas within the system. Eight of these, including Gladden Spit and Silk Cayes Marine Reserve, are designated under Fisheries Department as Marine Reserves, the remaining five being under Forest Department (Table 2). A serial designation also protects identified spawning aggregation sites within Belize, important for maintaining the viability of many commercial species.

Table 2: Marine Protected Areas in Belize				
Protected Area	Mgmt. / Co-mgmt	IUCN Category	SI	Area (Acres)
Bacalar Chico National Park & Marine Reserve	Fisheries Dept.	IV	88 of 1996	15,765.8
Blue Hole Natural Monument	Forest Dept. / BAS	III	96 of 1996	1,023
Caye Caulker Marine Reserve	Fisheries Dept. / FAMRACC	VI	35 of 1998	9,670.2
Corozal Bay Wildlife Sanctuary	Forest Dept.	IV	48 of 1998	180,508.5
Gladden Spit and Silk Cayes Marine Reserve	Fisheries Dept. / Friends of Nature	IV	95 of 2003	25,978.3
Glover’s Reef Marine Reserve	Fisheries Dept.	IV	70 of 1996	86,653
Half Moon Caye Natural Monument	Forest Dept. / BAS	II	30 of 1982	9,771
Hol Chan Marine Reserve	Fisheries Dept.	II	57 of 1987	3,813
Laughing Bird Caye National Park	Forest Dept. / Friends of Nature	II	94 of 1996	10,119
Port Honduras Marine Reserve	Fisheries Dept. / TIDE	IV	9 of 2000	100,000
Sapodilla Caye Marine Reserve	Fisheries Dept. / TASTE	IV	117 of 1996	38,594
South Water Caye Marine Reserve	Fisheries Dept.	IV	118 of 1996	117,875
Swallow Caye Wildlife Sanctuary	Forest Dept. / FOSC	IV	102 of 2002	8,972



**Site Status**

Gladden Spit and Silk Cayes, designated for the protection of the Gladden Spit spawning aggregation site, the congregating whale sharks, and the tourism value of the Silk Cayes, is a Marine Reserve, falling under the mandate of the Fisheries Department of the Ministry of Agriculture and Fisheries (Table 3). Management is guided by the Fisheries Act (1948, revised 1983) and Fisheries Department policies. These allow for zoned multiple use, with no-take areas and areas open for extractive use, regulated under a zoning system that is embedded within the Statutory Instrument.

<b>Table 3: Categories of Protected Areas in Belize</b>			
<b>Category</b>	<b>Legal Foundation</b>	<b>Purpose</b>	<b>Activities Permitted</b>
Nature Reserve	National Parks System Act, 1981	To protect biological communities or species, and maintain natural processes in an undisturbed state.	Research, education
National Park	National Parks System Act, 1981	To protect and preserve natural and scenic values of national significance for the benefit and enjoyment of the general public.	Research, education, tourism
Natural Monument	National Parks System Act, 1981	To protect and preserve natural features of national significance.	Research, education, tourism
Wildlife Sanctuary	National Parks System Act, 1981	To protect nationally significant species, biotic communities or physical features.	Research, education, tourism
Forest Reserve	Forests Act, 1927	To protect forests for management of timber extraction and/or the conservation of soils, watersheds and wildlife resources.	Research, education, tourism, sustainable extraction
Marine Reserve	Fisheries Act, 1948	To assist in the management, maintenance and sustainable yield of fisheries resources	Sustainable extraction, research, education, tourism

SI 68 of 2000 designated the area as a Marine Reserve and defined the boundaries of the General Use and Conservation Zones A series of rules and regulations established in 2003 (SI 95 of 2003) guide both tourism related and commercial fishing practices within the protected area (Annex 2). The Southern Environmental Association, in partnership with Fisheries Department, is responsible for all management activities within the marine protected area.

The Marine Reserve also includes one of the eleven legislated spawning aggregation sites established under SI 161 of 2000 (Table 4), and considered vital for the maintenance of Belize’s commercial finfish stocks. The Fisheries Department (through its on-site staff) and its



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partner, the Southern Environmental Association, are responsible for all management activities for the protected area and the spawning aggregation sites.

Table 4: Spawning Aggregation Sites Protected under SI 161 of 2003			
Protected Area	Location / Affiliated Management Unit	Adjacent to / within MPA	Area (Acres)
Rocky Point	Bacalar Chico Marine Reserve / BFD / Green Reef	Yes	1,402
Dog Flea Caye	Turneffe / BFD	No	1,424
Caye Bokel	Turneffe / BFD	No	1,402
Sandbore	Lighthouse Reef / FD / BAS	No	1,288
South Point Lighthouse	Lighthouse Reef / FD / BAS	No	1,378
Emily / Caye Glory	South Water Caye Marine Reserve / BFD	No	1,351
Northern Glover's	Glover's Reef / BFD	Yes	1,779
Gladden Spit	Gladden Spit and Silk Cayes Marine Reserve/ BFD/SEA	Yes	1,280
Rise and Fall Bank	Sapodilla Cayes Marine Reserve / BFD / SEA	Yes	4,250
Nicholas Caye	Sapodilla Cayes Marine Reserve / BFD / SEA	Yes	1,664
Seal Caye	Sapodilla Cayes Marine Reserve / BFD / SEA	Yes	1,600

BAS: Belize Audubon Society; BFD: Belize Fisheries Department; FD: Forest Department

### National Planning Strategies

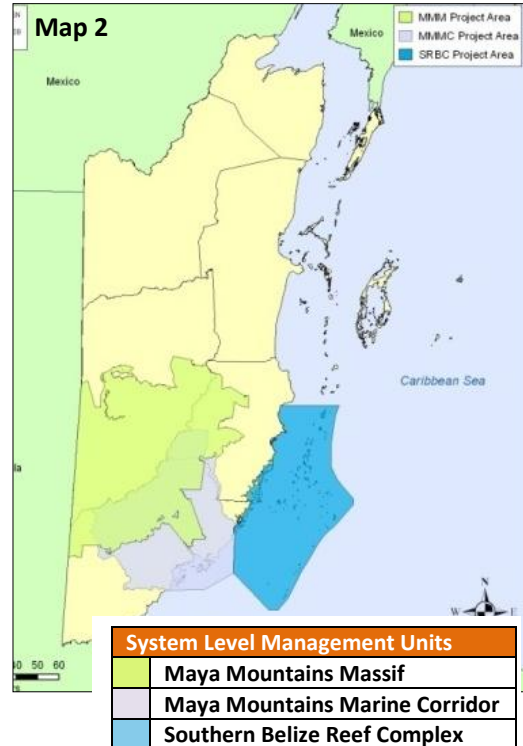
The national objectives for conservation revolve around the protection, conservation and rational use of Belize's natural resources within the context of sustainable human development. These objectives are supported by the **National Strategy on Biodiversity**, through the National Biodiversity Strategy and Action Plan (Jacobs and Castaneda, 1998) (though this was never ratified at Government level), and more recently, the **National Protected Areas Policy and System Plan (NPAPSP)** (Meerman and Wilson; 2005), adopted by the Government of Belize in 2006. Management is theoretically guided by the outputs of the NPAPSP planning, though limited resources currently restrict effective management at Government level.

The overall goals of both the National Biodiversity Strategy and the NPAPSP reflect the national objectives - ecological and economic sustainability over the long term, with the development of human and institutional capacity to effectively manage the biodiversity resources within Belize. There are also moves towards decentralisation of the management of these resources, with a strong focus on co-management partnerships (such as that between SEA and the Belize Fisheries Department), community-based participation and equitable benefit from conservation efforts.

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Under the NPAPSP, government seeks to increase management effectiveness through grouping protected areas into system level management units. Gladden Spit and Silk Cayes Marine Reserve is one of four protected areas (with South Water Caye Marine Reserve, Sapodilla Cayes Marine Reserve and Laughing Bird Caye National Park) that, and their seascape, form the Southern Belize Reef Complex, transcending site-level administrative categories.

Two other such system-level units are currently being established to increase management effectiveness by reducing overlap and maximizing on synergies – the Maya Mountains Massif and the Maya Mountains Marine Corridor (Table 5; Map 2).



System Level Management Unit	Protected Areas
<p><b>Southern Belize Reef Complex</b>  <i>Total number of pas: 4 (including Spawning Aggregation Sites)</i>  <i>Total pa area: 182,447 acres</i>  <i>Total seascape area: 779,682 acres</i></p>	<p>Laughing Bird Caye National Park; South Water Caye Marine Reserve, Gladden Spit and Silk Cayes Marine Reserve, Sapodilla Cayes Marine Reserve                      Spawning Aggregations: Rise and Fall Bank, Nicholas Caye, Seal Caye, Gladden Spit                      Bird Sanctuary: Man O' War Caye</p>
<p><b>Maya Mountains Massif</b>  <i>Total number of pas: 14</i>  <i>Total pa area: 1,260,800</i>  <i>Total landscape area: 1,260,800 acres</i></p>	<p>Bladen Nature Reserve; Chiquibul Forest Reserve; Chiquibul National Park; Cockscomb Basin Wildlife Sanctuary; Columbia River Forest Reserve; Deep River Forest Reserve; Maya Mountain Forest Reserve; Mountain Pine Ridge Forest Reserve; Noj Kaax Me'en Elijo Panti National Park; Sibun Forest Reserve; Sittee River Forest Reserve; Victoria Peak Natural Monument; Vaca Forest Reserve; (also includes Caracol Archaeological Site / IoA)</p>
<p><b>Maya Mountain Marine Corridor</b>  <i>Total number of pas: 10</i>  <i>Total pa area: 619,933 acres</i>  <i>Total landscape area: 729,630 acres</i>  <i>Total seascape area: 100,000 acres</i></p>	<p>Bladen Nature Reserve, Cockscomb Basin Wildlife Sanctuary, Columbia River Forest Reserve, Payne's Creek National Park, Deep River Forest Reserve, Golden Stream Corridor, Block 127, Maya Mountain Forest Reserve, Port Honduras Marine Reserve, Swasey Bladen Forest Reserve (also includes Num Li Punit Archaeological Site / IoA)</p>

**Table 5:** System Level Management Units

Conservation Planning initiatives for these system level management units recognize that resources exist in a larger landscape beyond the boundaries of the protected areas

themselves, and set out discrete goals and objectives at system rather than site-level, increasing management effectiveness through the development of mechanisms for collaboration for surveillance and enforcement and biodiversity monitoring, education, outreach, and management.

### **The Southern Belize Reef Complex**

The **Southern Belize Reef Complex** (SBRC) stretches southwards from the northern boundary of South Water Caye Marine Reserve to the northern boundary of Port Honduras Marine Reserve, and south-eastwards from the coastline of Belize to the Sapodilla Cayes and the outer reef (Map 3). This area is characterized by the variety of reef structures, important cross-shelf habitat linkages and an assemblage of ecosystems considered possibly the most biodiverse in the region. The SBRC is of great scientific value and importance for many species of conservation concern, including the critically endangered hawksbill turtle (*Eretmochelys imbricata*) and goliath grouper (*Epinephelus itajara*), and the endangered green and loggerhead turtles (*Chelonia mydas* and *Caretta caretta*) (IUCN, 2010).

The SBRC encompasses Gladden Spit and Silk Cayes Marine Reserve and three other marine protected areas - Sapodilla Cayes Marine Reserve, South Water Caye Marine Reserve and Laughing Bird Caye National Park. Laughing Bird Caye National Park, Sapodilla Cayes Marine Reserve and South Water Caye Marine Reserve are part of a serial nomination of seven sites that are recognized as components of the Belize Barrier Reef System - World Heritage Site, representing classic examples of fringing, faro and barrier reefs. Also covered within the scope of the SBRC are four legally protected critical spawning aggregation sites – the three sites within the Sapodilla Cayes Marine Reserve, and Gladden Spit, the largest aggregation known in the Mesoamerican Reef ecoregion.

Within the SBRC, the estuarine and coastal areas are considered important for the West Indian manatee, whilst the sandy beaches have a history of use as nesting sites for all three marine turtle species. The near shore mangrove nursery areas and seagrass are regionally important for recruitment for a significant number of

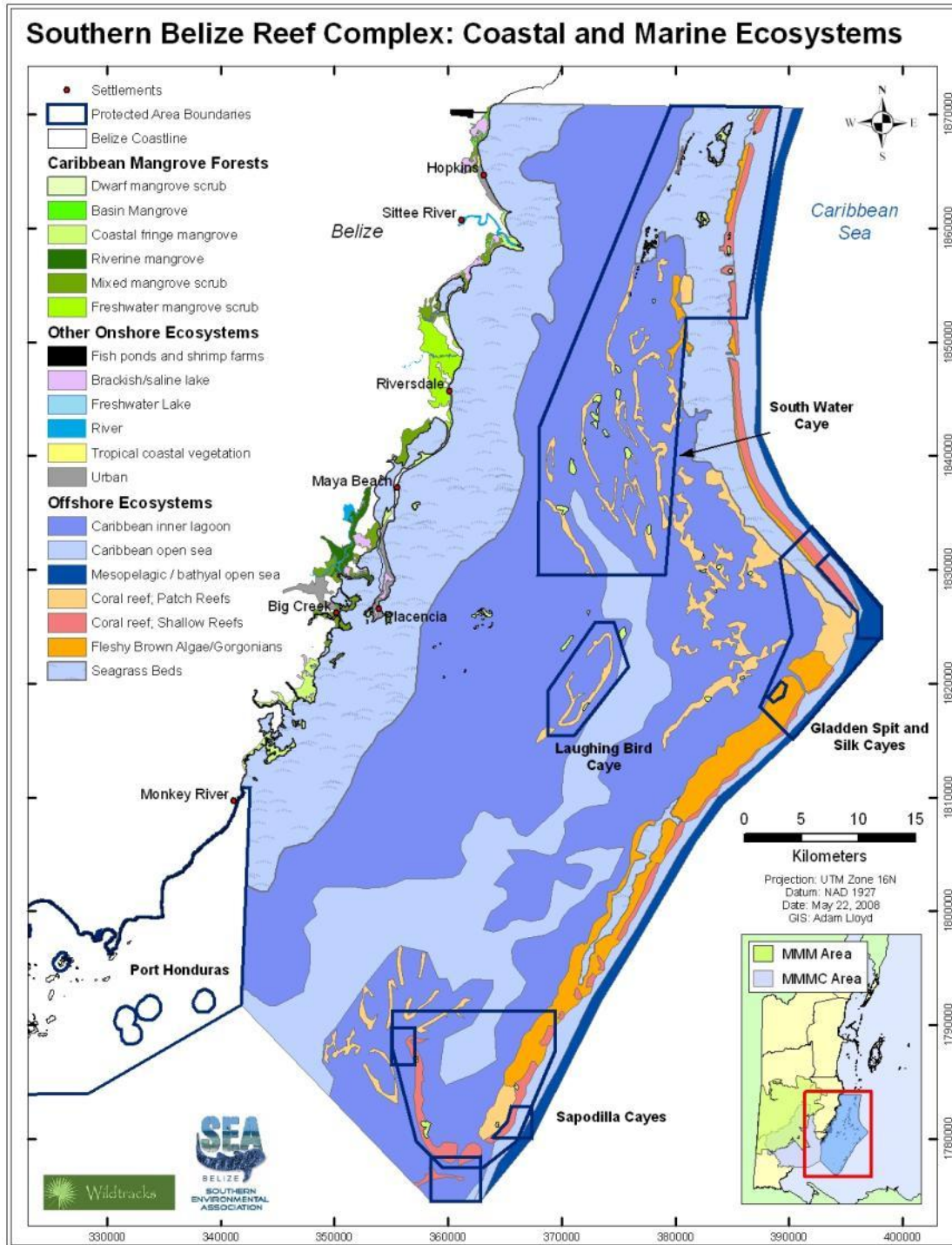
***A collaborative stewardship of the internationally recognized Southern Belize Reef Complex, through strategic partnerships to conserve and improve the integrity of these socio-economically and biologically important ecosystems for the benefit of future generations***

*A collective Vision for the Southern Belize Reef Complex  
Belize CAP Workshop, May, 2008*

the commercial marine species. These resources are an integral part in the support of the cultural traditions of the coastal fishing communities.

## Gladden Spit and Silk Cayes Marine Reserve – Management Plan 2011-2016

As part of the Southern Belize Reef Complex, management of Gladden Spit and Silk Cayes Marine Reserve needs to be aligned to the SBRC vision, with the SBRC goals and objectives for system level management being incorporated into the management planning process.



**Map 3: SBRC Project Scope**

The project scope, running from the northern boundary of South Water Caye Marine Reserve south to the southern boundary of Sapodilla Caye Marine Reserve; and from the mangroves and littoral forests of the coastline to the barrier reef, was defined by the SBRC Core Planning Team, and then later amended following stakeholder input at the first Conservation Action Planning workshop.

## **Legal Framework**

Contributing to the conservation framework of Belize are a number of laws designed to protect wildlife and national heritage. The **Fisheries Act** (1948, revised 1983, and currently being overhauled (2011)), administered under the Fisheries Dept, is the principal governing legislation to regulate the fishing industry, and is directly concerned with maintaining sustainable fish stocks and protecting the marine and freshwater environments. It also provides protection for nesting turtles and nest sites. Marine turtles themselves have been given protection since the original Fisheries Ordinance in 1940. The **Environmental Protection Act** (1992) was developed under the Department of the Environment, under the Ministry of Natural Resources, with the aim of ensuring that development initiatives within Belize are planned for minimum environmental impact – important in managing development impacts from cayes in the seascape adjacent to the Marine Reserve.

Also developed under the Ministry of Natural Resources are the **Forest (Protection of Mangrove) Regulations** (SI 52 of 1989, under revision, 2009), which provide for the protection of mangroves, with restrictions on mangrove alteration and / or clearance. Before granting a permit for mangrove alteration, Belize law requires the Forest Department to consider whether the project will adversely affect the conservation of the area's wildlife, water flow, erosion and values of marine productivity, and to find either 'that the proposed alteration will not significantly lower or change water quality' or that the degradation of water quality is in the "larger and long-term interest of the people of Belize." (Chapter 213, Section 5.5, Belize's Forest Act).

The **Wildlife Protection Act** (SI 12 of 1982, revised 2000) also falls under the Forest Department, and provides protection for a number of marine species (West Indian manatee, whales and dolphins), with the prohibition of hunting and commercial extraction.

The **Mines and Minerals Act** (1989) and the **Petroleum Act** (1991), regulate the exploration and extraction of all non-renewable resources, including petroleum. These Acts also control activities such as dredging, prospecting and drilling which, if conducted in the adjacent seascape, have the potential to impact the Marine Reserve.

Caye development is regulated through the requirement for an Environmental Impact Assessment, (EIA), under the associated **Environmental Impact Assessment Regulations** (SI 105 of 1995) which controls and regulates the EIA process. Under this legislation, an accepted EIA results in the production of an Environmental Compliance Plan (ECP), which is then approved and monitored by the DoE. The Department of the Environment is also responsible for responding to human impacts on the reef, such as pollution, boat groundings and fuel spills. DoE has a mechanism in place for assessment of damage from boat groundings, based on the area impacted.

## Gladden Spit and Silk Cayes Marine Reserve – Management Plan 2011-2016

The Port Authority is mandated to ensure the safety of navigational channels, through the installation of navigational aids (**Belize Port Authority Act**, 1976, revised, 2003) and installation and maintenance of demarcation buoys. It also has a role in the registration of boats and monitoring of vessels using navigational channels and the removal of boats from the reef, when groundings occur.

Financial sustainability is partially addressed at Government level through the development of a funding mechanism to assist in management and development activities within protected areas – the Protected Areas Conservation Trust (**PACT Act**, 1996), through a ‘conservation tax’ of Bz\$7.50 levied on non-residents as they leave the country. The Southern Environmental Association, as the co-management partner, is eligible for funding from the Trust, and has received funding in the past.

There is currently significant fragmentation in decision making, with these different Acts falling under different Ministries. This is being addressed through the **National Protected Areas Policy and System Plan** (NPAPSP; Figure 1), under which a single directive body – the National Protected Areas Committee (NPAC) – has been established. NPAC includes representatives from different Ministries in an attempt to bridge some of the communication gaps that have caused significant problems for protected areas in the past. More recently, the Policy Coordination & Planning Unit has been tasked to strengthen NPAC and ensure a greater level of inter-departmental communication and coordination than has been the case to date. It may still, however, be some time before NPAC becomes fully functional.



## National Protected Area Policy Declaration

### **Recognizing that:**

Protected areas in Belize provide irreplaceable public benefits from ecosystem services such as clean water, clean air, carbon sinks, gene pools, baseline data for research and development, all of which contribute to the local, national and regional economies,

### **And that:**

Protected areas are an important resource base for the development and strengthening of economic activities and contribute to poverty elimination by supporting industries such as agriculture, tourism, fisheries, timber and non-timber products, research, bio-prospecting, mining, water and energy services among others:

***The Government of Belize shall promote the sustainable use of Belize's protected areas by educating and encouraging resource users and the general public to properly conserve the biological diversity contained in these areas in order to maintain and enhance the quality of life for all. This shall be achieved by facilitating the participation of local communities and other stakeholders in decision making and the equitable distribution of benefits derived from them, through adequate institutional and human capacity building and collaborative research and development.***

### **General Principles:**

#### ***The Government of Belize shall:***

- 1. Assure, for all Belizeans, safe, healthy, productive, aesthetically and culturally pleasing surroundings by preserving important historic, cultural, aesthetic and natural aspects of Belize's natural heritage;***
- 2. Promote the widest range of beneficial uses of biodiversity without degradation, risk to health or safety, or other undesirable and unintended consequences in order to provide for sustainable economic development;***
- 3. Achieve a balance between population and biodiversity resource use which will permit a higher standard of living and the conservation of natural resources for future generations;***
- 4. Enhance the quality of renewable resources and strive for the optimum use of non-renewable resources.***

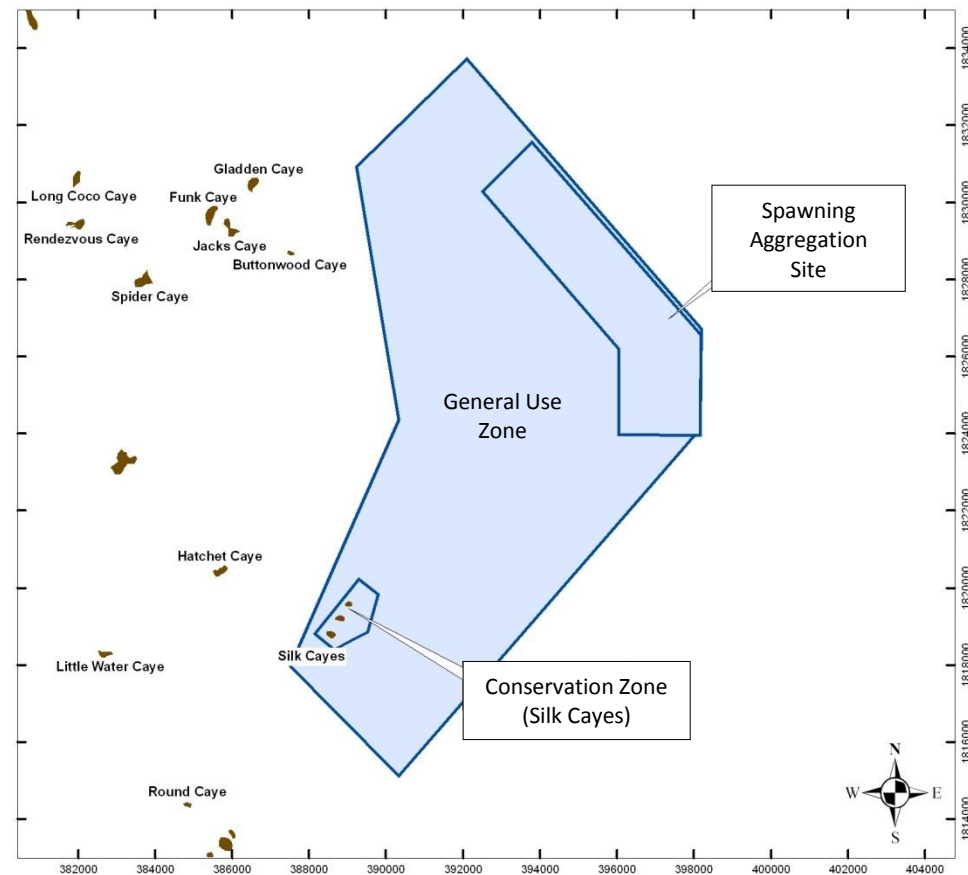
NPAPSP, 2005

Figure 1

### 1.3.2 Land and Sea Tenure

Gladden Spit and Silk Cayes Marine Reserve is a national protected area, included in Belize's territorial waters (Maritime Areas Act of 1992), with Fisheries Department as the legally mandated management authority. The seabed is national land, and thus any construction, such as piers, marinas, and seawalls, needs to be licensed by the Lands Department. Any mining, including beach sand mining or dredging activities, and oil exploration / drilling activities, require a license from the Geology & Petroleum Department.

Belizean fishermen have fished the area for many years, and are considered to have traditional rights to the fishing grounds, though this is regulated to some extent by the Marine Reserve regulations and zones.



**Map 4: Gladden Spit and Silk Cayes Marine Reserve – Zones and Cayes**



### 1.3.3 Evaluation of Protected Area

#### Global Importance

Gladden Spit and Silk Cayes Marine Reserve (GSSCMR) was declared in recognition of the importance and unique nature of the Gladden Spit spawning aggregation site and the natural beauty of the Silk Cayes. The aggregation site itself has also GSSCMR is the site of remarkable spawning aggregations, and has been extensively studied. Spawning behavior has been recorded in over twenty species of reef and near shore pelagic fish species.

Gladden Spit is also one of the few locations in the world known to have predictable aggregations of whale sharks (*Rhincodon typus*), which feed on fish spawn during April, May and June and visit the area year round. An area of critical cultural and natural value GSSCMR has been recognized as a site of key conservation value by The Nature Conservancy, World Wildlife Fund and Conservation International.

The protected waters of the reserve provide nursery and feeding habitats for at least twenty four species of international concern, recognized under the IUCN Redlist as Critically Endangered, Endangered or Vulnerable (Table 5; IUCN, 2010), including at least twenty five species of international concern, recognized under the IUCN Redlist as Critically Endangered, Endangered or Vulnerable (Table 6;

<b>Gladden Spit and Silk Cayes Marine Reserve Species of International Concern</b>	
<b>Critically Endangered</b>	
Staghorn Coral	<i>Acropora cervicornis</i>
Elkhorn Coral	<i>Acropora palmata</i>
Goliath Grouper	<i>Epinephelus itajara</i>
Hawksbill Turtle	<i>Eretmochelys imbricata</i>
<b>Endangered</b>	
Lamarck's Sheet Coral	<i>Agaricia lamarcki</i>
Loggerhead Turtle	<i>Caretta caretta</i>
Green Turtle	<i>Chelonia midas</i>
Pillar Coral	<i>Dendrogyra cylindrus</i>
Elliptical Star Coral	<i>Dichocoenia stokesii</i>
Nassau Grouper	<i>Epinephelus striatus</i>
Fire Coral	<i>Millepora striata</i>
Star Coral	<i>Montastraea annularis</i>
Star Coral	<i>Montastraea faveolata</i>
Montastraea coral	<i>Montastraea franksi</i>
Rough Cactus Coral	<i>Mycetophyllia ferox</i>
Great Hammerhead	<i>Sphyrna mokarran</i>
Scalloped Hammerhead	<i>Sphyrna lewini</i>
<b>Vulnerable</b>	
Queen Triggerfish	<i>Balistes vetula</i>
West Indian Manatee	<i>Trichechus manatus</i>
Marbled Grouper	<i>Dermatolepis inermis</i>
White Grouper	<i>Epinephelus flavolimbatus</i>
Snowy Grouper	<i>Epinephelus niveatus</i>
Hogfish	<i>Lachnolaimus maximus</i>
Mutton Snapper	<i>Lutjanus analis</i>
Cubera Snapper	<i>Lutjanus cyanopterus</i>
Yellowmouth Grouper	<i>Myctoperca interstitialis</i>
Whale Shark	<i>Rhincodon typus</i>
Whitelined Toadfish	<i>Sanopus greenfieldorum</i>
Rainbow Parrotfish	<i>Scarus guacamaia</i>

**Table 6: Species of international Concern of Gladden Spit and Silk Cayes Marine Reserve**

IUCN, 2008), including five species of coral, three species of turtle, fifteen species of fish. The reserve also protects the three small sandy Silk Cayes - popular destinations for day trips from Placencia.

### **National Importance**

Gladden Spit and Silk Cayes Marine Reserve protects Gladden Spit, a promontory formed when the reef makes an almost ninety degree turn about 25 miles off the coast of Placencia. This site has been fished by local fishermen since the 1920's but has risen to prominence in recent years due to the seasonal presence of whale sharks at the spawning site, and its socio-economic value to local communities as a tourism attraction. Over the past ten years, whale shark tourism has become a major part of Belize's tourism economy, and GSSCMR is the only location in the world where visitors can predictably dive with these amazing animals.

The Gladden Spit spawning site world renowned in its diversity with over twenty species of reef fish and near shore pelagics- including jacks, grouper and snapper- observed displaying spawning behavior. These spawning events and the whale sharks they attract have drawn international attention and have been featured on a number of prominent documentaries. The Southern Environmental Association has worked closely with the Belizean authorities and community members to ensure careful management of the spawning aggregation including the development of specific tourism guidelines and fishing regulations. In fact the Gladden Spit spawning site is one of the few sites in Belize reporting stable and even increasing numbers of a variety of important commercial fish species.

Gladden Spit and Silk Cayes Marine Reserve has an estimated yearly use value of approximately US\$1.25 million per year to the tourism industry, and provides over Bz\$136,000 in ticket revenue (Bravo, 2010). Whale shark tourism is a major draw for many visitors to Placencia, and other parts of southern Belize, with over 8,500 guests visiting in 2009. GSSCMR is also of economic importance as a lobster, conch and fin-fish resource for traditional fishermen from mainland fishing communities - particularly Sarteneja, Hopkins, Placencia and Monkey River. Although the small cayes within the reserve boundaries are uninhabited many of the cayes surrounding the reserve have been and continue to be used as fishermen's camps. Fishing is permitted at the spawning site for traditional fishermen, but is strictly regulated, with special licenses granted for fishing Mutton snapper from April-June and absolutely no night fishing allowed. Local fishermen still harvest conch, lobster and fin-fish within the GSSCMR's general use zone.

The GSSCMR, as part of the Southern Belize Reef Complex (SBRC), contributes to the variety of reef structures, important cross-shelf habitat linkages and an assemblage of ecosystems considered possibly the most biodiverse in the region. GSSCMR itself protects a number of high quality coral reefs including some large stands of endangered elkhorn (*Acropora palmate*) and

## Gladden Spit and Silk Cayes Marine Reserve – Management Plan 2011-2016

staghorn (*Acropora cervicornis*) corals. Endangered hawksbill, loggerhead and green turtles frequent the reserve along with dolphins and a variety of ray and shark species. The small Silk Cayes also provide protected nesting sites for Roseate Tern (*Sterna dougalli*), Laughing Gull (*Leucophaeus atricilla*) and the Caribbean subspecies of Osprey (*Pandion haliaetus ridgwayi*).

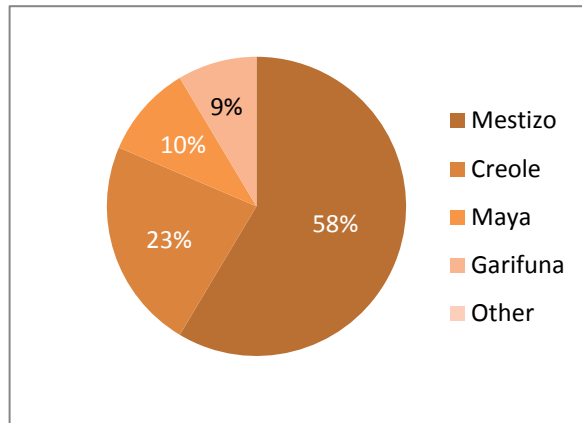
### 1.3.4 Socio-Economic Context

Belize has a low population currently estimated at approximately 307,900 (Figure 2; CIA, 2010), of which 51.2% are urban dwellers (UN data, 2007<sup>2</sup>). Population densities are low, with just over 13.1 persons per sq. km., concentrated mostly within the northern plain, southern coastal plain, Belize Valley and Stann Creek Valley, with much of the remaining country being less suited to habitation, with swampy lowlands and steep terrain in the Maya Mountains. It is a country of many ethnic cultures, with Mestizo, Creole, Maya and Garifuna being the major population groups (Figure 3). The Maya occupants of Belize, descendants of the original Central American civilization, at its height approximately 2,000 years ago, are subdivided into three ethnic groups – the Yucatec Maya of the north, the Mopan Maya of the west and south, and the Ketchi of the southern regions. The northern coastal fishing communities are based on the Mestizo culture, being settled in the 1850's by refugees from the Mexican Caste War. Communities in central Belize, particularly those of the Belize River Valley, are predominantly Creole, founded on the descendents of slaves brought to Belize direct from Africa, or via the West Indies, to work in the logging industry in the late 1700 / early 1800's. The southern coastal communities are more Garifuna based (descendents of Black African / Carib Indian), being settled by refugees who sailed to Belize from St. Vincent's in the West Indies.

**Figure 2: Belize Demographic Statistics (Average)**

Population (2010 est.)	307,899
Population density (2008 est)	13.1/sq. km.
Annual growth rate (2010)	2.2%
Birth rate (2010 est.)	27.3 per 1000
Mortality rate (2010 est.)	5.8 per 1000
Fertility rate (2010)	3.3 children per woman
Life expectancy (2010)	78 (female); 74 (male)
Below Poverty level	33.5% (2002)
	43% (2010)
Literacy rate (2010)	76.9%
Unemployment rate (2008)	8.2%
GDP (2008)	Bz\$2.75 million
GDP (per capita, 2008)	Bz\$9,138 per capita

Ref: UN data, 2010  
CIA Factbook, 2010  
Ministry of Health  
CSO, Mid-term 2004  
CSO, Poverty Assessment Report, 2002



**Figure 3: Belize Demographic Statistics**

<sup>2</sup> World Statistics Pocketbook | United Nations Statistics Division

## Gladden Spit and Silk Cayes Marine Reserve – Management Plan 2011-2016

There is an ongoing emigration of Belizeans to the United States – generally those from urban areas who have completed secondary school or have professional training. There is also a significant influx of Central American refugees – primarily from Guatemala and Honduras – with an estimated 20% of heads of households being born outside of Belize (2010 Poverty assessment data).

The economy of Belize has, in the past, been based largely on agriculture, with fisheries, banana, sugar and citrus forming some of the traditional exports that contribute significantly towards the GDP. This has recently been exceeded by revenue from oil extraction, and there is an increasing reliance on the developing tourism industry, which is rapidly becoming the major foreign exchange earner.

The fishing sector that utilizes Gladden Spit and Silk Cayes Marine Reserve is part of traditional industry that provides employment for over 2,750 fishers (Ministry of Agriculture and Fisheries,

2010). The majority of the Gladden Spit and Silk Cayes Marine Reserve traditional fishermen originate from the mainland communities of Hopkins, Sittie River, Riversdale, Seine Bight, Placencia, Independence and Monkey River, and the northern coastal communities of Sarteneja, Copper Bank and Chunox. Fishing techniques vary, with the more southerly communities using hand lines for finfish, particularly the traditional fishers permitted to use the spawning aggregation sites during the spawning season. There is a switch to free-diving for spiny lobster and queen conch at the opening of lobster and conch seasons, though some fishermen from Dangriga and Hopkins use shade and traps. Fishermen from the northern communities focus more on lobster and conch, and fish these more intensively during the open season, throughout the shallow protected lagoon of the Belize Barrier Reef, including Gladden Spit and Silk Cayes Marine Reserve. Fishermen tend to be between 15 and 35 years of age, often with limited education. Alternative job opportunities in many of these coastal communities, particularly

### State of National Capture Fisheries (2007)

In 2007, overall fisheries production volume decreased by 6.0% from 570.4 tonnes (1,254,861.5 lbs) in 2006 to 534.6 tonnes (1,176,033.7 lbs) in 2007. The overall monetary value of the exports of the capture fishery commodities amounted to BZ\$22,700,000. (SIB and Belize Fisheries Department 2008).

In general, lobster tail production volume increased by 10% from 190 tonnes (419,863 lbs) in 2006 to 210 tonnes (462,152.3lbs) in 2007. The increase in production volume of lobster tails also produced an increase in lobster head meat production volume, from 17.2 tonnes (37,835 pounds) in 2006 to 18.8 tonnes (41,294 lbs) - equivalent to 9.14% in weight - with an export value of \$98,480 in 2007.

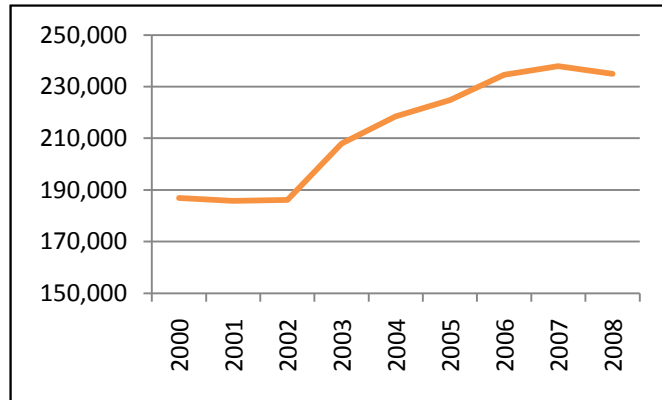
Conch production volume decreased by almost 17% from 314.7 tonnes (692,302.5 lbs) in 2006 to 261.3 tonnes (574,756.1 lbs) in 2007 with an export value amounting to \$5,389,117.

Fish fillet, lobster head meat and whole fish showed an increase in production volume of 37.91 % (from 20 tonnes in 2006 to 27 tonnes in 2007), 9.14% (17 tonnes in 2006 to 19 tonnes in 2007) and 4.64% (4 tonnes in 2006 to 4.3 tonnes in 2007), respectively.

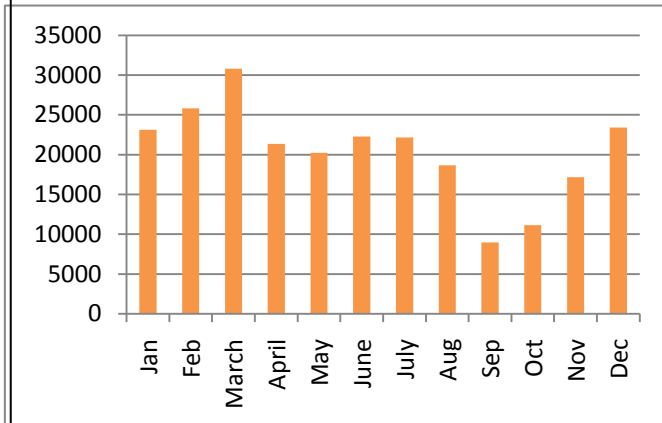
those of the north, are limited, with many fishermen leaving primary school to go directly into fishing (FAO, 2005; SACD, 2009<sup>3</sup>).

The Fisheries Sector (including aquaculture) ranked 4<sup>th</sup> in its contribution to the national GDP, though the actual percentage contribution has declined from 23% in 2006 to 1.5% in 2008, as petroleum exports and tourism sectors continue to grow. Fisheries products are composed of two major components – capture fisheries (predominantly lobster, conch and finfish – representing approximately 45%) and aquaculture (shrimp and tilapia – 55%), primarily for the export market. The primary exploited capture fisheries species, lobster and conch, have both declined since the early 1980’s, when the industry was at its peak. It is estimated that 80% of the lobster and conch is exported through the four fishing cooperatives, and the remaining 20% is sold for local consumption (Cooper et. al. 2008), with the majority of the finfish being marketed locally. Capture fisheries export earnings totaled approximately Bz\$20.5 million dollars in 2008, primarily from the traditional lobster and conch capture fisheries (Ministry of Agriculture and Fisheries, 2008).

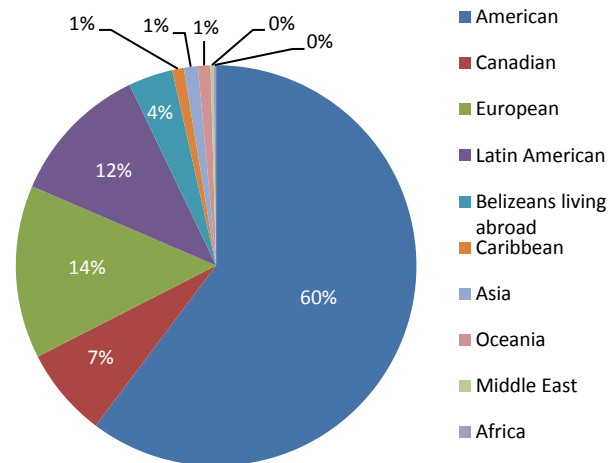
The developing tourism industry, one of the fastest growing sectors in Belize, is also rapidly becoming one of the major foreign exchange earners, with



**Figure 4:** Belize International tourism arrivals (2000 – 2008) (BTB, 2009)



**Figure 5:** Belize International tourism arrivals per month



**Figure 6:** Belize International tourism arrivals by origin (2008) (BTB, 2009)

<sup>3</sup> Sarteneja Tourism Development Plan (SACD, 2009)

over 840,000 tourists arriving in Belize in 2008 (BTB, 2009). Of these, 234,929 (approximately 28%) are overnight visitors (Figure 4), the balance being cruise ship visitation. Overnight tourism in Belize shows a distinct seasonality, with the majority of visitors arriving in the first quarter of the year. The lowest months are September and October, the main tropical storm season (Figure 5). Only a small percentage of these visitors (less than 1%) make it to Gladden Spit and Silk Cayes Marine Reserve, primarily as day visitors. The majority of visitors are snorkelers and divers, with a small number of kayaking groups, and provide substantial employment opportunities for local guides and tourism developments on the mainland.

Gladden Spit and Silk Cayes Marine Reserve, with its dual benefits of idyllic cayes in crystal clear waters, and impressive whale sharks, is an important tourism attraction in Belize. Placencia, the main departure point for tours to GSSCMR, started as a small fishing community with ten hotels (with 58 beds) in 1988, and has since developed into a major tourism destination, with 99 hotels (with 706 beds), with tourism operations generating 12.4% of the national hotel room revenue for 2008 (BTB, 2009). Reef based tourism now also provides substantial employment opportunities for local guides and tourism developments on the mainland. In 1994, tourism in Placencia provided an estimated 19 people with direct employment...steadily increasing to 429 in 2008, approximately 28% of the population of Placencia – a significant shift from fishing to a tourism-based economy.

Placencia is just one of eight communities that have been identified as major stakeholders in the protected area, directly through tourism and/or commercial fishing (Table 7; Map 5). A basic stakeholder analysis identifies stakeholder interests and impacts (Table 8; Table 11).

#### **State of Tourism in Belize**

Tourism is the third ranking productive sector in Belize, contributing 28.2% (BZ\$816.3mn) in 2009, with projections suggesting that this will increase to 31.4% (BZ\$1,601.2mn) by 2020. The tourism sector provided an estimated 34,000 jobs in 2009, 28.3% of total national employment or 1 in every 3.5 jobs. This is predicted to increase to 53,000 jobs, 31.6% of total employment or 1 in every 3.2 jobs by 2020 (WTTC, 2010).

2008 statistics show that the cruise ship visitors far outnumber overnight visitors, but provide less income for the country – it is estimated that the average cruise passenger inputs \$44 per day into the local economy, while the average overnight visitor spends \$96 per day - more than twice as much. Per visit, stay-over visitors spend on average 6.8 days in Belize, which translates into an average of \$653, or over 14 times more than the average cruise passenger.

Currently (2010), Placencia is being targeted as a potential cruise ship tourism destination, and is faced with the decision as to whether to follow this path, or maintain its current reliance on overnight tourism.

**Gladden Spit and Silk Cayes Marine Reserve – Management Plan  
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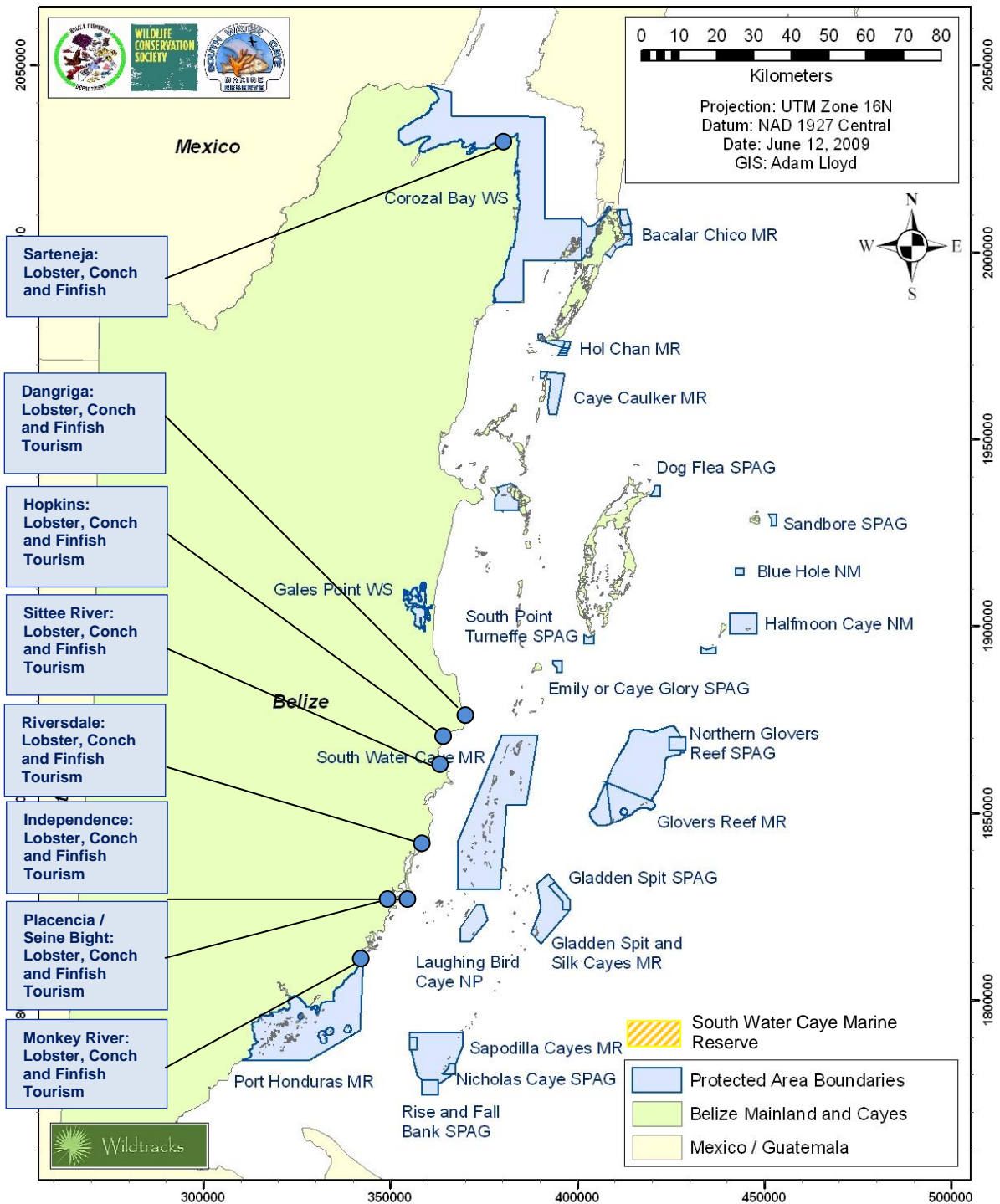
<b>Table 7: Stakeholder Communities of Gladden Spit and Silk Cayes Marine Reserve</b>				
<b>Community</b>	<b>Location (UTM) Distance (km)</b>	<b>Population (approx.)</b>	<b>Population components</b>	<b>Comments</b>
<b>Sarteneja</b>	E16 0378750 N18 2029500 (158 km)	2,300 <sup>1</sup>	Mestizo	Largest fishing community, concentrating on lobster and conch throughout Belize waters using traditional sail boats. Largest number of fishermen utilizing natural resources of GSSCMR.
<b>Hopkins</b>	E16 0363200 N18 64680 (13km)	1,027 <sup>2</sup>	Garifuna	Small number of skiffs, focused on GSSCMR and adjacent seascape - hand lines, traps and shades. Tourism Tourism developments (eg. Hamanasi and Kanantik)
<b>Sittee River</b>	E16 0363200 N18 64680 (13.3km)	641 <sup>2</sup>	Garifuna	Fishing community gradually shifting to tourism. Current impacts on manatee population – illegal slaughter for meat (2010).
<b>Independence</b>	E16 0348723 N18 2027872 (39 km)	2,880 <sup>3</sup>	Mixed – primarily Creole	Fish the aggregation sites and at start of open season for lobster and conch
<b>Monkey River</b>	E16 0341187 N18 09691 (km)	200 <sup>2</sup>	Creole	Fish the aggregation sites and at start of open season and at start of open season for lobster and conch. Tourism
<b>Placencia (including Riversdale)</b>	E16 03653894 N18 26544 (14.3km)	1,200 <sup>4</sup>	Predominantly Creole	Historically a fishing community – now a primarily tourism based economy
<b>Seine Bight</b>	E16 0363200 N 18 64680 (km)	831 <sup>3</sup>	Garifuna	Historically a fishing community – now moving towards primarily tourism based economies

<sup>1</sup>Sarteneja Health Committee, 2005; <sup>2</sup>CSO Census data, 2000; <sup>3</sup>Abstract of Statistics, 2007; <sup>4</sup>SEA



# Gladden Spit and Silk Cayes Marine Reserve – Management Plan 2011-2016

## Primary Stakeholder Communities of Gladden Spit and Silk Cayes Marine Reserve



**Map 5: Principal Stakeholder Communities of Gladden Spit and Silk Cayes Marine Reserve**



## **Gladden Spit and Silk Cayes Marine Reserve – Management Plan 2011-2016**

Due to its location within the Gulf of Honduras, Gladden Spit experiences significant impact from Honduran and, to a lesser extent, Guatemalan fishermen, who, whilst fishing illegally, should still be considered stakeholders. These incursions predominantly occur at night, and are part of organized businesses operating out of these neighbouring countries.

**Gladden Spit and Silk Cayes Marine Reserve – Management Plan  
2011-2016**

<b>Table 8: Stakeholder Analysis for Gladden Spit and Silk Cayes Marine Reserve</b>						
<b>Stakeholder</b>	<b>Influence or Impact of Gladden Spit and Silk Cayes Marine Reserve on Stakeholder</b>			<b>Influence or Impact of Stakeholder on Gladden Spit and Silk Cayes Marine Reserve Marine Reserve</b>		
<b>Community Stakeholder</b> Hopkins, Sittee River, Seine Bight, Riversdale, Placencia, Monkey River, Independence	<ul style="list-style-type: none"> <li>▪ Management of reef, spawning aggregation site and whale shark congregation for tourism and fisheries</li> <li>▪ Shifting income base from fisheries dependency to tourism, with increased economic benefits</li> <li>▪ Focus of NGOs on education, awareness and alternative livelihoods for fishermen, associated with the protected area</li> <li>▪ Protection of reef resources in perpetuity for future generations</li> <li>▪ Exclusion from traditional fishing areas</li> </ul>	+	+	<ul style="list-style-type: none"> <li>▪ Cooperation and collaboration towards effective protected areas management</li> <li>▪ Greater awareness amongst community stakeholder – particularly youth – of the importance of reef and environmental services they provide</li> <li>▪ Adoption of reef tourism Best Practices through awareness and alternative livelihood training</li> <li>▪ Illegal fishing within the Conservation areas</li> <li>▪ Anchor damage to coral and seagrass</li> </ul>	+	+
<b>Community Stakeholder</b> Sarteneja	<ul style="list-style-type: none"> <li>▪ Management of reef and spawning aggregation site for fisheries</li> <li>▪ Protection of fish, lobster and conch resources within the Conservation Zone ensuring continued viability of fishery</li> <li>▪ Exclusion from traditional fishing areas</li> </ul>	+	+	<ul style="list-style-type: none"> <li>▪ Low level of cooperation or openly antagonistic towards protected area</li> <li>▪ Illegal fishing within the Conservation Zone</li> <li>▪ Fishing impacts within protected areas (including damage to coral)</li> <li>▪ Anchor damage to reef</li> </ul>	-	-
<b>Commercial Fishermen</b>	<ul style="list-style-type: none"> <li>▪ Management of reef and spawning aggregation site for fisheries</li> <li>▪ Protection of fish, lobster and conch resources within the Conservation Zone ensuring continued viability of fishery</li> <li>▪ Exclusion from traditional fishing areas</li> </ul>	+	+	<ul style="list-style-type: none"> <li>▪ Some support for effective management of protected area (southern communities)</li> <li>▪ Low level of cooperation or openly antagonistic towards protected area (Sarteneja)</li> <li>▪ Illegal fishing within the Conservation Zone</li> <li>▪ Fishing impacts within protected areas (including damage to coral)</li> <li>▪ Anchor damage to reef</li> </ul>	-	-

**Gladden Spit and Silk Cayes Marine Reserve – Management Plan  
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Table 11: Stakeholder Analysis for Gladden Spit and Silk Cayes Marine Reserve (cont.)				
Stakeholder	Influence or Impact of Gladden Spit and Silk Cayes Marine Reserve on Stakeholder		Influence or Impact of Stakeholder on Gladden Spit and Silk Cayes Marine Reserve	
<b>Tour Guides (including tour boat captains)</b>	<ul style="list-style-type: none"> <li>▪ Benefit from having Gladden Spit and Silk Cayes Marine Reserve as a major venue for snorkeling, dive- and kayak-associated tourism</li> <li>▪ Benefit from the management of tourism access to the whale shark congregation at Gladden Spit as a major venue for snorkeling and dive-associated tourism</li> <li>▪ Benefit from training opportunities associated with Gladden Spit and Silk Cayes Marine Reserve</li> <li>▪ Employment in reef-based tourism initiatives</li> <li>▪ Income from using Gladden Spit and Silk Cayes Reserve for tourism</li> </ul>	+  +  +  +  +	<ul style="list-style-type: none"> <li>▪ Support the conservation goals of Gladden Spit and Silk Cayes Marine Reserve</li> <li>▪ Provide interpretation for visitors, facilitating overall visitor appreciation</li> <li>▪ If well trained, assist with visitor management within the protected area through in-depth briefings</li> <li>▪ If poorly trained, can result in poor visitor management and increased impact on corals and associated fauna, anchor damage etc.</li> <li>▪ Impact behaviour of fish through feeding</li> <li>▪ Potential impact on spawning aggregation and whale sharks from dive boat noise impacts</li> <li>▪ Anchor damage to coral and seagrass</li> <li>▪ Illegal fishing impacts within Conservation Zone at Silk Cayes from campers and overnighting sail charters</li> <li>▪ Camping impacts on Silk Cayes from kayak groups</li> </ul>	+  +  -  -  -  -
<b>Local / National Tour Operators</b>	<ul style="list-style-type: none"> <li>▪ Benefit from having Gladden Spit and Silk Cayes Marine Reserve as a major venue for dive- and snorkeling-associated tourism</li> <li>▪ Benefit from the management of tourism access to the whale shark congregation at Gladden Spit as a major venue for snorkeling and dive-associated tourism</li> <li>▪ Income from using Gladden Spit and Silk Cayes Marine Reserve as a tourism destination</li> </ul>	+  +  +	<ul style="list-style-type: none"> <li>▪ Provide marketing at a national level, and send visitors to Gladden Spit and Silk Cayes Marine Reserve</li> <li>▪ Support the conservation goals of Gladden Spit and Silk Cayes Marine Reserve</li> <li>▪ Provide a financial sustainability mechanism for management of the protected area</li> <li>▪ Increase the potential for exceeding the carrying capacity of the protected area</li> </ul>	+  +  +  -

**Gladden Spit and Silk Cayes Marine Reserve – Management Plan  
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Table 8: Stakeholder Analysis for Gladden Spit and Silk Cayes Marine Reserve (cont.)					
Stakeholder	Influence or Impact of Gladden Spit and Silk Cayes Marine Reserve on Stakeholder			Influence or Impact of Stakeholder on Gladden Spit and Silk Cayes Marine Reserve	
<b>International Tour Operators</b>	<ul style="list-style-type: none"> <li>▪ Benefit from having Gladden Spit and Silk Cayes Marine Reserve as a major venue for dive- and snorkeling-associated tourism</li> <li>▪ Benefit from the management of tourism access to the whale shark congregation at Gladden Spit as a major venue for snorkeling and dive-associated tourism</li> <li>▪ Income from using Gladden Spit and Silk Cayes Marine Reserve as a tourism destination</li> </ul>	+	+	<ul style="list-style-type: none"> <li>▪ Provide marketing at a national level, and send visitors to Gladden Spit and Silk Cayes Marine Reserve</li> <li>▪ Support the conservation goals of Gladden Spit and Silk Cayes Marine Reserve</li> <li>▪ Provide a financial sustainability mechanism for management of the protected area</li> <li>▪ Increase the potential for exceeding the carrying capacity of the protected area</li> </ul>	+
<b>BTIA</b>	<ul style="list-style-type: none"> <li>▪ Benefit from having Gladden Spit and Silk Cayes Marine Reserve and the whale shark congregation as a tourism draw,</li> </ul>	+	+	<ul style="list-style-type: none"> <li>▪ Providing national and international marketing of Gladden Spit and Silk Cayes Marine Reserve</li> <li>▪ Support the conservation goals of Gladden Spit and Silk Cayes Marine Reserve</li> </ul>	+
<b>General Belize Public (excluding primary stakeholder communities)</b>	<ul style="list-style-type: none"> <li>▪ Maintenance of fish, lobster and conch stocks</li> <li>▪ Maintenance of spawning aggregation and whale shark congregation</li> <li>▪ Environmental services</li> <li>▪ Cultural and aesthetic appreciation</li> <li>▪ Increased awareness through education</li> </ul>	+	+	<ul style="list-style-type: none"> <li>▪ Support of the general public will strengthen the position of protected area</li> <li>▪ Lack of support may increase chances of dereservation</li> </ul>	+
<b>Visitors: Tourists</b>	<ul style="list-style-type: none"> <li>▪ Enjoy Gladden Spit and Silk Cayes Marine Reserve as a tourism destination</li> <li>▪ Benefit from education and awareness opportunities</li> </ul>	+	+	<ul style="list-style-type: none"> <li>▪ Entrance fee contributes towards the goal of sustainability</li> <li>▪ Provide marketing nationally and internationally by word of mouth, if happy with level of product</li> <li>▪ Presence deters illegal fishing within the Conservation Zone and Spawning Aggregation Site</li> <li>▪ Negatively impact marine and terrestrial environments</li> </ul>	+

**Gladden Spit and Silk Cayes Marine Reserve – Management Plan  
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Table 8: Stakeholder Analysis for Gladden Spit and Silk Cayes Marine Reserve (cont.)					
Stakeholder	Influence or Impact of Gladden Spit and Silk Cayes Marine Reserve on Stakeholder			Influence or Impact of Stakeholder on Gladden Spit and Silk Cayes Marine Reserve	
<b>Visitors: Researchers</b>	<ul style="list-style-type: none"> <li>▪ Benefit from being linked to Gladden Spit and Silk Cayes Marine Reserve</li> <li>▪ Benefit from access to a virtually pristine reef environment, spawning aggregation site and whale shark congregation</li> <li>▪ Benefit from historic baseline information on past research activities within protected areas</li> </ul>	+	+	<ul style="list-style-type: none"> <li>▪ Conservation management benefits from data gathered, greater knowledge of marine and terrestrial environments and species within area</li> <li>▪ Benefit from increased research activity within area</li> <li>▪ Possible impact of research activities on marine environments</li> </ul>	+  + -
<b>Sailboat Charter Companies</b>	<ul style="list-style-type: none"> <li>▪ Benefit from protection of Gladden Spit and Silk Cayes Marine Reserve as a major bareboat destination</li> </ul>	+	+	<ul style="list-style-type: none"> <li>▪ Support the conservation goals of Gladden Spit and Silk Cayes Marine Reserve</li> <li>▪ Impacts of sewage and detergent, bilge water, grey water and oil</li> <li>▪ Visual impact of non-traditional sailing boats</li> <li>▪ Anchor damage on mooring sites</li> <li>▪ Potential for grounding on the reef</li> <li>▪ Lack of compliance to rules and regulations due to limited awareness</li> </ul>	+  - - - -
<b>Government of Belize</b>	<ul style="list-style-type: none"> <li>▪ Provides fisheries management for fishing Industry</li> <li>▪ Provides environmental services</li> <li>▪ Gladden Spit and Silk Cayes Marine Reserve included within the National Protected Areas System Plan - assists in fulfilling Belize Government's commitment to the conservation of natural resources, CCAD, CBD, and MBRS</li> <li>▪ Income generation of significant foreign revenue</li> <li>▪ Provides employment opportunities in stakeholder communities</li> </ul>	+	+	<ul style="list-style-type: none"> <li>▪ Political support (currently being strengthened through the NPAPSP)</li> <li>▪ Lack of political support</li> <li>▪ Uncertainty of long term future commitment</li> </ul>	+  - -

## 1.4 Physical Environment of Management Area

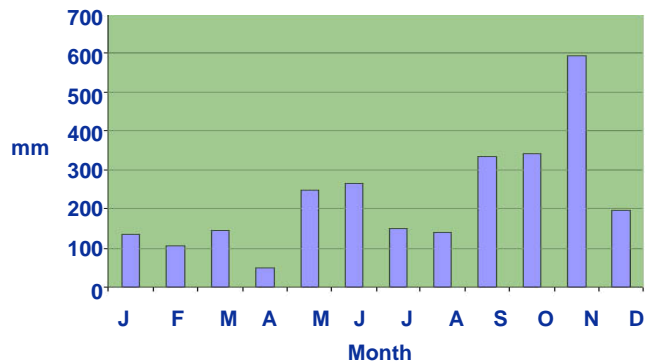
### 1.4.1 Climate

#### Temperature and Rainfall

Whilst Gladden Spit and Silk Cayes Marine Reserve lies only 36kms from Placencia, on mainland Belize, it has a distinct climate that differs from the rest of the Country. Carrie Bow Caye, 35km to the north, within the adjacent South Water Caye Marine Reserve, has been selected as a long term monitoring site, information on meteorological, oceanographic, and biological conditions having been recorded for the area since 1993, under the Caribbean Coastal Marine Program (CARICOMP) - one of the longest continuous programs of its type. Principal parameters recorded are land-sea-water temperatures, water salinity (conductivity), dissolved oxygen, solar radiation, tides, wind direction and speed, and rainfall (CCRE 2002).

Rainfall varies throughout the year - there is a pronounced dry season stretching from January through to the end of April, with minimum monthly rainfall of as low as 47mm in April, the driest month. This is followed by a wetter season (May to December) with maximum monthly rainfalls in the region of 300 and 600mm, punctuated by a mini dry season in July/August. The majority of the rain falls within the hurricane season, associated with passing tropical storms, particularly between September and November (Figure 7).

Annual temperatures on Carrie Bow Cay average 27.1°C, fluctuating throughout the year from a minimum of 23.5°C in January, during the cold fronts, and a maximum in September of 29.2°C (Table 9; Caribbean Coral Reef Ecosystems Program, 2005)



**Figure 7: Rainfall - Carrie Bow Caye (2002 – 2004)**

Month	Mean Temperature 2002 - 2004	Mean Total Rainfall (mm) 2002 - 2004
January	24.61	136
February	25.08	106
March	26.47	146
April	26.88	47
May	27.96	248
June	28.60	264
July	28.39	149
August	28.83	140
September	29.06	334
October	28.30	342
November	26.45	594
December	24.95	196

**Table 9: Mean Temperature and Rainfall  
(Carrie Bow Caye, 2002 – 2004)**

## Gladden Spit and Silk Cayes Marine Reserve – Management Plan 2011-2016

**Weather Systems:** Belize is affected by three very distinct seasonal weather systems: trade winds, northers and tropical storms. All three have an influence on the rainfall and temperature patterns, on the sea level, and on the currents around the Gladden Spit and Silk Cayes Marine Reserve itself.

- **Trade Winds** – the predominant winds, blowing from the east and north-east
- **Northers** - high-pressure fronts moving down from the north, occurring between October and April
- **Tropical Storms** - occurring between June and November, originating in the mid-Atlantic

**Tropical Storms:** Tropical storms affect Belize every year, with the effects being felt particularly strongly on the outlying cayes and atolls. Originating in the Atlantic Ocean over warm, tropical waters, these storms are non-frontal, developing highly organized circulations, and ranging in scale from tropical depressions and tropical storms (with sustained wind speed < 74 mph) to hurricanes (with sustained wind speed > 74 mph). These storms move westward towards the Caribbean, gathering strength until they hit land.

The hurricane season stretches from the month of June through November, with historical records identifying ten hurricanes and nine tropical storms that have passed within a 50-km radius of Gladden Spit and Silk Cayes Marine Reserve (Table 10; NHC, 2010). Whilst many hurricanes have very focused paths of destruction, their effects are wide ranging, particularly at sea. As well as the physical and mechanical damage to the coral, hurricanes also stir up the water, increasing turbidity and can reduce water clarity for a significant time after the storm event itself. Water clarity can be further reduced following tropical storms by the associated heavy rainfall, which can exacerbate erosion and increase sediment transport from the mainland via the rivers.

The most recent extreme hurricane impacts have been from Hurricane Mitch (1998) and Hurricane Iris (2001). In late October, 1998, shortly after peak bleaching temperatures, Hurricane Mitch swept across the Gulf of Honduras. The storm then stopped for 2 days adjacent to the Bay Islands of Honduras, approximately 150 miles (244 km) south west of Gladden Spit. The storm tide at Gladden Spit was reported to reach 2.8m, with up to 29% of coral colonies showing signs of mechanical damage (FoN, 1999). In 2001, Hurricane Iris passed almost directly over Gladden Spit, with waves of between 4 and 5.5 meters above normal (Bood, 2001). As with

Name	Cat.	Year	Date Passed GSSCMR
Not named	H1	1906	13 <sup>th</sup> October
Not named	H1	1918	26 <sup>th</sup> August
Not named	TS	1931	16 <sup>th</sup> August
Not named	TS	1933	30 <sup>th</sup> September
Not named	TS	1934	8 <sup>th</sup> June
Not named	TS	1938	11 <sup>th</sup> October
Not named	TS	1943	22 <sup>nd</sup> October
Not named	H1	1945	4 <sup>th</sup> October
Gilda	TS	1954	27 <sup>th</sup> September
Abby	H1	1960	15 <sup>th</sup> July
Anna	H1	1961	24 <sup>th</sup> July
Francelia	H2	1969	3 <sup>rd</sup> September
Laura	TS	1971	21 <sup>st</sup> November
Fifi	H2	1974	19 <sup>th</sup> September
Greta	H3	1978	19 <sup>th</sup> September
Gert	TS	1993	16 <sup>th</sup> September
Kyle	TS	1996	12 <sup>th</sup> October
Mitch*	H5	1998	
Iris	H4	2001	9 <sup>th</sup> October

TS: Tropical Storm  
H: Hurricane  
H1: Category 1: winds > 74 – 95mph  
H2: Category 2: winds 96 - 110mph  
H3: Category 3: winds 111 - 130mph,  
H4: Category 4: winds 131 – 155mph  
\*Whilst Mitch did not pass within 50km, it had a huge impact on the reef in the area

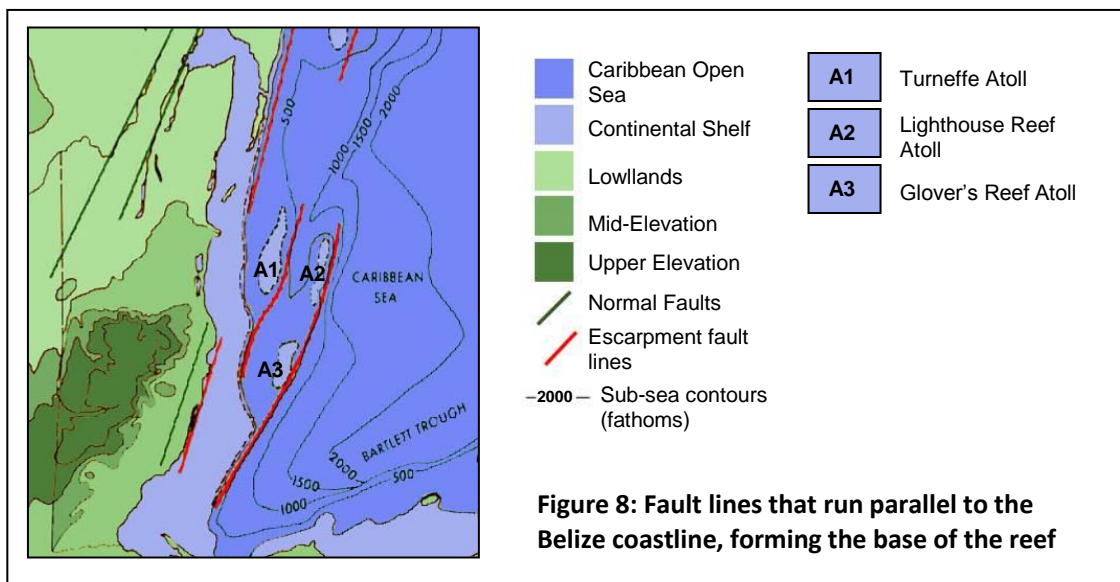
**Table 10: Hurricanes Affecting Gladden Spit and Silk Cayes Marine Reserve (<50km) ([www.nhc.noaa.gov](http://www.nhc.noaa.gov))**

Hurricane Mitch, the event occurred shortly after a period of unusually high water temperatures, the increased hurricane activity being correlated with the same high water temperatures that caused the bleaching event. Survey sites within Gladden Spit and Silk Cayes Marine Reserve reported a 58% incidence of coral bleaching, with no significant increase in bleaching following the hurricane. The most recent hurricane, Hurricane Richard, passed to the north with minimal impact.

### 1.4.2 Geology

The Belize continental shelf underlies the entire coastline of Belize and extends seaward 15-40 km from the coast. It is a complex underwater platform of Pleistocene limestone rock that ends abruptly on top of the first of three northeast-southwest escarpments that lie off the coastline. The first escarpment runs parallel to the coast, dropping off to the east to a depth of about 1km (Figure 8). An extensive reef system has developed upon the rim of this escarpment, forming the Belize Barrier Reef (Rath, 1996), sheltering the lagoon to the west. Cayes dot this platform, some formed on mangrove peat, others from coral outcrops and sand deposition.

The second ridge supports Turneffe Atoll, and joins the main barrier reef escarpment north of South Water Caye Marine Reserve. The third provides the foundation for Lighthouse Reef and Glover’s Reef Atolls, and then extends south to eventually intersect the Barrier Reef at Gladden Spit itself, forming the ‘elbow, providing the conditions required for the regionally important spawning aggregation site. At this point, the escarpment drops to the east to a depth of 250m. Beyond this, a further two deeper ridges eventually fall into the Cayman Trench, which reaches depths of up to 7.5 kilometers.



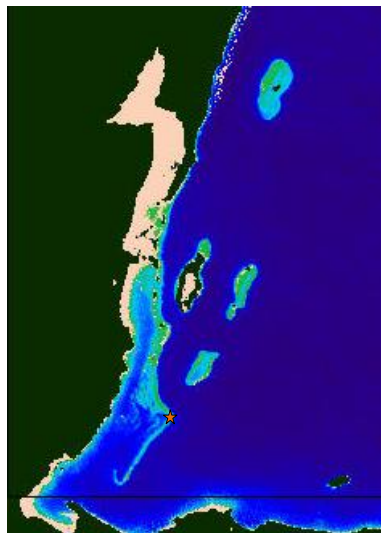
The central province, in which the northern portion of Gladden Spit and Silk Cayes Marine Reserve is located, contains some of the most spectacular reef development, with an almost continuous well-developed barrier reef, three sand cays and numerous patch reefs and seagrass beds in the center and



landward edge of the barrier platform (Burke, 1982; Macintyre and Aronson, 1997). To the south of the Spit, the barrier reef is less well formed. The dividing point – Gladden Spit itself - is a unique geological feature with a series of mid-shelf reefs (Kramer and Kramer, 2002).

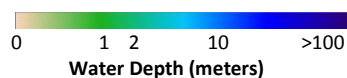
### 1.4.3 Bathymetry

Belize has an extensive maritime area of 10,000km<sup>2</sup> (Hartshorn et. al., 1984). Unique to this area is a 250 km long barrier reef that extends from the tip of the Yucatan Peninsula southward into the Gulf of Honduras (Burke, 1982). Seaward of the reef crest are three coral atolls: Glover’s Reef, Lighthouse and Turneffe Islands Atolls.



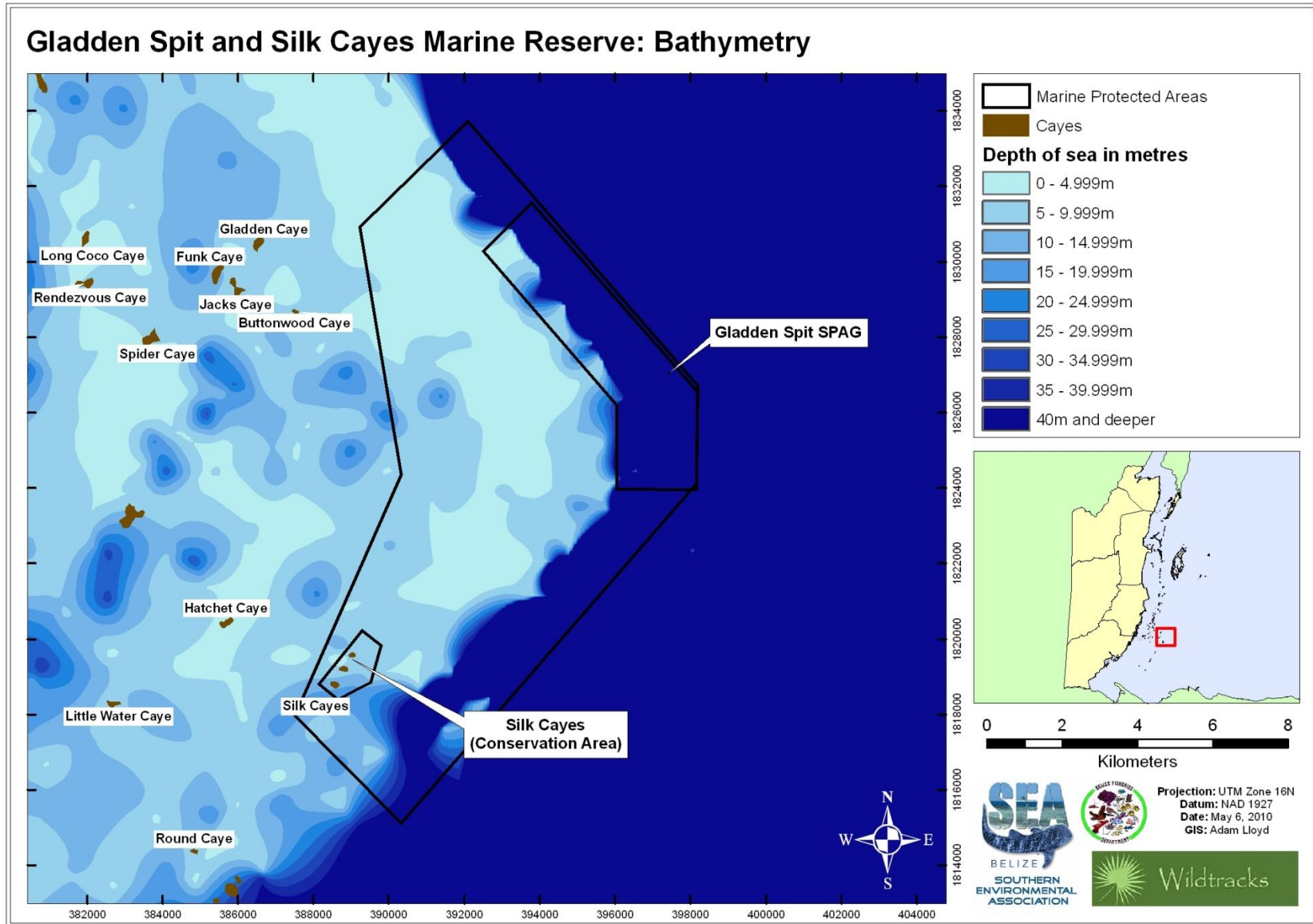
The barrier reef complex has been divided into three provinces based on their community distribution and geomorphic characteristics: Northern, Central, and Southern Provinces (Burke, 1982). The protected area spans both the Central and Southern Provinces, with Gladden Spit forming the division between the two. The depths of the water over these reefs are less than 5 meters forming exposed reefs during low tides. Depth contours for the inner lagoon increase from 10 meters to 40 meters toward the center of the lagoon. Outside the main barrier, the reef slopes gradually from 10 meters to 50 meters (Figure 9).

Within the Marine Reserve, there is a clear distinction between the reef lagoon and the reef drop-off (Maps 5 and 6).

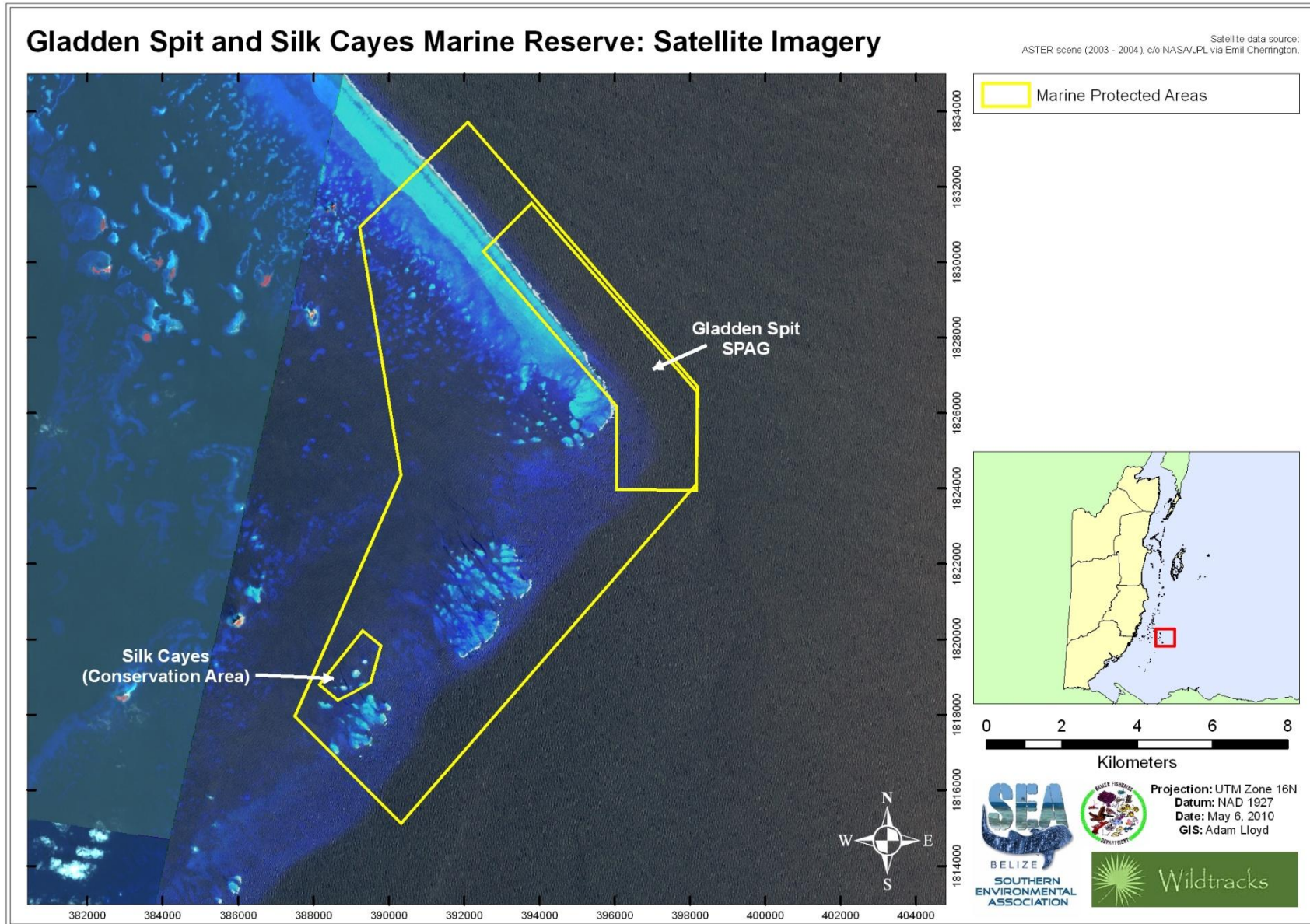


★ Gladden Spit and Silk Cayes  
Marine Reserve

**Figure 9: Water Depth  
(SeaWiFS, 1999)**



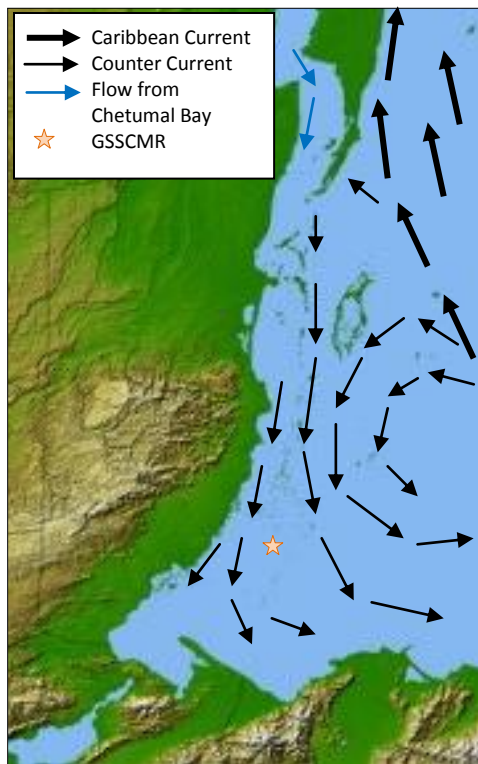
Map 5: Gladden Spit and Silk Cayes Marine Reserve: Bathymetry (estimated)



Map 6: Gladden Spit and Silk Cayes Marine Reserve: Relief (Satellite)



### 1.4.4 Tides and Water Movement



Knowledge of currents is essential in determining the transport of larvae, nutrients and pollutants, as well as abetting the spread of disease and invasions (demonstrated by the rapid spread of disease in *Diadema antillarum* throughout the Caribbean region in the 1980's). Connectivity through currents has also resulted in the rapid invasion of Belize by the lionfish (*Pterois volitans*), which has been increasing exponentially at Gladden Spit and Silk Cayes Marine Reserve, as part of a larger, regional invasion. An initial, isolated report of its presence was recorded in 2001, in the Laughing Bird Caye area (B. Sutton / Ecomar), though no more were seen until 2009, when populations have grown exponentially.

On a regional scale, the main oceanic current, the warm-water Caribbean Current, forms the main surface circulation in the Caribbean Sea, flowing westwards from the Lesser Antilles towards southern Belize, then northwards offshore, beyond the atolls, eventually through the Yucatan Channel,

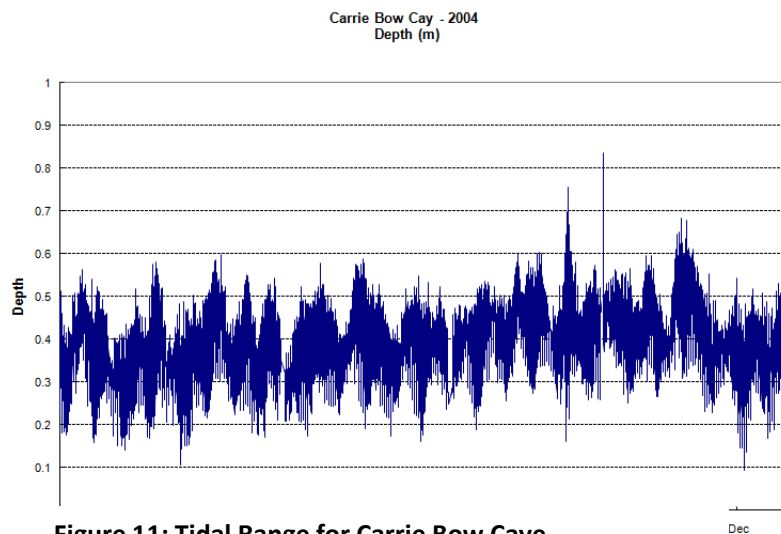
with an average flow rate of between 38 to 43 cm (15 to 17 inches) per second. This creates a counter

**Figure 10: Currents of the Belize Reef**  
(after Ezer et al., 2005)

clockwise gyre in the Gulf of Honduras area, including much of the coastal waters of Belize, which flows south / southwestwards past the Belize coastline and Barrier Reef (Figure 10;

Heyman et. al., 2000; Stoddart, 1962), in the shelf lagoon and offshore basins (Purdy et al., 1975), with strong currents up to 5 knots in the reef channels especially during low tides.

Tides in the central region of the Belize reef system are considered to be microtidal, with a mean range of 15 cm at Carrie Bow Cay (Kjerfve et al., 1982) and 21 cm at Twin Cays (Wright et al., 1991), and averaging an estimated 30cm throughout the area (Figure 11; Stoddart, 1962; Caribbean Coral Ecosystems Program, 2005). The currents generated by these tides as they pass through reef cuts and at river mouths are thought to



**Figure 11: Tidal Range for Carrie Bow Caye**  
(<http://cbc.riocean.com>, accessed 2009)

play a significant role in the spatial dispersion of sediment, nutrients, and larvae along the shallow reef flats and back reef (Heyman & Kjerfve, 2001).

Winds may have a more influential impact on sea level than tides, with strong north winds resulting in currents shifting to a more southerly direction, and lower sea levels - throughout Belize, the northerly winds are known to depress the water level on the mainland by as much as a foot for several days at a time during the early part of the year. This is true on the reef as well, and probably has a greater influence on shallow water and reef crest biodiversity than the regular tides (Stoddart, 1962; Caribbean Coral Ecosystems Program, 2005).

### 1.4.5 Water Parameters

Smithsonian Institute Field Station has been monitoring basic water parameters within South Water Caye Marine Reserve since 1994 / 1995 in the central reef region – this monitoring site is considered sufficiently close (approximately 22 miles/ 35km to the north) to provide an indication of conditions within Gladden Spit and Silk Cayes Marine Reserve (Table 11).

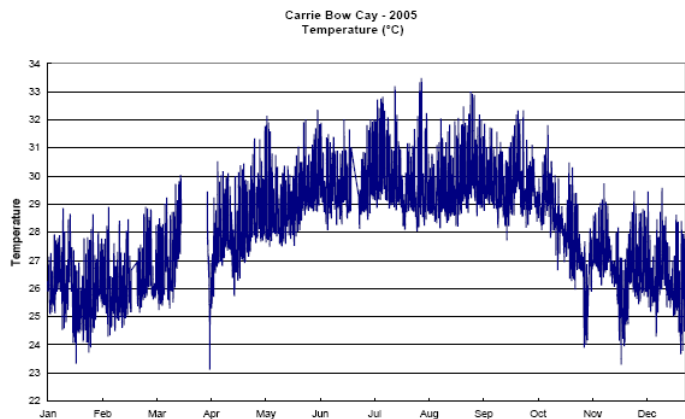
Data Set	Visibility (m) (Range)	Salinity (ppt) (Mean Monthly Range)	Temperature (°C) Mean Monthly Range
Seagrass	7.0m – 15.8m	33.3‰ – 37.3‰	23.6°C – 31.3°C
Reef	-	-	25.4°C – 30.3°C

**Table 11: Mean and range values of visibility, salinity, conductivity, and temperature (From: CARICOMP data, Carrie Bow Caye)**

### Water Temperature

The Smithsonian Institute Field Station has been monitoring basic water parameters within the Southern Belize Reef Complex since 1994 / 1995 (Figure 14). Whilst this is in the central reef region, this monitoring site also provides an indication of conditions within the southern reef region, in the absence of other long term data.

Water temperature varies throughout the year, reaching a peak in August / September (Figure 12). Increasing peak water temperatures have been recorded over recent years, and have been linked with coral bleaching - during September, 1995, for example, sea surface temperatures reached a 12-year high of 29.9°C to the east, at Glovers Reef. Surface water temperatures over the drop-off at



**Figure 12: Water Temperature at Carrie Bow Caye across the year** (<http://cbc.riocean.com>, accessed 2009)

Carrie Bow Caye were the highest recorded since CARICOMP monitoring began in January 1993, reaching a peak of 30.4°C during the first two weeks of June 1995 (Jones, 2003). Bottom water temperatures at CARICOMP Coral Reef Site I (13m water depth) averaged 29.8°C (±0.16) during the last week of August. This coincided with the first widespread coral bleaching event within Belize reef waters. By December 1995, temperatures had fallen to a monthly average of 27.7°C, due partly to the passages of Hurricanes Opal and Roxanne across the Yucatan Peninsula in late September and early October, respectively. This pattern has been replicated across the entire reef of Belize, including Gladden Spit and Silk Cayes Marine Reserve.

### Sedimentation / Turbidity

Sedimentation and agrochemical contamination from mainland watersheds have been highlighted as perhaps one of the greatest impacts on the Belize reef, after climate change. Gladden Spit and Silk Cayes Marine Reserve lies east of five watersheds - South Stann Creek, Santa Maria Creek, Mango Creek, Sennis Creek and Monkey River (Map 7), which drain some of the principal citrus and banana growing areas of central Belize (Map 8). Following storm events, the increased sediment load of these rivers is also accompanied by an increased pesticide load, as rain washes agrochemicals from the watersheds into the rivers, and from there into the sea (Figure 13). Generally occurring between August and October, these events impact water turbidity and quality within the Marine Reserve, as seen following the passage of Hurricane Mitch in October 1998.

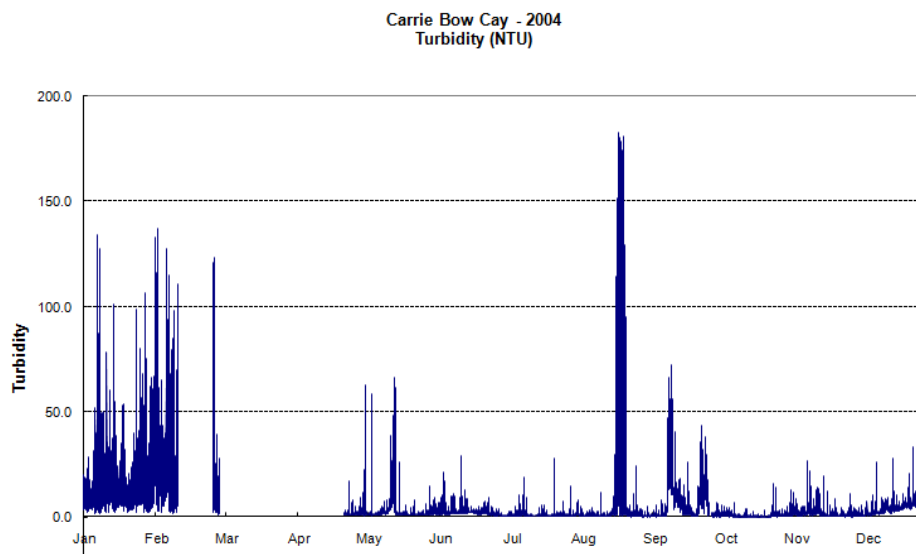
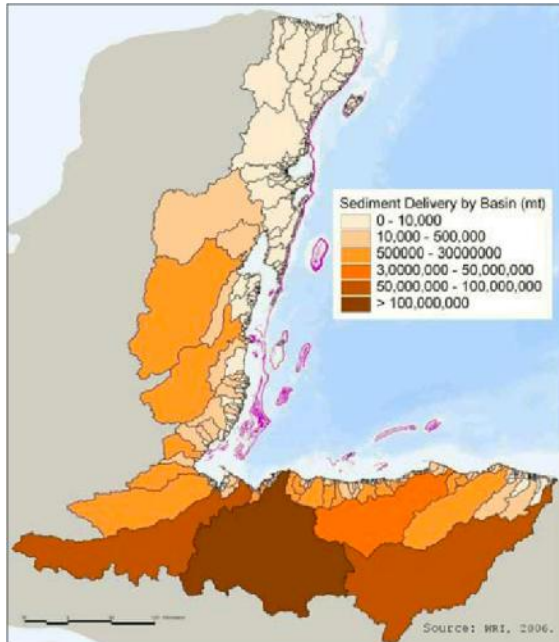


Figure 13: Turbidity at Carrie Bow Caye (<http://cbc.riocean.com>, accessed 2009)



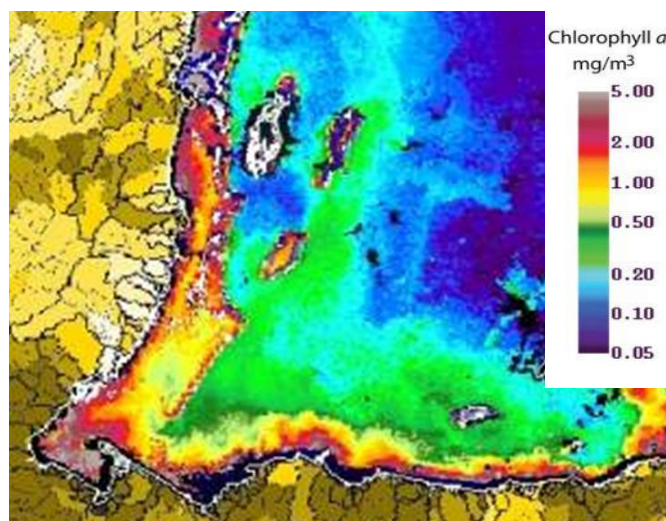
**Figure 14: Sediment Delivery by watersheds. After Burks and Sugg / WRI, 2006.**

- More than 80 percent of sediment, and more than half of all nutrients (both nitrogen and phosphorous) entering the Mesoamerican Reef originate in Honduras
- Guatemala was identified as a source of about one-sixth of all sediments and about one-quarter of all nitrogen and phosphorous entering coastal waters.
- Compared to the other countries, relatively minor percentages of the regional sediment load come from Belize 10 to 15%) and the Yucatan Peninsula in Mexico (5 %) of the nutrients from all modelled watersheds.
- Of the 400 watersheds in the region, the Ulu’a watershed in Honduras was found to be the largest contributor of sediment, nitrogen, and phosphorous. Other significant contributors are the Patuca (in Honduras), Motagua (in Guatemala and Honduras), Aguan (in Honduras), Dulce (in Guatemala), Belize (in Belize), and Tinto o Negro (in Honduras).

*Adapted from “Human-caused Pollution Damaging Prized Central American Reefs; WRI analysis maps sources in Belize, Guatemala, Honduras, Mexico” WRI, 2006*

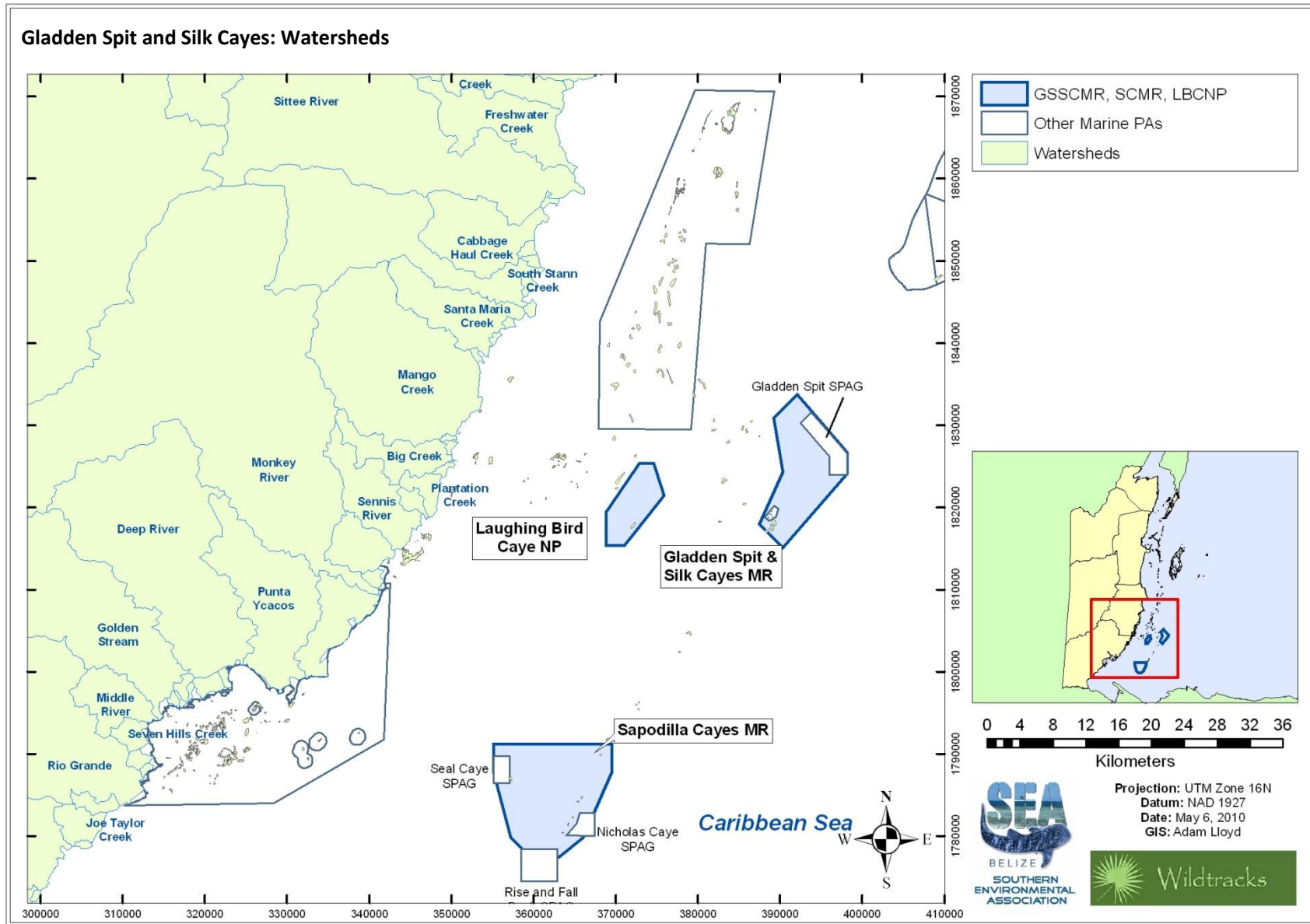
Sediment core analysis of two sites within the Belize reef system (Turneffe Atoll and Sapodilla Cayes), indicate that sediment and agrochemical runoff onto the reef has increased relatively steadily over time, consistent with historical and current land use trends. Sediment supply to the reef is greater in the south, in the Sapodilla reef area with greater urgency for action to reduce runoff impacts (Figure 14; Carilli et. al. 2009), though the Gladden Spit and Silk Cayes area is also affected seasonally.

SeaWiFS ocean colour images also shows that a large pulse of river water extends from the Guatemalan and Honduran rivers, stretching all the way to Gladden Spit and Silk Cayes Marine Reserve, and even out as far as Glover’s Reef Atoll, during these storm events (Figure 15; Soto et. al. 2009; WRI/ICRAN, 2006; Andrefouet et al. 2002). Connectivity was tracked using the proxy of weekly mean chlorophyll-a concentrations, derived from satellite imagery over a nine-year period. These studies indicated that Honduran river plumes, particularly that of the Ulu’a River, reached the southern part of the Belize Reef 61% of the time. This provides further support for WRI studies on the origins of impacting watershed run-off on the Mesoamerican Reef (Figure 15).



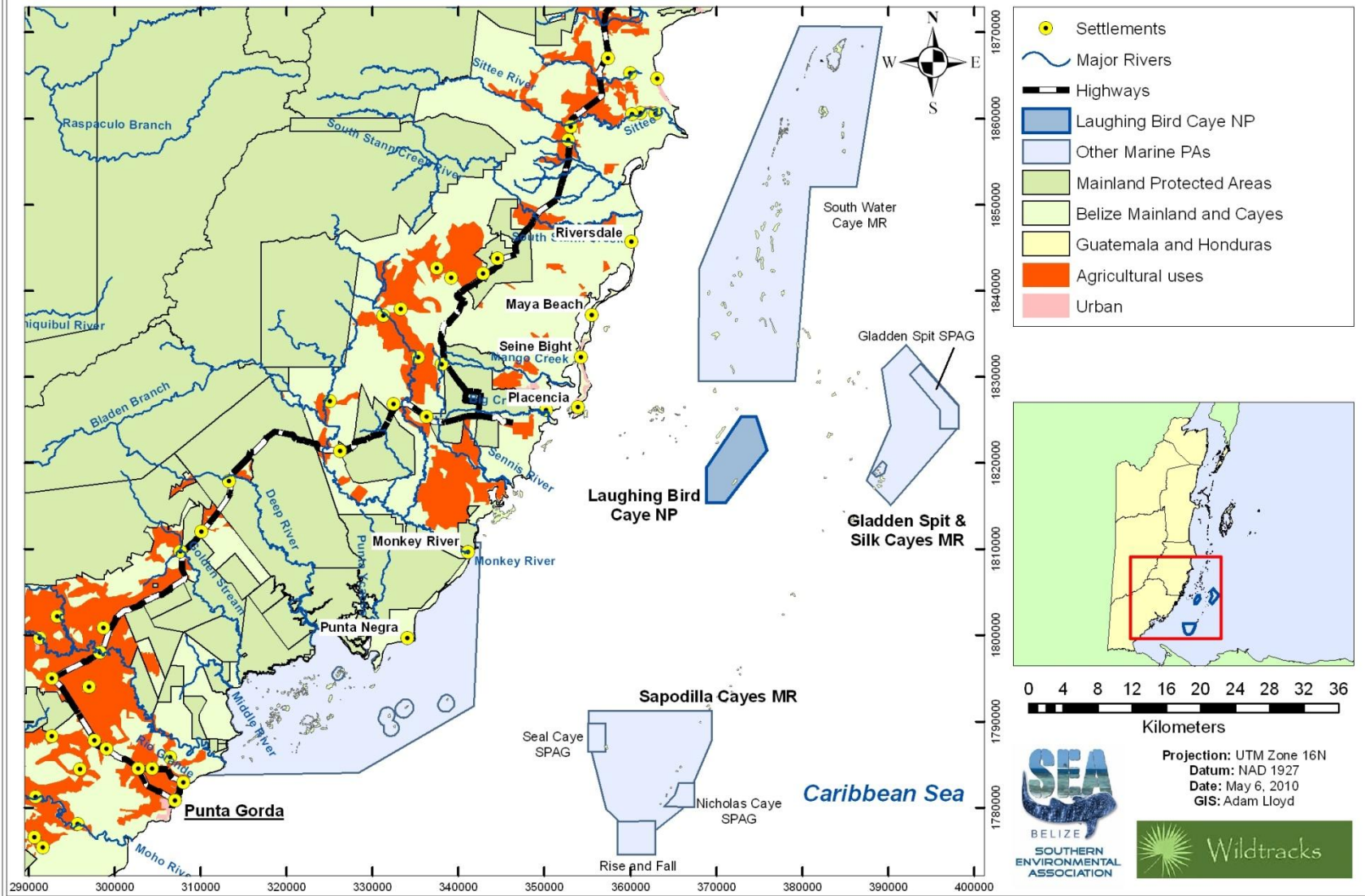
**Figure 15: SeaWiFS Chlorophyll  $\alpha$ . After Shank et. al. 2010/ Soto et. al. 2009**





Map 7: Gladden Spit and Silk Cayes Marine Reserve: Watersheds

Gladden Spit and Silk Cayes: Landscape Context



Map 8: Gladden Spit and Silk Cayes: Landscape Context

## Salinity

Salinity varies dependent on the time of year, with lower salinity during the wet season (Figure 16). The salinity of normal seawater is 36 parts per thousand (ppt), with variation from 33.0‰ to 37.4‰ at the Carrie Bow Caye site. This range of salinities persists throughout the Belize continental shelf, including the Laughing Bird Caye area (Rath, 1996).

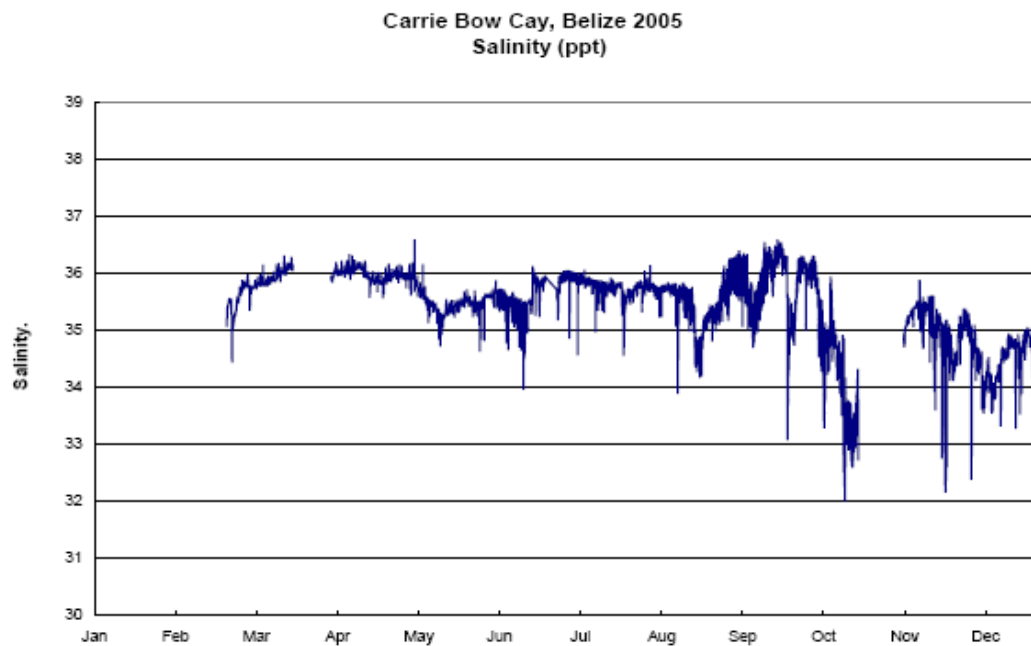


Figure 16: Salinity at Carrie Bow Caye (<http://cbc.riocean.com>, accessed 2009)

## pH

The general pH is 7.2 in the vicinity of the reef and surrounding areas. The alkaline pH is attributed to the high calcium carbonate saturation along the reef. There is a growing global concern about ocean acidification, with the increasing absorption of carbon dioxide from the atmosphere, which is predicted to result in the inhibition of growth of reef builders. Whilst predictions are not yet considered as accurate, the process was identified and flagged as a concern as long as 40 years ago (Kleypas et. al., 2006). Studies in Australia have demonstrated that there has been a 13.3 percent drop in calcification over a twenty year period, (1990 – 2009), an unprecedented decline in at least the past 400 years (De'ath et. al., 2009), and extrapolations suggests that calcification rates may decrease by up to 60% within the 21st century, with ocean pH levels expected to drop by another 0.3 units by 2100.

## 1.5. Biodiversity of Management Area

Biological information about Gladden Spit and Silk Cayes Marine Reserve has been accumulated over the years by a variety of researchers and organizations. Significant focus has been on research associated with the spawning aggregation site and the whale shark congregation, as well as monitoring the health of the reef and target species (primarily coral, commercial species, and parrotfish). The area is highlighted as one of the most biodiverse within the Mesoamerican Barrier Reef, an ecoregion that is, itself, recognized for its biodiversity and representational values, which are considered outstanding on a global scale, leading to recommendations for this to be recognized as a priority area for conservation (Olson & Dinerstein, 1998; Roberts, 2001; Kramer and Kramer, 2002).

### 1.5.1 Ecosystems

National ecosystem mapping gives a broad overview of the ecosystems to be found in the Gladden Spit and Silk Cayes Marine Reserve (Meerman, 2004), which encompasses a range of ecosystems stretching from the bathypelagic zone of the open sea to the shallow epipelagic waters of the continental shelf:

#### **Mesopelagic / Bathypelagic Zone (200m and deeper)**

The Mesopelagic and Bathypelagic Zones include the deeper waters to the east of the barrier reef. The mesopelagic zone extends from a depth of 200m downwards, merging into the bathypelagic zone (which begins at the edge of the continental slope and extends beyond into the deeper water). The deep waters to the east of the 'elbow' provide the geomorphology and oceanographic current conditions required by many species for the formation of spawning aggregations (Heyman et. al. 2008) – Gladden Spit is recognized for its importance as the most active, species-diverse aggregation within Belize, and with the region (Heyman et. al. 2002). These deep water aggregations also attract whale sharks, and other deep-water species are known to travel up and down parallel to the reef, passing inside the eastern boundaries of Gladden Spit and Silk Cayes Marine Reserve.

#### **Epipelagic Zone (0m – 200m)**

The Epipelagic Zone ranges from 0 to 200m depth, and includes the shallow waters of the inner lagoon and the deeper waters of the forereef. Within this zone there is an array of ecosystems that have evolved in response to the degree of exposure and impact of wave action, current direction and intensity, light intensity and light spectra, and are defined by their species composition, formation and substrate characteristics.

#### **Broad Ecosystems**

- Forereef (upper and lower reef slopes, including spur and grove topography)
- Reef crest and reef flats
- Back reef (with patch reefs)
- Seagrass
- Sparse algae / sand
- Herbaceous Beach Community

**Gladden Spit and Silk Cayes Marine Reserve – Management Plan  
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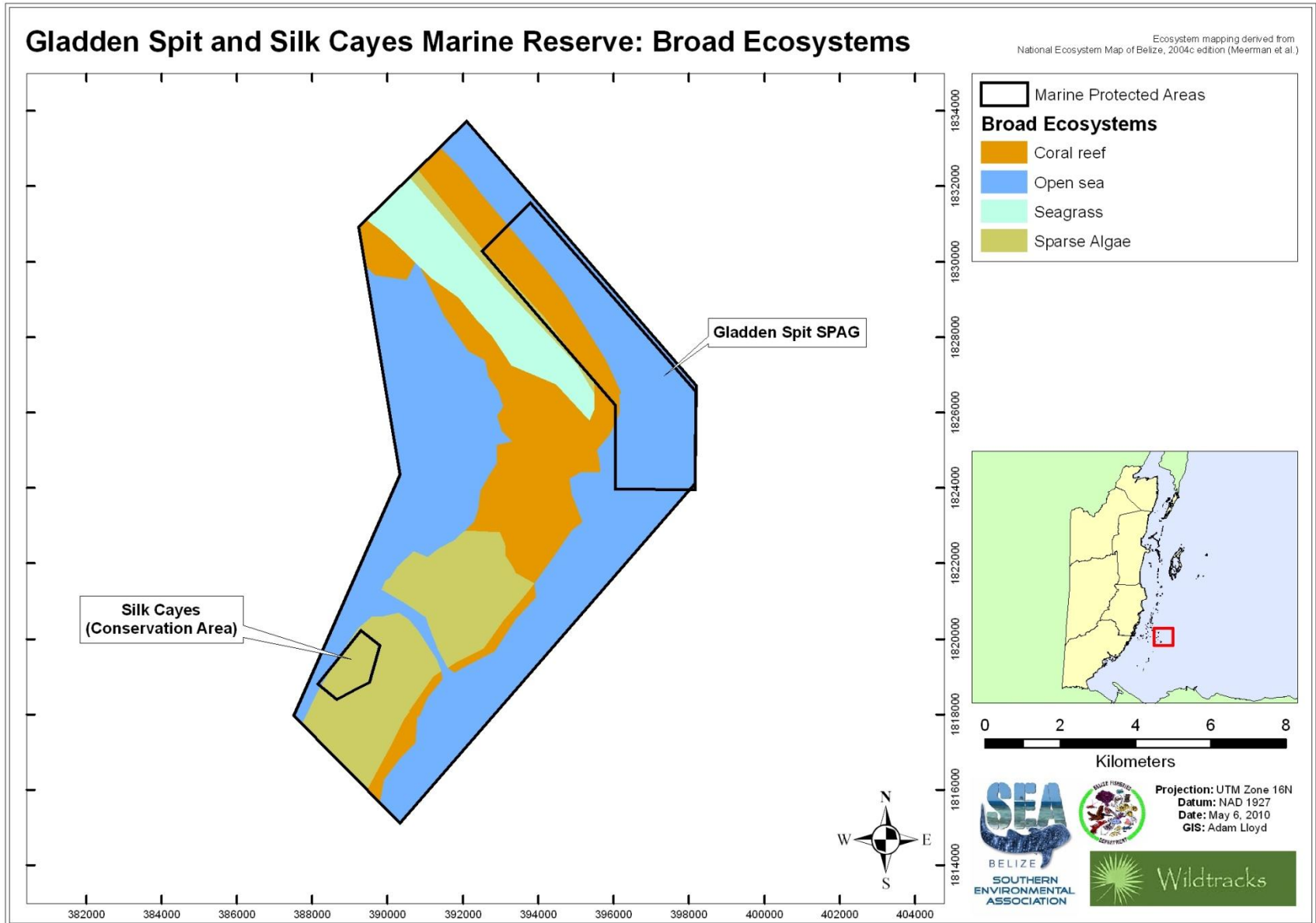
Six broad ecosystems have been identified and mapped (Map 9; Meerman, 2004). The marine components are further categorized by into seven primary categories and twenty-one sub-categories (Table 12; Mumby and Harborne,1999).

Ecosystems of Gladden Spit and Silk Cayes Marine Reserve				
	Meerman (2004)		Mumby and Harborne (1999)	
<b>Terrestrial</b>	Herbaceous Beach Community	Sandy Beaches		
		Littoral Forest		
<b>Epipelagic</b>	Reef	Shallow Coral Reef	Forereef	With sparse massive and encrusting corals
				With dense massive and encrusting corals
		Patch Reef	Patch Reef	Dense patch reef
				Diffuse patch reef
		Shallow Coral reef	Other Reef	Reef crest
			Low relief spur and groove	
	Seagrass	Seagrass beds	Shallow Lagoon Floor – Seagrass dominated	Sparse seagrass
				Medium density seagrass
				Dense seagrass
				Seagrass with distinct coral patches
	Caribbean inner lagoon / Sparse Algae	Fleshy brown Algae / Gorgonians	Algal dominated	Fleshy brown Algae and sparse Gorgonians
				Green algae
		<i>Lobophora</i>		
<i>Euchmea</i> and <i>Amphiroa</i>				
Bedrock / rubble and dense gorgonians				
Bedrock / rubble and sparse gorgonians				
Bare substratum dominated		Rubble and sparse algae		
		Sand with sparse algae		
		Mud / bedrock		
<b>Mesopelagic / Bathypelagic</b>	Open Sea	Caribbean Open Sea	Caribbean Open Sea	Bathyal
				Mesopelagic

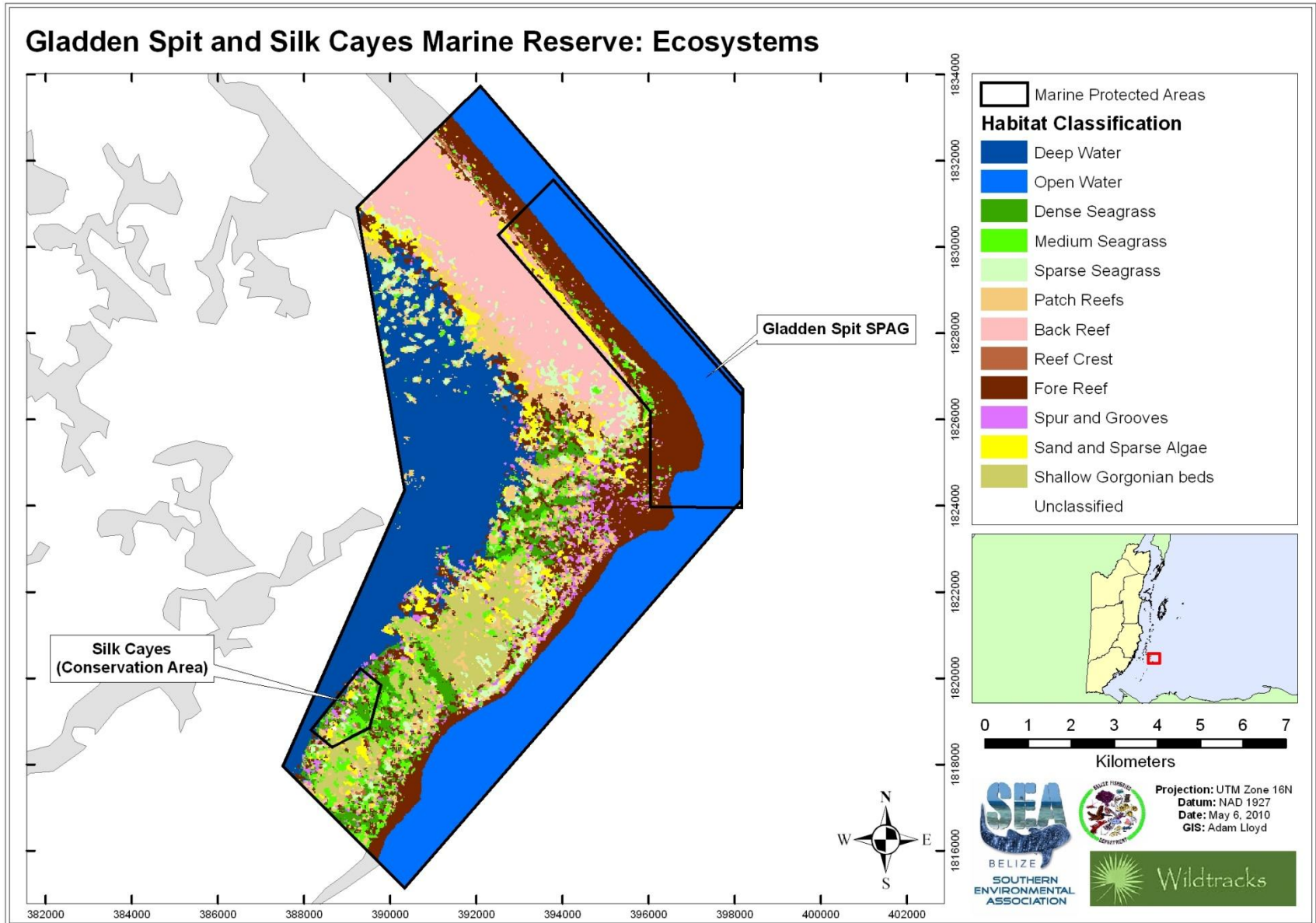
**Table 12: Ecosystems of Gladden Spit and Silk Cayes Marine Reserve**



**Gladden Spit and Silk Cayes Marine Reserve – Management Plan  
2011-2016**



**Map 10:** Gladden Spit and Silk Cayes Marine Reserve: Ecosystems (coarse – Meerman, 2004)



Map 11: Gladden Spit and Silk Cayes Marine Reserve: Ecosystems (fine detail - UNESCO)



## Coral Reef

### The Barrier Reef

Located at the intersection of the central and southern regions of the Belize Barrier Reef system, the barrier reef runs northwest to south east and, within the northern portion of Gladden Spit and Silk Cayes Marine Reserve, is considered to be one of the most highly developed examples of barrier reef formation in the Western Hemisphere. The core components, Forereef, Reef Crest, and Back Reef are all present.

#### Forereef

The forereef lies on the outer side of the reef crest, facing the open sea, and includes the upper and lower reef slopes. The upper forereef begins at the outer edge of the reef crest, and extends out to a depth of 14-22m. This zone is characterized by impressive spur and groove formations, and is a major tourism resource, attracting divers from all parts of the world to Belize.

The tops of these spurs are carpeted with a variety of corals and other invertebrates, with the large surface area provided by the canyon sides and currents that pass through the 'grooves' (or surge channels) providing ideal living conditions for a multitude of marine organisms. The strong currents that occur in the deep grooves sweep the floor of fine sediments, the grooves providing the most obvious pathways for sediment movement into the deep water to the east.

Moving southward to and beyond the promontory, the inner reef spur-and-groove and the outer forereef gradually becomes much less well formed. East of the reef crest the water drops to between 50 and 100m – the lower reef slope. Here, coral diversity and density decreases in correlation with decreasing light intensity. Beyond this, the reef drop-off extends to depths of 700m and more.

#### Reef Crest and Reef Flats

The reef crest and reef flats lie behind the forereef, and are considered typical of high energy surf zones around the Caribbean. Coral species inhabiting these areas are hardy enough to be able to withstand the breaking waves, constant strong current, exposure at low tide, and high light intensity. In the northern portion of the Gladden Spit and Silk Cayes Marine Reserve, the reef crest forms a relatively unbroken barrier, protecting the back reef waters to the west, with few channels allowing water flow between the fore and back reefs. South of the promontory, the reef crest becomes very fragmented, and is bisected by a number of larger reef channels such as Tarpon Swash and Big White (Mcfield, 2002; FoN, 2003).

The reef crest has suffered significant hurricane damage over the years, and corals are slowly starting to recover – with lettuce coral (*A. tenuifolia*) as the predominant species, replacing the previously dominant elkhorn coral (*A. palmata*) (McField, et al. 2008 (ed. Wilkinson et. al.); Carne, pers. com., 2007).

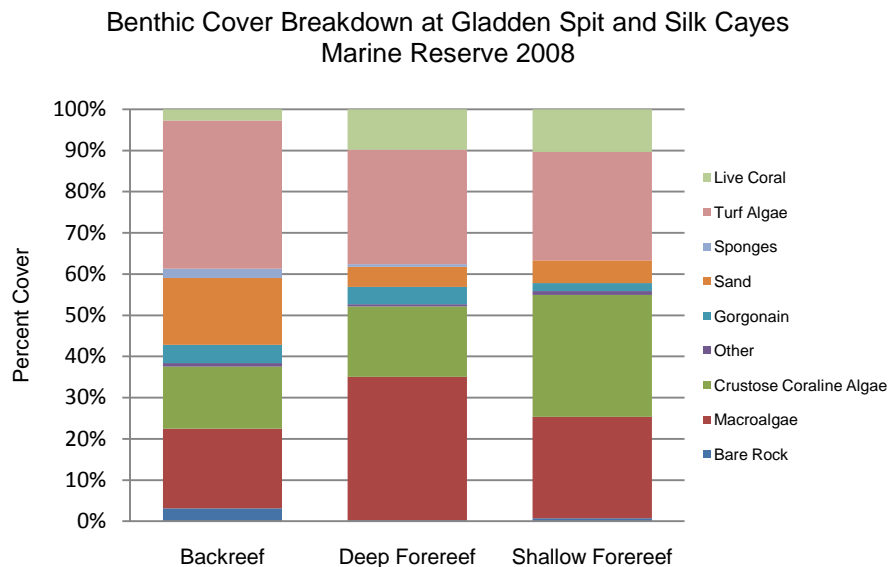
**Back Reef**

The Back Reef includes a continuum of habitats in waters ranging from 0.3 to 6m deep sheltered by the presence of the reef crest, from the algae-encrusted coral rubble near the reef crest to the sandy mudflats of the *Thalassia* meadows and scattered patch reefs.

The sheltered waters of the back reef promote the growth of spectacular coral formations and impressive sponges, with numerous patch reefs varying in size and orientation. This is intersected in the south by deeper channels.

**Benthic Cover**

SEA has developed a baseline of overall benthic cover within GSSCMR - a combination of back reef, shallow forereef and deep forereef (Figure 17).



**Figure 17:** Gladden Spit and Silk Cayes Marine Reserve: Benthic Cover % per reef site (SEA data, 2008)

On a regional level, two-thirds of wider Caribbean reefs are said to be at risk from human activities (Burke & Maidens, 2004), a figure that has probably increased since that assessment. In general, reefs in Belize are perceived to be at slightly lower risk, due in part to the small human population, and relatively low levels of coastal development, and were once considered amongst the better reefs of the Caribbean. However, in recent years coral health has generally been on a par with, or slightly below, the rest of the Caribbean, with impacts from a combination of disturbance events (primarily hurricanes) and chronic stressors, leading to declining coral cover and increases in macro-algae (McField, et al. 2008 (ed. Wilkinson et. al.)).

An ecological shift towards algal dominance on coral reefs has occurred across the Caribbean in recent years, attributed to several impacts. These include coral diseases (black, white and yellow band diseases), overfishing, the population crash of the herbivorous long-spined sea urchin *Diadema antillarum* and other environmental stressors such as, sedimentation and pollution (Liddell et. al, 1986; Aronson et. al, 1998). Overfishing of the herbivorous fish is also thought to have played a role in the decline of reef health, but more recently, global climate change (with increasing sea temperatures and UV levels) has been identified as the biggest contributing factor (Aronson et. al., 2006), overlying all other stresses.

Belize has always had the enviable reputation of having pristine reefs, but in more recent years there would appear to be a shift in species composition of structural corals, with the loss of *A. cervicornis* has been lost to disease, and replaced by *A. tenuifolia*. The increased temperatures have also caused by global warming results in bleaching in corals - the expulsion of the zooxanthellae which provide essential nutrients to the coral polyps. If severe and prolonged enough, bleaching can affect coral reproduction, growth, and accretion rates and even lead to death (CCRE 2002). The harmful effect of increased levels of UV radiation acts synergistically with increased seas surface temperatures to exacerbate bleaching by producing harmful oxygen radicals, increasing coral mortality (Lesser and Lewis, 1996; Marshall et. al., 2006).

No global bleaching event was recorded before 1979 (McField et. al., 2007), and the Belize Barrier Reef experienced mass coral bleaching for first time in 1995 (McField, 1999). Since then, major bleaching events have been recorded in Gladden Spit and Silk Cayes Marine Reserve with increasing frequency - in 1995, 1998, 2005, 2008 and 2009 - and are thought to be accentuated by increased acidification resulting from higher CO<sub>2</sub> levels (Anthony et. al., 2008). The first recorded bleaching event in 1995 resulted in large-scale bleaching of hard corals in Belize, especially *Montastraea annularis*. Bleaching of *Agaricia agaricites*, *A. tenuifolia*, *Madracis* spp., and *Porites porites* was also reported in 1995 (McField, 2000). Other areas in the Southern Belize Reef Complex (in the more northerly South Water Caye Marine Reserve) reported loss of up to 50% of the large corals, with partial mortality reported in 10% of corals throughout the country.

Within Belize, the effects of the 1998 bleaching event are well known. The impacts from this event were likely exacerbated by the combination of the major coral bleaching event and a catastrophic hurricane (Hurricane Mitch) which caused dramatic changes in reef community structure, including a 48% reduction in the live coral cover in Belize. Live coral cover decreased at all monitored sites during 1998-1999, with mean values dropping from 28% to 15% benthic cover. Given the impacts of the hurricane on the Southern Barrier Reef it is logical that it experienced the greatest loss (62%), followed by the Northern Barrier Reef (55%), atolls (45%) and Central Barrier Reef (36%).

*Agaricia tenuifolia* and *Acropora cervicornis* were the coral species most heavily affected by bleaching in 1998 (Wilkinson et. al., 2008). The variation in these responses was attributed to varying wave energies from the hurricane and differences in the resiliency of the reef communities.

With no observed phase-shift to macroalgal domination during the 1998 event, the prognosis was considered favourable for the recovery of these reefs. However, a resample of sites in 2005 indicated that recovery from the 1998 event has been slow (McField, et al. 2008 (ed. Wilkinson et. al.)).

In 2008 the National Coral Reef Monitoring Network implemented a national bleaching monitoring program with SEA conducting monitoring at all three of its protected areas including Gladden Spit and Silk Cayes Marine Reserve. with the highest percentage of bleaching 29% observed in the shallow reef areas and 18% in deeper waters at the Gladden Spit and Silk Cayes Marine, recorded during October of 2008 (SEA, 2009). Even with these higher rates of recovery from bleaching events has been good, with bleaching dropping to a minimal average of 1.5% and 3% respectively four months later in February (Figure 22).

Looking at the data from the past two years it appears that bleaching has become part of the reef's annual cycle, tied into annual water temperature cycles. With bleaching occurring during the warmer months of September to November and recovery occurring during periods of cooler waters in December-March, but it is unclear whether corals will be able to continue to recover from what may become chronic annual bleaching. Generally, shallow-living corals of Gladden Spit and Silk Cayes Marine Reserve show lower levels of bleaching than those that live at deeper levels.

Live coral cover is a popular measure for coral reef health. At the GSSCMR the percentage of live coral cover seems to be directly related to site selection with surveys by different agencies giving different snapshots of the stats of the reef.

**Coral Bleaching:** Corals are highly sensitive to changes in water temperature, and increases of only 1 to 2°C can have potentially lethal effects. The MAR region has experienced several large-scale bleaching events (e.g., in 1995 and 1998) that caused significant coral mortality in some areas.

Human-induced global warming is widely believed to be responsible for increases in global sea surface temperature.

**Diseases:** Coral disease outbreaks are one of the single most devastating disturbances to coral reefs in the Caribbean and MAR in the recent past.

Disease has always been a natural process in regulating populations, but the recent increased magnitude of disease and resultant mortality may be unique in the last several thousand years. Diseased organisms tend to thrive in higher temperatures, and some may also benefit from increased ultraviolet (UV) radiation. Both stressors (temperature and UV) may render host organisms more vulnerable to disease.

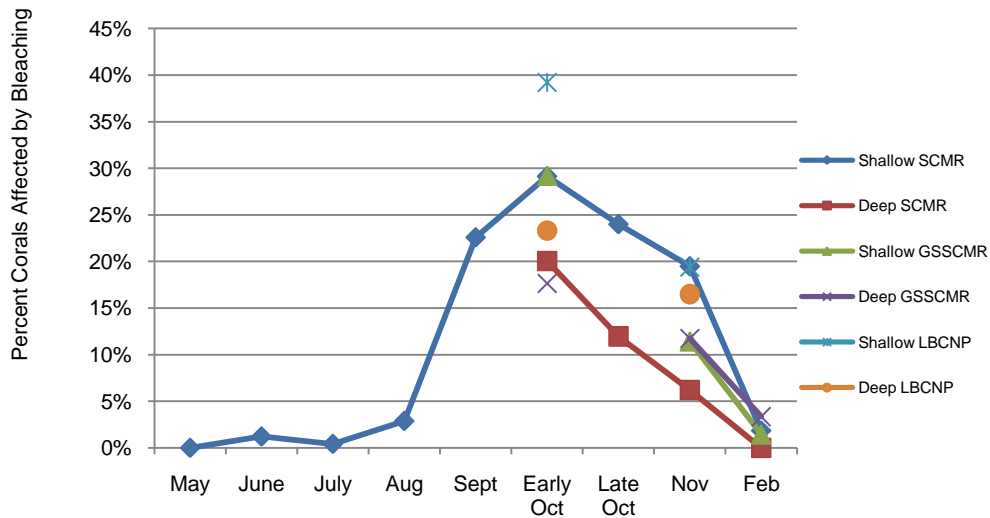
In addition to these effects related to global climate change, diseases have also been linked to elevated nutrients (especially from sewage), sedimentation and runoff.

Similar to humans, corals seem to be more prone to disease when affected by other stressors.

**Healthy Reefs for Healthy People Initiative, 2007**

## Gladden Spit and Silk Cayes Marine Reserve – Management Plan 2011-2016

Comparison of Percent of Corals Affected by Bleaching at the GSSCMR, LBCNP and the SCMR



**Figure 22: Bleaching cycle across the year (SEA data, 2008)**

According to 2007-2008 assessments of 96 sites across Belize, percentage live coral cover for

Gladden Spit and Silk Cayes Marine Reserve averaged 11% (McField, et

al. 2008 (ed. Wilkinson et. al.)), lower than the national average of 16.6% (McField, et al. 2008 (ed. Wilkinson et. al.)). A more recent survey, in 2010, estimates the average live coral cover of the marine protected area at 13.6%, ranging from 18.1% on the outer barrier reef (at a depth of 10m), and 8.3% on the shallow back reef. An average algal cover of 18.7% macro algal cover was recorded at the same monitoring sites (Table 13; SEA data, 2010).

Gladden Spit and Silk Cayes Marine Reserve hosts ten species of coral considered critically endangered or endangered on the global scale (Table 14; IUCN, 2010).

Site Code	Site Description	% Coral Cover	% Macroalgal cover
GSMBRS3	Outer barrier reef, 10 m depth	14.4	26.7
GSMBRS6	Outer barrier reef, 10 m depth	18.1	9.4
GSMBRS9	Back reef site, 2 m depth	8.3	20
<b>Average</b>		<b>13.6</b>	<b>18.7</b>

**Table 13: % coral cover and % macroalgal cover for GSSCMR, 2010**

Gladden Spit and Silk Cayes Marine Reserve Coral Species of International Concern	
<b>Critically Endangered</b>	
Staghorn Coral	<i>Acropora cervicornis</i>
Elkhorn Coral	<i>Acropora palmata</i>
<b>Endangered</b>	
Lamarck's Sheet Coral	<i>Agaricia lamarcki</i>
Pillar Coral	<i>Dendrogyra cylindrus</i>
Elliptical Star Coral	<i>Dichocoenia stokesii</i>
Fire Coral	<i>Millepora striata</i>
Star Coral	<i>Montastraea annularis</i>
Star Coral	<i>Montastraea faveolata</i>
Montastraea coral	<i>Montastraea franksi</i>
Rough Cactus Coral	<i>Mycetophyllia ferox</i>

**Table 14: Coral Species of International Concern of Gladden Spit and Silk Cayes Marine Reserve**

## Seagrass

Much of the reef platform north of the promontory is shallow and sheltered from strong waves and currents, with a soft bottom supporting extensive meadows of seagrass. These seagrass meadows stretch from the reef crest westwards across the back reef, interspersed with rubble, patch reefs, and large sponges. Two species of seagrass have been identified to date within the seagrass ecosystem of (turtle grass (*Thalassia testudinum*), interspersed with sparse strands of manatee grass (*Syringodium filiforme*)), along with algae such as *Halimeda* spp, also considered important components of this ecosystem, and distributed throughout the seagrass beds.

Seagrass meadows create high diversity habitats in shallow marine ecosystems, with important roles in nutrient cycling, filtration and sediment stabilization (Bos et. al., 2007). Seagrass also provides a critical habitat for many fish and invertebrate species - an acre of seagrass has been shown to support up to 40,000 fish and 50 million small invertebrates (Seagrass Ecosystems Research Laboratory, 2005). This ecosystem fills a critical role as a nursery area for the commercially important conch, many reef fish (including commercial species such as tarpon, hogfish, yellowtail snapper and great barracuda), and for the key herbivore guild species assemblages - the parrotfish. The seagrass beds also provide corridors for juvenile lobsters between habitats and important settlement areas for post-larval stages of commercial species (Acosta, 2001).

Seagrass areas of Gladden Spit and Silk Cayes Marine Reserve are considered to be in very good condition, with minimal human impacts, (SEA, 2010), with impacts restricted to scarring of the seagrass beds in shallow areas of high boat activity.

## Terrestrial Ecosystems

The terrestrial vegetation of the three Silk Cayes is constantly changing over time, as past and current storm events change the shape, height and substrate of the cay (SEA staff, 2010; Stoddart, 1963).

Variouly called **Tropical Littoral Forest and Beach Communities**, or **Tropical Coastal Vegetation on Recent Sediments**, this ecosystem typically includes herbaceous ground-cover plants and vines on the upper beach, grading into woody shrubs with a relatively open canopy of salt-tolerant trees.

Herbaceous beach vegetation is highly under-represented under the current National Protected Areas System - the target protected coverage is 60%, but in fact only 8.6% is included within current protected areas, and even this is often poorly protected because of the economic pressure to provide white sandy beaches and (non-native) coconuts for visitor appeal. The vegetation on the Silk Cayes has been heavily impacted by both tropical storms and clearance for tourism.

Whilst small, these cayes are recognized as critical nesting habitat for endangered marine turtles, as well as an important re-fuelling station for migratory birds. The above and below ground structure of littoral forest /herbaceous beach vegetation is important in providing protection against the potentially massive beach erosion by tropical storm events. Natural vegetation has been removed completely from South Silk Caye, whilst Middle and North Silk Cayes still retain characteristic plants of the natural herbaceous beach community. South and Middle Silk Caye also have introduced coconuts. When cleared and maintained as sandy beaches with coconut trees, the cay is significantly destabilized and exposed to greatly increased risk of erosion or complete loss.



**Top:** North Silk Caye  
**Middle:** Middle Silk Caye  
**Bottom:** South Silk Caye



### 1.5.2 Fauna

Gladden Spit and Silk Cayes Marine Reserve has long been recognized for its regionally important, species diverse spawning aggregation and the associated whale shark congregation, as well as for its rich and diverse reef fauna. Conch, lobster and commercial finfish species are covered under Commercial Species

#### Fish

The main focus of fish research at Gladden Spit and Silk Cayes Marine Reserve has been the spawning aggregation and the seasonal whale shark congregations.

Of the over 260 species included in the current species list, three are considered to be Critically Endangered or Endangered at global scale, including the critically endangered goliath grouper (*Epinephelus itajara*) and endangered Nassau grouper (*Epinephelus striatus*), great and scalloped hammerheads (*Sphyrna mokarran* and *S. lewini*) (Table 15), all of which have been targeted commercially in the past.

Nassau grouper has declined within Belize by more than 80% since the late 1970s, primarily due to fishing pressure at spawning aggregation sites where it is most vulnerable (Paz and Grimshaw, 2001).

Fish Species of International Concern	
<b>Critically Endangered</b>	
Goliath Grouper	<i>Epinephelus itajara</i>
<b>Endangered</b>	
Nassau Grouper	<i>Epinephelus striatus</i>
Great Hammerhead	<i>Sphyrna mokarran</i>
Scalloped Hammerhead	<i>Sphyrna lewini</i>
<b>Vulnerable</b>	
Queen Triggerfish	<i>Balistes vetula</i>
Marbled Grouper	<i>Dermatolepis inermis</i>
White Grouper	<i>Epinephelus flavolimbatus</i>
Snowy Grouper	<i>Epinephelus niveatus</i>
Hogfish	<i>Lachnolaimus maximus</i>
Mutton Snapper	<i>Lutjanus analis</i>
Cubera Snapper	<i>Lutjanus cyanopterus</i>
Yellowmouth Grouper	<i>Myctoperca interstitialis</i>
Whale Shark	<i>Rhincodon typus</i>
Rainbow Parrotfish	<i>Scarus guacamaia</i>

**Table 15: Fish Species of International Concern (IUCN, 2010)**

In 2001 it was predicted that under the existing management conditions, Nassau grouper (once the second most commonly caught fish in Belize) would disappear from Belize waters by the year 2013 (Paz and Grimshaw, 2001). In light of these concerns amendments made to the regulations now impose size limits and make it illegal to take Nassau grouper during the peak spawning months of December to March, though it can still be fished outside of this time. The regional outlook is similarly bleak - it is thought that one-third of all known Nassau grouper spawning aggregation sites in the Caribbean region have disappeared.

Herbivorous fish populations – such as the parrotfish (Scaridae) and surgeonfish (Acanthuridae) - are considered important for the maintenance of the health of the reef, being the dominant grazers of the ecosystem, keeping algal growth under control, and have been shown to effectively reduce algal cover in the Bahamas (Mumby et. al., 2006).

The world's largest fish, the whale shark (*Rhincodon typus*) is the flagship species of Gladden Spit and Silk Cayes Marine Reserve, forming congregations at full moon each year to feed on spawn at the aggregation site during the ten days of the full moon in May, June and July. This vulnerable species (IUCN, 2008) is considered highly migratory, travelling 1000's of kilometers, and occurs throughout tropical and warm temperate waters around the globe.

The whale shark (*Rhincodon typus*) is protected under the Fisheries Act, with no fishing, or even touching, permitted. This species is an important tourism resource, especially within the spawning aggregation area of Gladden Spit and Silk Cayes Marine Reserve, and has been reported passing through the deeper waters of the outer reef. Whale shark tourism is a highly lucrative industry based on an ecologically vulnerable species that is sensitive to anthropogenic impacts. The whale shark congregation at Gladden Spit provides a focus for tourism for adjacent communities – particularly Placencia – and is managed by SEA. In 2009, during the full moon period, the whale sharks attracted over 1,700 visitors, primarily during April, May and June (SEA, 2010). Whilst Gladden Spit is possibly the only site in the world that allows diving with the explicit aim of seeing whale sharks, access to the whale shark congregation area is strictly regulated by SEA, with a cap on the number of tours allowed to use the area at any one time or on any one day, to minimize impacts on whale shark behaviour, or on the behaviour of spawning fish at the aggregation site.

A further eleven shark species have been confirmed as present within the Marine Reserve, with a four others (deep water species) thought to be present but yet to be confirmed (R. Graham, pers. com.). These include endangered great and scalloped hammerheads (*Sphyrna mokarran* and *S. lewini*), which have both been reported at Gladden Spit. These species are still fished within Belize, despite its global status.

## **Mammals**

Four species of dolphin have been reported from within the adjacent South Water Caye Marine Reserve, two of which (Atlantic bottlenose dolphin (*Tursiops truncatus*) and the Atlantic spotted dolphin (*Stenella plagiodon*)) are commonly seen inside the Belize Barrier Reef (CCC, 1993). The deeper-water rough-toothed dolphin (*Steno bredanensis*) has also been reported, as has Fraser's Dolphin (*Lagenodelphis hosei*), though presence of these dolphins within the protected area boundaries still requires confirmation.

Antillean (or West Indian) manatees (*Trichechus manatus manatus*) have been reported from the Silk Cayes area, and as far west as the inside of the barrier reef in the Gladden Spit area. The Belize coast is home to the largest population of Antillean manatee in the Caribbean (Morales-Vela *et al*, 2000), with a population estimated at between 800 and 1,000 individuals (Auil, pers. com.). Historically the manatee has been hunted for meat, with bone middens discovered on archaeological sites, and in the 17<sup>th</sup> century, it was taken to provide food for privateers and explorers (Self-Sullivan and LaCommare, 2004).

This unfortunately still continues, though illegal, with a recent incident in Seine Bight of the capture and butchering of a manatee for its meat (SEA, 2010). Despite the arrest of the offenders, the fines were so minimal that they are not considered a deterrent when compared with the profit from the sale of the meat. Today, the Antillean manatee is considered threatened throughout its range, and is listed as ‘Vulnerable’ (IUCN, 2008), but is fully protected under the Wildlife Act.

**Birds**

No long term monitoring of bird species has been conducted for Gladden Spit and Silk Cayes Marine Reserve with only a token species list of five species resulting from single visits (Lee, 1996; Site visit, 2010). The cayes, however, support important nesting colonies of gulls and terns, with laughing gulls relocating here when disturbed at Laughing Bird Caye. A resident osprey has also nested on Middle Caye, and was present during the site visit (2010). When nesting is in progress, visitation to Middle Silk Caye is not permitted, ensuring the nesting season is successful.

Even small cayes such as the Silk Cayes are important as stepping stones for migratory species during southbound and northbound migrations. Many thousands of migrants follow the mainland coast southwards and meander off course each year, ending up on the cayes every spring and fall after being blown offshore by shifting winds. Others may use the cayes and ranges of Belize as part of a straight line migration path down the Yucatan Peninsula coastline, through Ambergris Caye and southwards, and from there to Guatemala and Honduras, where they again hook up with the mainland and its “infinite” food resources.

**Reptiles**

A total of four reptile species have been documented to date from Gladden Spit and Silk Cayes Marine Reserve, including the critically endangered hawksbill turtle (*Eretmochelys imbricata*) and endangered loggerhead and green turtles (*Caretta caretta* and *Chelonia midas*) (Table 16). As elsewhere, sea turtle numbers have plummeted in recent decades, having been exposed to enormous exploitation for over 250 years in Belize and adjacent countries. In the early 1900s, the size of the turtle industry, harvesting hawksbills for their shells, supported two or more schooners in Belize, based out of Tobacco Caye, having a massif impact on the turtle populations of the entire Belize shelf. As relatively recently as 1925, their numbers were considered inexhaustible in Belize (Smith, *et. al.* 1992) – a far cry from the current situation. The high sandy beaches of the Silk Cayes have been used historically by green and hawksbill (Perkins, 1983; Miller, 1984; Moll, 1985; Smith, *et. al.*, 1992), though numbers

Gladden Spit and Silk Cayes Marine Reserve Reptiles of International Concern	
<b>Critically Endangered</b>	
Hawksbill Turtle	<i>Eretmochelys imbricata</i>
<b>Endangered</b>	
Loggerhead Turtle	<i>Caretta caretta</i>
Green Turtle	<i>Chelonia midas</i>

**Table 16: Reptile species of International Concern (IUCN, 2008)**

have been small (between one and three nests reported in any one year). Only false crawls were reported for 2010, and no successful nests (SEA, 2010). Five nests were reported on the adjacent Little Water Caye, though only one of these hatched successfully (SEA, 2010).

Whilst now afforded full legal protection from harvesting in Belize, turtle populations remain highly threatened by loss or degradation of nesting habitat - the same high, sandy beaches used for millennia by turtles are now being converted into beach properties, with all the impacts associated with human habitation on mainland beaches and inhabited cayes outside of the protected area, increasing the critical importance of maintaining those characteristic of the Silk Cayes that increase nesting success, and balancing this with tourism activities in the area.

The Hawksbill turtle tends to be more confined to shallow waters than loggerhead and green turtles, where it feeds primarily upon sponges and marine invertebrates. It has a protracted nesting season of 6 months or more – peaking in June and July, with the period between nesting seasons generally being 2-4 years, sometimes longer. With a regional average of 4.5 nests per female in the years they breed, 1 to 3 nests in all probability represent only 1 or 2 females coming ashore to breed. Nesting occurs at night, generally at high tide, with a clutch size of 50-200 eggs. Nests tend to be concealed in beach vegetation quite high on the beach and, except for a faint asymmetrical crawl leading to and from the sea, there is seldom any obvious evidence of the visiting female.

Loggerhead and green turtles still frequent the waters of Gladden Spit and Silk Cayes Marine Reserve, and green have reported as nesting on the caye (Smith *et. al.* 1992). Whilst the green turtle is primarily herbivorous, feeding mostly upon sea grasses and seaweeds, the loggerhead is more omnivorous, feeding on a wide range of marine invertebrates, seaweeds and turtle grass.

There are reports of the critically endangered leatherback turtles (*Dermochelys coriacea*) swimming off the adjacent Pelican Cayes (Coral Caye Conservation Expedition Report, 1993), though this species is not known to nest in Belize. Like the loggerhead, it is omnivorous, feeding on seaweeds and a variety of marine invertebrates – primarily tunicates and jellyfish.

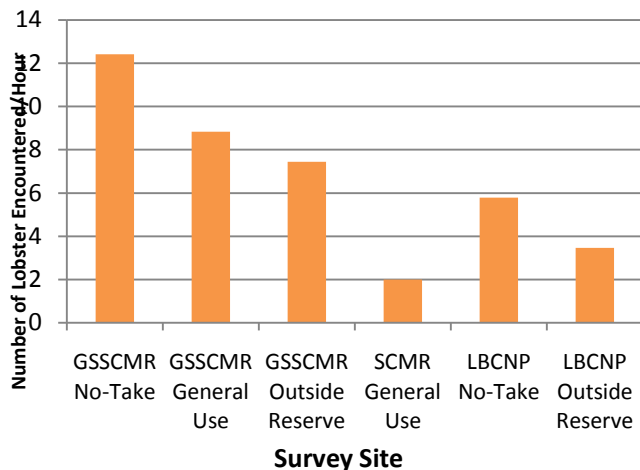
The brown anole (*Norops sagrei*) is the fourth reptile species to have been recorded on the cayes (Site visit, 2010). This human commensal occurs on or close to human buildings along the Belize coast and cayes.

### **1.5.3 Economically Important Species**

The Gladden Spit and Silk Cayes Marine Reserve plays an integral role in maintaining the viability of the Belizean fishery. The Caribbean Spiny Lobster (*Panulirus argus*) and Queen conch (*Strombus gigas*) are two invertebrate species of commercial importance protected within no-take zones of the Marine Reserve. The conch and lobster fisheries form the two most important components of the capture

fisheries in Belize, with production representing over 90% of total capture fisheries production in 2008, and an export value of US\$10.15 million (Ministry of Agriculture and Fisheries, 2009<sup>4</sup>). Lobster landings peaked in 1981 at 2,204,622 lbs, but fell to 457,680 lbs in 2006, with 511,389 lbs harvested in 2009 (tails and head meat combined), with a market value of US\$6.90 million (Ministry of Agriculture and Fisheries, 2009).

It is significant to note that the general trend of total national lobster production over the period from 1981 to 2008 is a decline of almost 77%, and there are concerns for the continued sustainability of the lobster fishing industry. Whilst in the past there has been continued optimism that lobsters are being harvested at a sustainable level (Gillet, 2003), there is also concern that the average size per lobster appears to be declining, and the catch per fisherman is no longer sufficient to support a fisherman and his family (anecdotal reports, Sarteneja, 2009) – representative of a community with over 80% of families directly reliant on the lobster and conch fishing industry (Sarteneja community consultation, 2005), and the largest fishing stakeholder community of the Belize reef (Catzim, 2009<sup>5</sup>).



**Figure 18: Comparison of Lobster Encounters at GSSCMR, SCMR and LBCNP in 2008**

Lobster has traditionally been a major fisheries target at the Gladden Spit and Silk Cayes Marine Reserve. Most lobster fishermen within the GSSCMR use hook sticks to free dive for lobster. Over the past few years commercial species monitoring has been occurring within the GSSCMR. These studies have shown relatively moderate numbers of lobster within the reserve, approximately 12.4 lobster observed per hour in the no-take zone, and approximately 8.8 per hour in the General Use Zone (SEA data, 2008). When compared with Laughing Bird Caye National Park and Sapodilla Cayes Marine Reserve, lobster encounter rates are higher within GSSCMR (Figure 18).

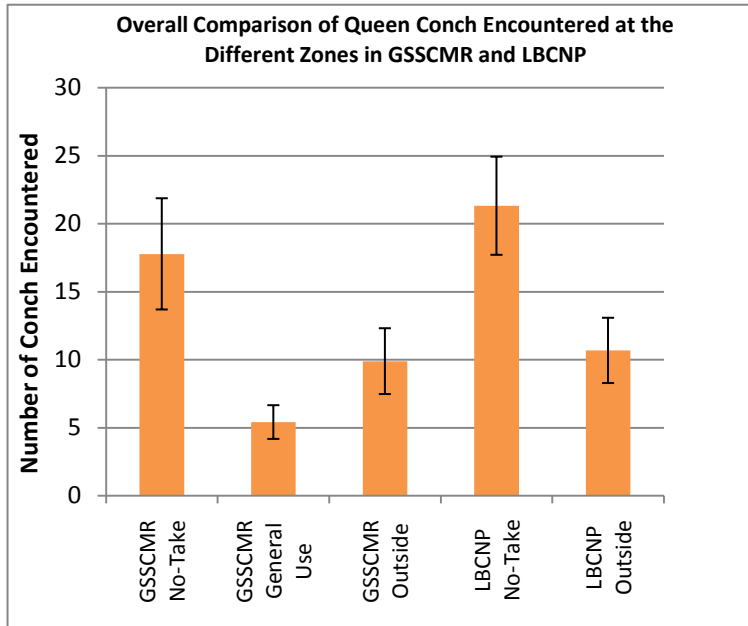
As with lobster, national conch landings have declined significantly, peaking at 1,239,000 lbs in 1972, and subsequently declining by 54% to 574,756 lbs in 2008 (Ministry of Agriculture, 2008). It has been suggested that the maximum sustainable yield for this species was reached in 2006, with the steep decline of 17% observed in 2007 serving as an indication of the “maturity” of the fishing industry, and the possible overfishing of this fishery resource (Ministry of Agriculture and Fisheries, 2007). Even as far back as 1996, there was evidence that fishing pressure was too high, with the national population consisted primarily of juveniles, resulting in recommendations for capping of the number of fishermen.

<sup>4</sup> Ministry of Agriculture and Fisheries Annual Report, 2008

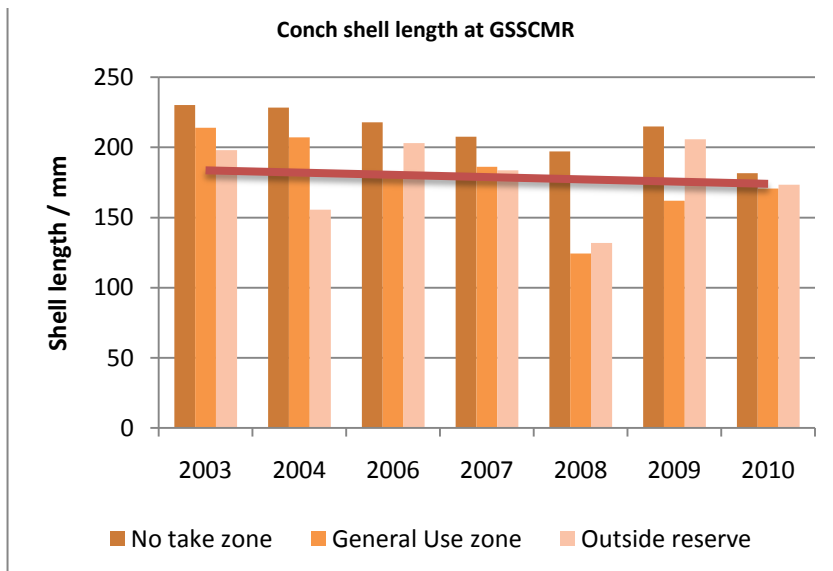
<sup>5</sup> Adele Catzim: Data produced by the Belize ISIS Enterprises Ltd. with support from the Betty Moore Foundation, through Conservation International

Strict regulations and quotas are now being implemented towards more sustainable use of this resource, and an increase in production was noted in 2008 (Ministry of Agriculture and Fisheries, 2009), though the number of fishermen has still not been capped.

Conch landings, too, have declined significantly, peaking at 1,239,000 lbs in 1972, and subsequently declining to 574,756 in 2008 (Ministry of Agriculture, 2008), representing a drop of over 50%. It has been



**Figure 19:** Gladden Spit and Silk Cayes Marine Reserve: Conch encounters (SEA Data, 2008)

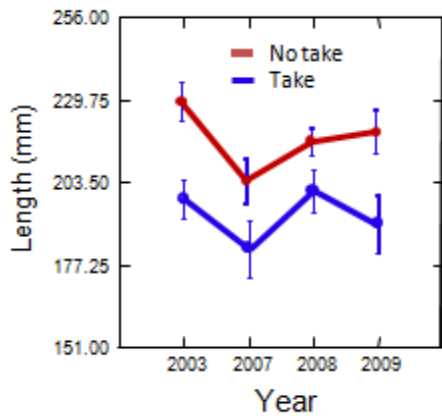


**Figure 20:** Gladden Spit and Silk Cayes Marine Reserve: Conch shell length (SEA Data, 2010)

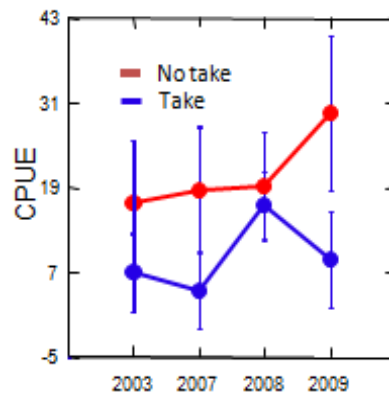
suggested that the maximum sustainable yield for this species was reached in 2006, with the steep decline of 17% observed in 2007 being an indication of the “maturity” of the fishing industry, and the possible overfishing of this fishery resource (Ministry of Agriculture and Fisheries, 2007). Even as far back as 1996, there was evidence that fishing pressure was too high, with the national population consisting primarily of juveniles, and recommendations for capping of the number of fishermen. Strict regulations and quotas are being implemented towards more sustainable use of this resource, and an increase in production was noted in 2008 (Ministry of Agriculture and Fisheries, 2009).

SEA has conducted significant monitoring of conch populations within the Gladden Spit and Silk Cayes Marine Reserve over the years with an approximate CPUE of 18.7 conch encountered per man hour within the No-Take zone in 2008, and 5.4 per hour in the General Use Zone – an indication of the effectiveness of zones in affording protection to commercial species (SEA

data, 2008). There would appear to be a general trend towards decreasing shell length, though this may not be significant.



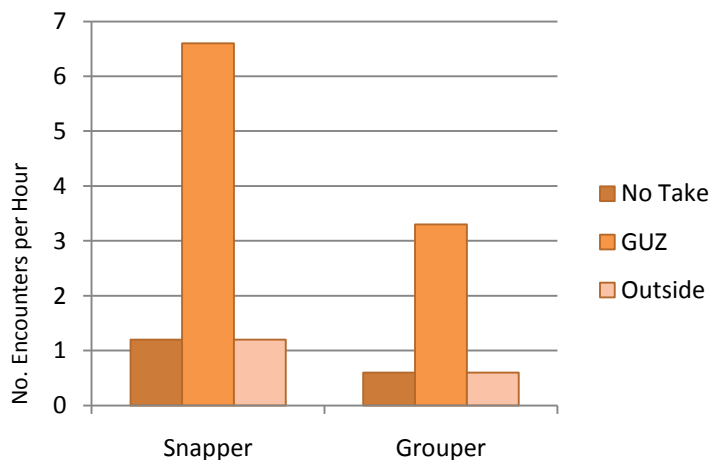
**Figure 21** Average GSSCMR conch sizes inside and outside no-take zones (C.I. = S.D.) from 2003 to 2009



**Figure 22:** Average GSSCMR conch CPUE inside and outside no-take zones (C.I. = S.D.) from 2003 to 2009

Further comparison of the existing SEA data between the no-take preservation zone and the fished general use zones has shown that there appears to be some correlation between the size and age of conch within each of the zone types (Figures 21 and 22). The results indicate a trend towards larger conch in the no-take zones indicating some kind of a reserve effect.

Finfish are also extracted from the marine protected area, and in general provide an important component of the commercial catch – most are fished using hand lines. Much of this catch is sold in local markets and directly to hotels rather than through the co-operatives, though some is marketed for export. The targeted export species include groupers (*Epinephelus* sp. and *Mycteroperca* sp.), snappers (*Lutjanus* sp. and *Ocyurus* sp.), the hogfish (*Lachnolaimus maximus*), king mackerel (*Scomberomorus cavalla*), great barracuda (*Syhyraena barracuda*), and jacks (*Alectis* sp., *Caranx* sp. and *Trachinotus* sp.)



**Figure 23:** Gladden Spit and Silk Cayes Marine Reserve: Snapper and Grouper encounters inside and outside GSSCMR, 2010 (SEA Data, 2010)

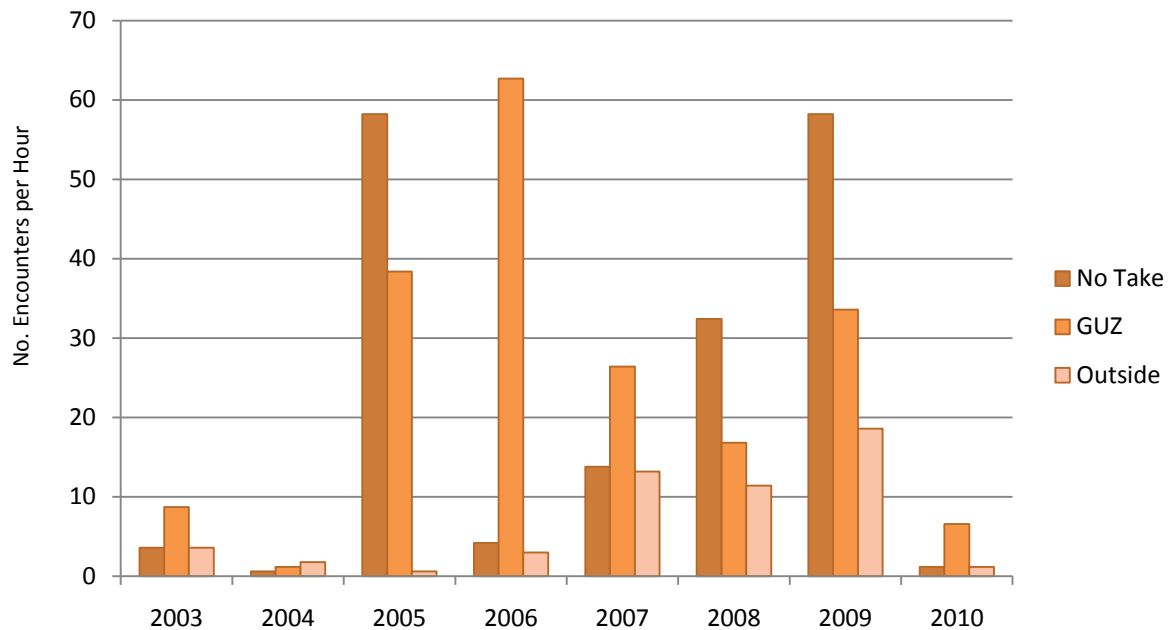
([www.fao.org/fishery/countrysector/FL-CP\\_BZ/en](http://www.fao.org/fishery/countrysector/FL-CP_BZ/en)). Snappers are reported to make up the largest single family of fish that are exported, with whole fish and fish fillet exports totaling 113,500 lbs in 2001, dropping to 52,316 lbs in 2006 (Belize Fisheries Dept. 2002; Ministry of Agriculture and Fisheries, 2007). Species harvested for local consumption include grunts (Haemulidae), snooks (Centropomidae), mullets (Mugilidae), porgies (Sparidae), triggerfish (Balistidae), and tarpon (Megalopidae).



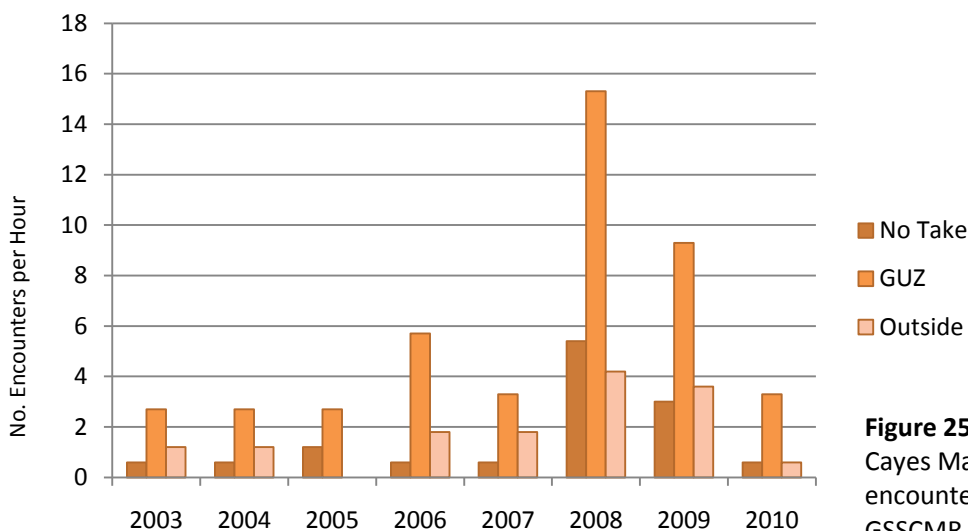
## Gladden Spit and Silk Cayes Marine Reserve – Management Plan 2011-2016

For both snapper and grouper, 2010 commercial species surveys reported higher encounters in the General Use Zone than the No Take Zone, and significantly higher numbers than outside the marine protected area boundaries. Number of snapper encounters recorded in the No Take Zone for 2007 to 2009, however, were higher than the General Use Zone and outside the MPA (Figures 23 and 24), and showed a trend of increasing encounters over time, though this wasn't reflected in the 2010 survey.

Grouper encounters have shown a steady decline between 2008 and 2010 (Figure 25), reflecting the regional trend.



**Figure 24:** Gladden Spit and Silk Cayes Marine Reserve: Snapper encounters inside and outside GSSCMR, 2003 - 2010 (SEA Data, 2010)



**Figure 25:** Gladden Spit and Silk Cayes Marine Reserve: Grouper encounters inside and outside GSSCMR, 2003 - 2010 (SEA Data, 2010)

## Gladden Spit and Silk Cayes Marine Reserve – Management Plan 2011-2016

Management of the Gladden Spit and Silk Cayes Marine Reserve has historically centred on the internationally recognized spawning aggregation site. GSSCMR is the site of remarkable spawning aggregations, with over thirty species of reef fish and near shore pelagics- including jacks, grouper and snapper- observed displaying spawning behavior.

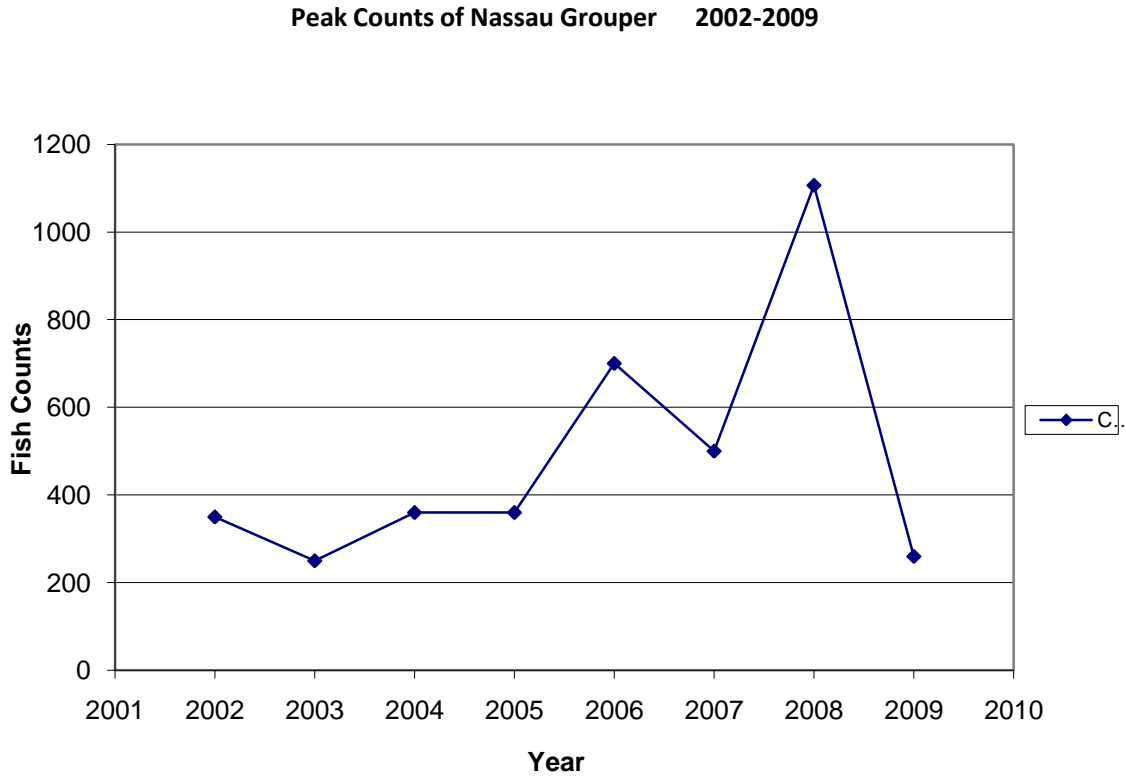
The area of Barrier Reef around Gladden Spit contains the best-developed and most continuous reef due to its elevation, good water quality, and modified wave regime. The southernmost tip of this area sticks out and is called The Elbow or Gladden Spit. In 1992-1993, tourists were beginning to be taken out to Gladden Spit to see the whale sharks. Foreign fishers from Honduras and Guatemala were also operating in the area. By 1995, tourism was increasing to see the whale sharks. In 1999, Friends of Nature with support from The Nature Conservancy began lobbying government for the declaration of the Gladden Spit and Silk Caye Marine Reserve. The area was declared a marine reserve in 2000. In 2002 FoN was given delegated co-management of the GSSCMR, making the NGO responsible for day-to-day management of the park. An additional ten spawning aggregation sites were declared protected by the Government of Belize in 2002, making eleven spawning sites within Belize protected from overfishing.

The spawning aggregation site at Gladden Spit attracts over thirty species of reef fish and near shore pelagics. Since 2002 FoN with support from the Nature Conservancy as well as other local partners has conducted monthly monitoring of the SPAG site at GSSCMR. This monitoring has followed the Reef Fish Spawning Aggregation Monitoring Protocol for the Mesoamerican Reef and the Wider Caribbean. Monitoring has been targeted at the days surrounding the full moon and is conducted monthly as weather permits. This monitoring, which has occurred consistently over the past five-years, has allowed for the compilation of a significant data set.

Although a wide number of species are known to aggregate at the Gladden Spit, four species of commercial importance have often attracted the most attention and will be discussed here. These include the Nassau Grouper (*Epinephelus striatus*), Mutton Snapper (*Lutjanus analis*), Dog Snapper (*Lutjanus jocu*) and Cubera Snapper (*Lutjanus cyanopterus*). Nassau grouper is currently listed on the IUCN red list as endangered and has been a conservation target across the region and Belize due to impacts from fishing. Mutton snapper has been a fishing target for fishermen at GSSCMR for many years and has been the focus for managers of the site. Dog snapper is a prevalent species at GSSCMR and is known to spawn through-out the year, however due to its smaller size it has not been specifically targeted by fishermen. Finally, spawning Cubera snapper are thought to be the major draw for the whale sharks which are found in their greatest density during the peak months for Cubera. These four fish species have been the main management focuses of FoN at Gladden Spit.

Although there has been a documented decline in Nassau Grouper around the Caribbean, at Gladden Spit however FoN is noticing what perhaps maybe a more positive trend. The graph below shows the peak counts recorded for each of the past five years that monitoring has occurred at GSSCMR. There has been some fluctuation in the total number of grouper observed

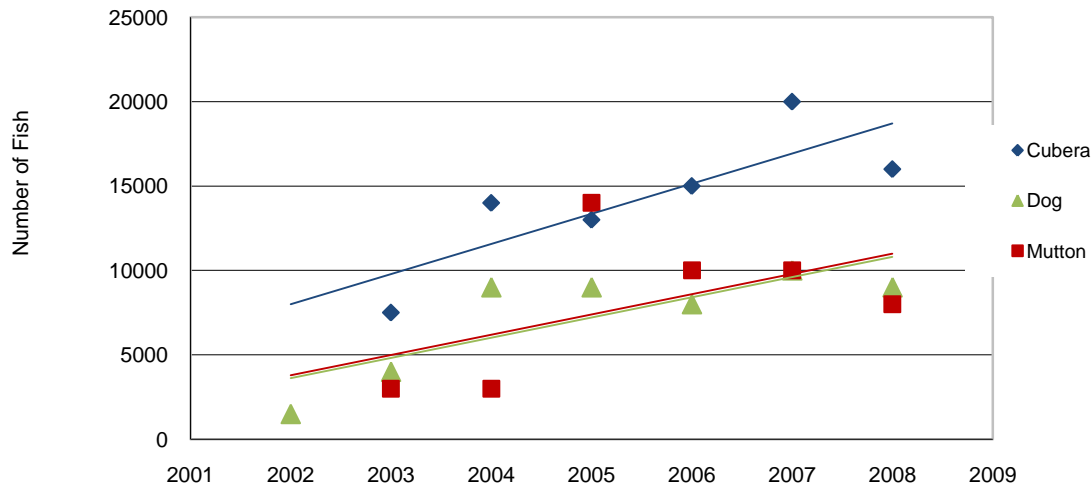
at the spawning site, however there appears to be an upward trend to the numbers (Figure 26). Even though this upward trend is encouraging it is important to note that the numbers observed at this spawning site are not indicative of a functional breeding population.



**Figure 26: Peak Counts of Nassau Grouper, 2001 - 2009**

Like the data collected for Nassau grouper, the data that FoN has collected for Mutton, Cubera and Dog snapper has shown a similar upward trend (Figure 27).

Peak counts for three snapper species at GSSCMR Spawning Aggregation Site  
2002 - 2008



**Figure 27: Peak yearly counts for three *Lutjanidae* fish species at the GSSCMR spawning site**

These numbers seem to indicate that although there has not been a significant increase in the numbers of fish seen at the spawning sites, there has also been no significant decrease. Unlike Nassau grouper less is known about the spawning populations of snapper and other fish species within Belize, however the trend is encouraging.

When considering these numbers and trying to interpret the results of the monitoring at Gladden Spit questions arise as to possible explanations for what appears to be an upward trend. Since GSSCMR was declared in 2002 the rangers have targeted their enforcement efforts especially around the SPAG sites. The Gladden Spit SPAG site is closed to fishing during the months of December to March. The statutory instrument also stipulates that fishing is not permitted anywhere within the park at night. This forces the rangers to remain vigilant in the enforcement of rules and regulations. When GSSCMR was declared in 2002 FoN phased in enforcement starting with a period of warnings followed in 2004 with a period of no-tolerance.

Over the past four years, SEA / FoN's enforcement efforts have been netted increasing numbers of charges brought and the number of convictions received, while the net number of rules infractions or incidents has remained fairly stable. For the most part the enforcement effort has remained similar with consistent night and day patrols and targeted efforts during the closed season for conch and lobster, as well as the spawning seasons for both grouper and snapper. Given this effort over the past five years the organization has learned a great deal about how to conduct successful patrols and as the graph above shows there has been an overall increase in the number of charges and convictions.

Relating enforcement efforts directly to the increase in fish observed at the spawning site is tenuous at best. However, the past five years have indicated that enforcement may play an

## Gladden Spit and Silk Cayes Marine Reserve – Management Plan 2011-2016

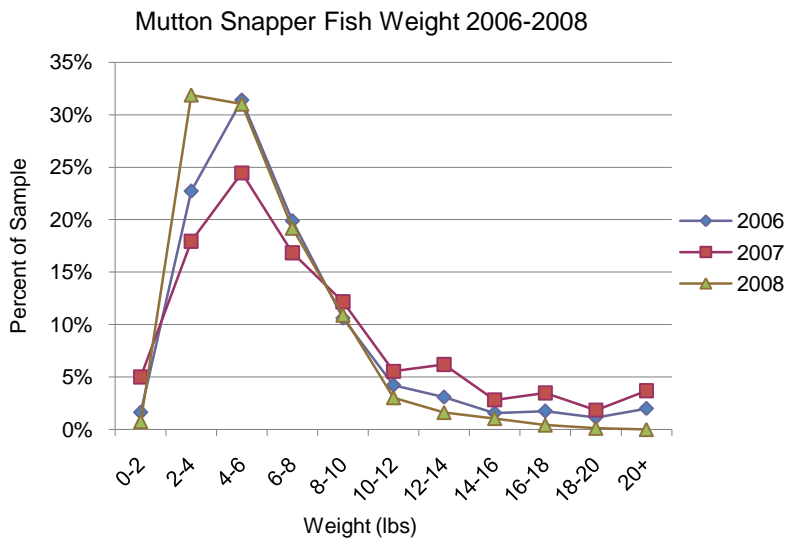
important role in ensuring improved management of these sites. The fact that numbers of fish observed at GSSCMR appears to be increasing does indicate that perhaps some of the management actions are having an effect. However the analysis of this data raises many questions.

The location of GSSCMR and the abundance of fish recorded during the spawning period make Gladden Spit a prime target for illegal fishing activities. Located relatively close to both Guatemala and Honduras it is clearly a popular destination for unlicensed or illegal fishermen from these two countries as well as local Belizean fishermen. Over the past five years FoN's rangers have worked closely with local fishermen to try to ensure protection of these valuable fisheries resources. This has included developing protocols for the issuing of special licences for fishing at the spawning site as well as targeted enforcement efforts. These efforts have resulted in a number of successful arrests and convictions as the data above indicates.

Although directly linking the apparent rise in grouper and snapper numbers to enforcement activities is a bit tenuous, there does appear to be a similar trend in both fish numbers and arrests and convictions. As the Belize National Spawning Aggregation Working Group continues to look for solutions to what appears to be a steady decline in fish numbers the lesson at GSSCMR provides some key information about the power role that more effective enforcement can play in ensuring sustainability of spawning aggregation related fisheries. It is clear that further protection for some species, specifically the Nassau grouper is warranted, however continued investment in effective enforcement should help efforts to conserve these unique locations.

Because of the value of Gladden Spit as an active spawning aggregation fishery from March to June, special regulations have been developed by Southern Environmental Association and the Fisheries Department to ensure that fishing at this sensitive location is closely monitored. This includes the granting of special licenses to traditional fishermen, careful enforcement of fisheries laws and the prohibition of night fishing. Due to these regulations the vast majority of fish targeted by local fishermen are mutton snapper, not the cubera and dog snapper which are the major attraction for whale sharks.

For a number of years at first in collaboration with researchers and now as part of SEA's monitoring program data has been collected about fishers' catches at the fishermen's camp on Buttonwood Caye. Biologists and community researchers count, measure, weigh and assess gonad state for each fish, providing a comparison of average size distribution for Mutton Snapper 2006-2008. (Figure 28).



**Figure 28: Comparison of Mutton Snapper weights, 2006 – 2008 (SEA, 2008)**

Although statistical analysis is necessary for SEA’s data evidence from prior studies has shown a significant decline in the mutton snapper fishery at Gladden Spit. A 2008 study has shown a 22% decrease in mean landings of Mutton snapper for fishermen at Gladden Spit coupled with a decrease in fish size (R. Graham, et al 2008). This indicates a further management efforts may be necessary to maintain a viable aggregation.

Except for the whale shark (for which there is a complete ban on fishing under the Fisheries Act), there is the recognition in Belize that sharks, in general, are under pressure from over-fishing, having a close stock-recruitment relationship, long recovery times in response to over-fishing, with few offspring and late sexual maturity, resulting in low biological productivity. This, in combination with complicated patterns of size/sex segregation and seasonal migration, raise concerns at the national levels about the sustainability of the shark fishery, particularly under the current unregulated fishing levels. The Belize Fisheries Department is developing a National Plan of Action for the shark fishery following the guidelines of the International Plan of Action for the Conservation and Management of Sharks (IPOA – Sharks), which is designed to achieve the conservation and sustainable use of shark species through the protection of the marine environment (ecosystems and biodiversity), with the minimization of by-catch, waste and discard, and through the adoption of selective and environmentally safe fishing practices.

Shark fishing has also been conducted in the waters of GSSCMR. Common species caught include bull, hammerhead, nurse, reef and lemon sharks, with the dried shark fins and salted or frozen shark meat being exported through the co-operatives, or illegally sold directly to buyers in various coastal ports in Guatemala and Honduras. Shark fishing in Belize was assessed in 2005 during the initial drafting of the National Plan of Action – Sharks (Fisheries Department, 2005), when an estimated twenty-five fishermen were identified as being involved, originating from various communities along the coastline, with the greatest activity concentrated between December and March. In 2001, about 9,500 lbs of shark products were exported (Belize Fisheries Dept. 2002) – however, this is accepted as an under-estimation of the fishing level, as the largest market is the illegal trade with Guatemala and Honduras (R. Graham, pers. com., 2010). In addition despite growing scientific evidence of a decline in shark populations many of the traditional fishermen who fish at the Gladden Spit spawning aggregation site have expressed concern about the apparent abundance of sharks who often take hooked snappers before the fishermen



are able to safely land them in their boats. This has caused some backlash from local fishermen when discussing ways to increase or protect shark populations.

#### **1.5.4 Past and Present Research**

There are no established research facilities within the Marine Reserve, though a number of organizations have ongoing research programmes, primarily targeting the spawning aggregation site, and resulting in a number of papers focusing on the whale sharks, spawning aggregation, currents, physical oceanography, and connectivity. Principle long term researchers include Will Heyman, Rachel Graham, and B. Kjerfve

Monitoring of target fish abundance is ongoing in the area, and has been since 2003, first under Friends of Nature, and now under SEA. A monitoring manual has recently been completed by SEA to ensure standardized monitoring techniques across the three protected areas, and across time. Lobster and Conch stock assessments are also included, with data being submitted to the Belize Fisheries Department.

SEA is a member of the National Coral Reef Monitoring Network, which is the national body responsible for coordinating national monitoring efforts. In conjunction with the efforts of the National Coral Reef Monitoring Network, Ecomar coordinates bleaching data and lionfish reports for Belize. Data from Ecomar will be submitted to the Environment and Research Institute, once it has been fully established.

Gladden Spit and Silk Cayes Marine Reserve encompasses three Healthy Reef monitoring sites (Table 17), developed to provide an indication of the status of the coral reef throughout the region. The first Healthy Reef report was based on data from 2006, the second from 2009.

<b>Site Code</b>	<b>Latitude</b>	<b>Longitude</b>
1038	16.5079	-87.9707
1179	16.4955	-87.9863
1184	16.5323	-87.9844

**Table 17: Healthy Reef Monitoring Sites within GSSCMR**

## **1.6 Cultural and Stakeholder Use of Gladden Spit and Silk Cayes Marine Reserve**

### **1.6.1 Community and Stakeholder Use**

The Belize coast and cayes have been used by local populations since the times of the early Maya. Fishing stations, trading posts, ceremonial centers, and burial grounds are found throughout coastal Belize, dating from as early as approximately 300 B.C., with many of the cayes used during the height of the Maya civilization.

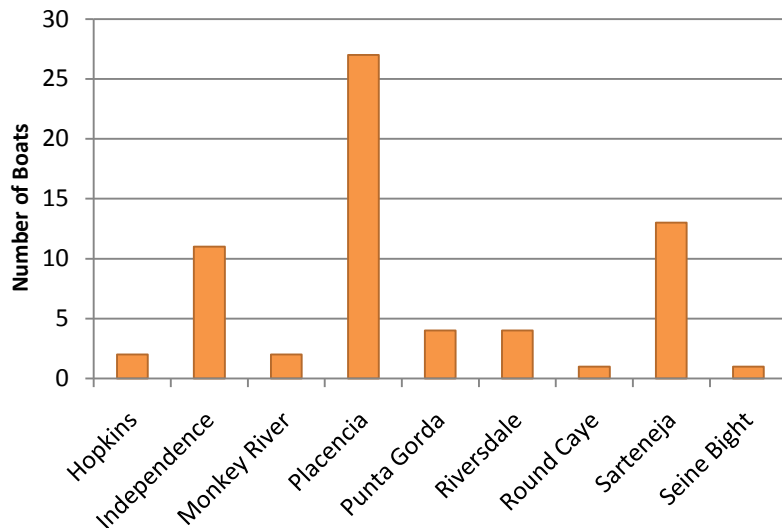
From the early 19<sup>th</sup> century, the coastal communities of the central coastal plain from Dangriga to Placencia, and down to Monkey River, have traditionally been subsistence fishermen, paddling in dories close to shore and rarely venturing beyond Ragged Caye. In the 1960's, the expanding footprint of the Sarteneja free-diving lobster and conch fishermen, with their traditional wooden sail boats, extended to include the Marine Reserve – this use continues today. With the arrival of outboard motors and fiberglass skiffs, many of today's fishing descendants from the central coastal communities are able to travel further, better utilizing the resources of the Marine Reserve.

This has included use of the spawning aggregation site at Gladden Spit, and harvesting of finfish, lobster and conch throughout the area. With the designation of the Marine Reserve, fishing became more restricted, with surveillance and enforcement patrols ensuring that fishermen kept the Fisheries Act laws, and setting aside a Conservation Zone for resource protection and tourism use, centered on the Silk Cayes.

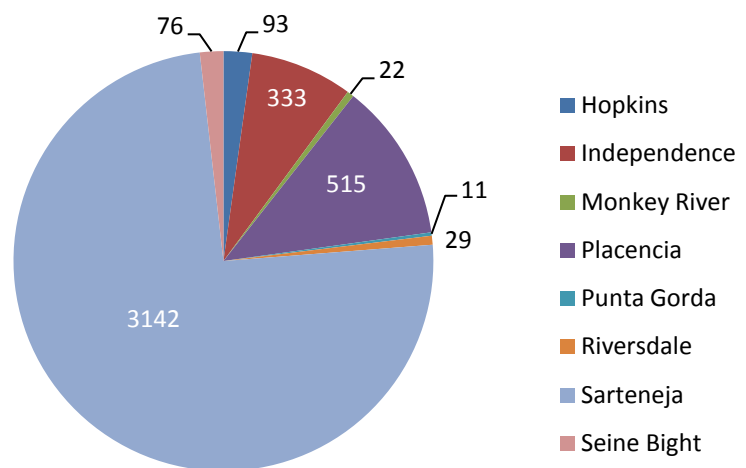
The seasonal protection of the spawning aggregation site in 2003 and subsequent management, with access being restricted to traditional fishermen, is seeking to ensure the sustained viability of the fish stocks in the long term, though there is general agreement that management of the permit system needs to be reviewed and tightened.

**Fishing Patterns**

65 commercial fishing boats were reported as using Gladden Spit and Silk Cayes Marine Reserve in 2008. The fishing boats originate primarily from communities on the central coastline, with Placencia and Independence having the highest number of boats using the area, with 27 and 11 boats respectively (Figure 29). These Stann Creek / southern fishermen generally use smaller skiffs, and access the area on one day / two day fishing trips, with between 2 and 4 fishermen per boat. Fishing methods may include traps, shades and lines, as well as free diving for conch and lobster. The third largest number of boats is from Sarteneja, to the north of Belize. The Sartenejans use larger traditional sailboats to reach the Marine Reserve, and dug-out canoes, or dories for daily fishing (one per fisherman). The number of fishermen per sailboat varies from a minimum of 3 to 18 - the highest number of fishermen recorded for a single boat in 2008. These fishermen camp on their boats or on adjacent cayes, spending up to 12 days at sea, free-diving for lobster and conch (depending on the season) and catching finfish, generally, in 2008, using spearguns (speargun use is now prohibited within Marine Reserves, as per the revised SI, 2009).

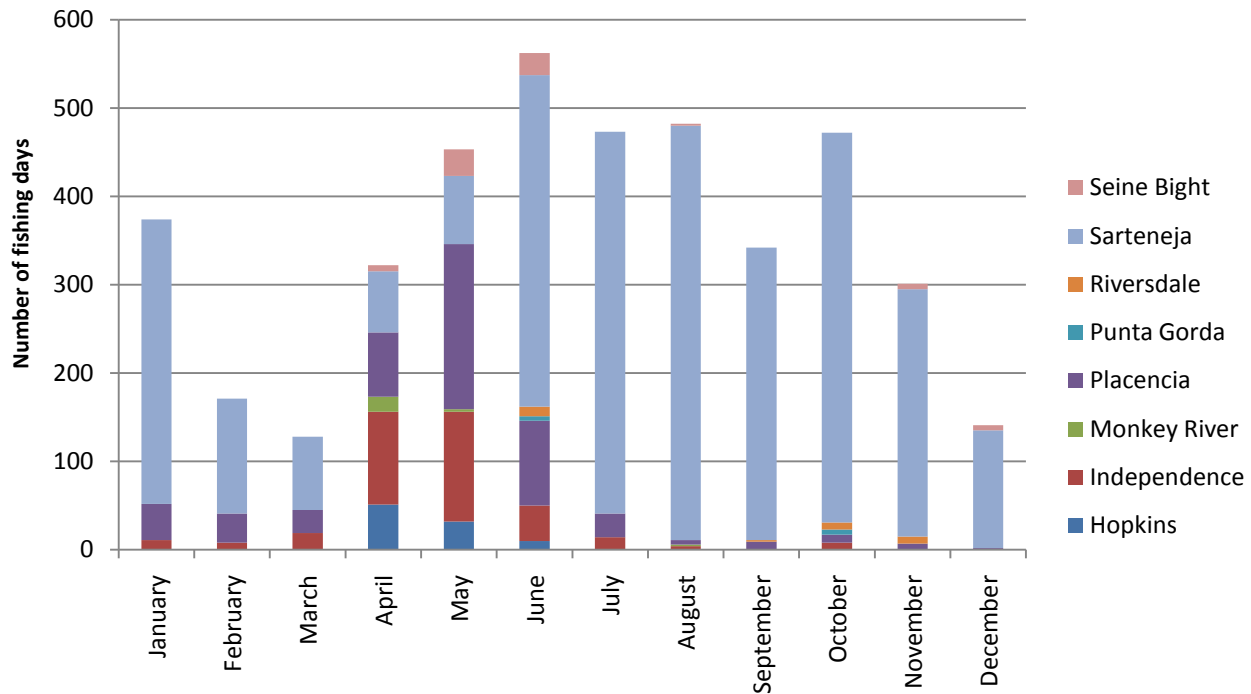


**Figure 29: Origin and number of Boats using Gladden Spit and Silk Cayes for commercial fishing (SEA data, 2008)**



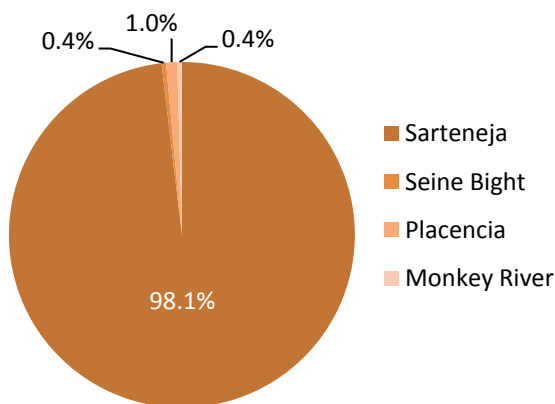
**Figure 28: Number of man days per community spent fishing commercially within Gladden Spit and Silk Cayes Marine Reserve in May, 2008 (SEA data, 2008)**

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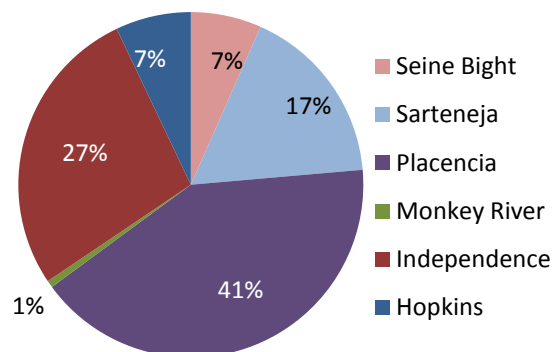


**Figure 29: Proportional stakeholder use of Gladden Spit and Silk Cayes Marine Reserve for Commercial Fishing (2008)**

Analysis of use patterns by fishermen reveals an annual pattern (Figures 28 and 29, SEA data 2008). The highest users in all months, with the exception of April and May, are the Sartenejan fishermen. This is particularly clearly demonstrated in August, 2008, when of the 480 fishing days reported for the Marine Reserve in August, 2008, 469 of them (97.8%) were Sarteneja fishermen (Figure 30). This pattern switches in the two months when the traditional fishermen from the central Belize coastal communities fish the spawning aggregation site – April and May. In May, for example, the majority of fishing days (187 man days / 41%) are by Placencia fishermen, and a further 27% by Independence fishermen, with only 17% of fishing days being by Sarteneja fishermen (Figure 31).



**Figure 30: Origin of commercial fishermen reported in Gladden Spit and Silk Cayes Marine Reserve for August, 2008, per man day (SEA data, 2008)**



**Figure 31: Origin of commercial fishermen reported in Gladden Spit and Silk Cayes Marine Reserve for May, 2008, per man day (SEA data, 2008)**

When analyzed by boat usage, eleven boats use the Marine Reserve for more than 30 days of the year, and can therefore be considered as primary users, with an income generation tied to the MPA to some extent. The boat most frequently encountered within the Marine Reserve is the Lady B, from Independence, which is recorded as present within GSSCMR for 74 days of the year (Figure 32). This is closely followed by Darink, Ardenny and Gianna, all from Sarteneja, and all of which spend 58 days or more within the MPA (Figure 33).

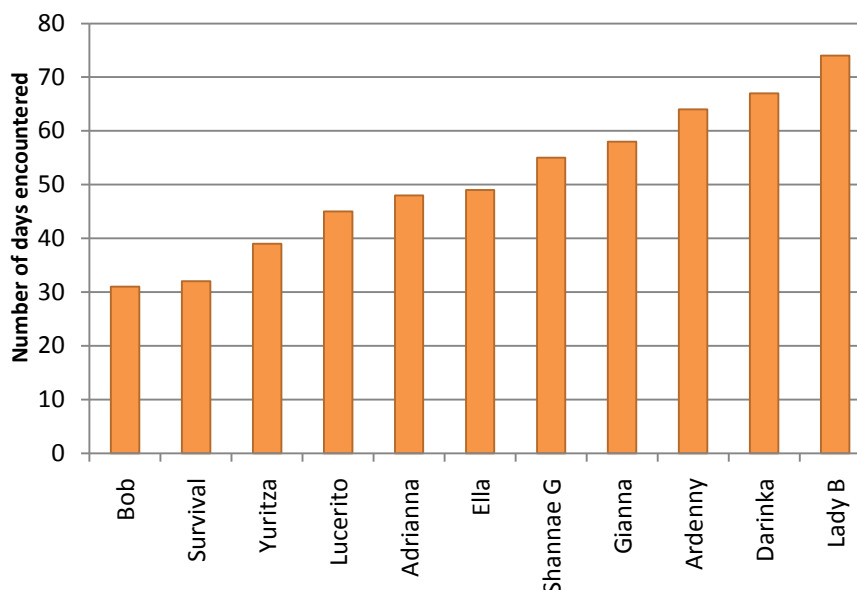


Figure 32: Most Frequently Encountered Commercial Fishing Boats using GSSCMR (> 30 days per year) – Number of days recorded within GSSCMR (SEA data, 2008)

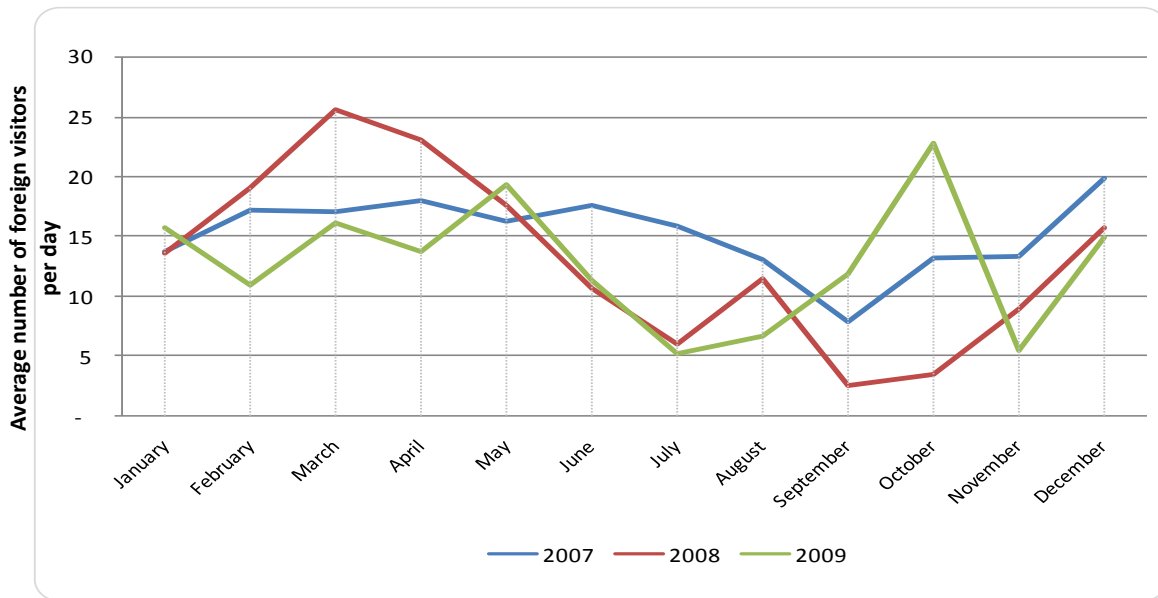
Boat Name	No. Days	Origin	Average crew size	Time of Year (No. days per month)											
				J	F	M	A	M	J	J	A	S	O	N	D
Lady B	74	Independence		3	4	10	12	10	8	4			1		
Darinka	67	Sarteneja		10	1			2	6	6	13	11	8	4	6
Ardenny	64	Sarteneja		7	5		3		7	8	10	9	7	7	1
Gianna	58	Sarteneja		7	4	6	4	3	6	3	8	5	8	1	3
Shannae G	55	Placencia		10	9	7	11	9	8	1					
Ella	49	Sarteneja		4	5	1			7	7	8	5	5	4	3
Adrianna	48	Placencia		4	4	5	10	11	8	3	1	1	1		
Lucerito	45	Sarteneja		4	1	1	1		6	7	8	3	6	4	4
Yuritza	39	Sarteneja		5	1	2	2		3	6	3	5	7	4	1
Survival	32	Placencia		4	1	3	7	9		1	1	3	2	1	
Bob	31	Independence		2			19	3	5	1	1				

Figure 33: Boats using GSSCMR >30 days in the year, and number of days per month (SEA data, 2008)

**1.6.2 Recreation and Tourism Use**

Belize is a well known tourism destination for those seeking the reef, coral sand beaches and laid-back Caribbean culture. Gladden Spit and Silk Cayes Marine Reserve provides an excellent resource for marine based activities - the proximity of pristine reef, dive sites, whale sharks and world class sport fishing draws many visitors to the area. Snorkeling and diving tours originate from the mainland (principally Dangriga, Placencia, Sittee River, and Hopkins), with many of the larger coastal resorts, such as Hamanasi (Hopkins) and Pelican Beach Hotel (Dangriga) providing day tour packages.

Visitation is highest in March and April (Figure 34), tying in with the whale shark season and the optimum time for seeing these amazing fish, with many tour operators offering an inclusive tour, stopping at both the Silk Cayes and the whale shark zone.



**Figure 34: Foreign visitation to Gladden Spit and Silk Cayes Marine Reserve 2007 - 2009 (Bravo, 2010)**

With 8,580 visitors to GSSCMR in 2009, and 1,285 of those to the whale shark zone, tourism is a significant income generation mechanism for both SEA, as the co-manager, with ticket sales reaching over Bz\$136,100 in 2009 (Bravo, 2010). Tourism is also an important source of revenue for the tour operators, hotels and associated tourism infrastructure of central Belize - particularly Placencia. Private yachts and charters also utilize the area on a frequent basis, with a number of companies providing charter services, based primarily from Placencia and San Pedro.

Tour guides are encouraged to use best practices when taking tours on the reef – the majority of visitors are focused on day trips, snorkeling in the Silk Cayes area and, if it is within the whale shark season, in



the whale shark zone. Whale shark visitation is strictly controlled through a series of regulations agreed to by the tour operators, and stiff penalties if these regulations are broken.

### **1.6.3 Educational Use**

SEA continues to work closely with communities to promote education, alternative livelihoods and community engagement in the management process, and education of both stakeholders and visitors is an important task for effective management of the Marine Reserve, though has been limited in the past. There are no Visitor facilities within Gladden, and there is limited education, with the Marine Reserve being considered under-utilized. SEA recognizes the importance of hands-on experience in reaching out to its stakeholders, and the SEA's Education and Outreach Programme hosts school trips to the reef – predominantly in the Laughing Bird Caye area, with its easier, access and a larger caye. This activity, which has been ongoing throughout the history of the current organization and its predecessor, Friends of Nature, was strengthened during 2010 under a COMPACT-funded project that assisted SEA in developing greater understanding among stakeholders of all ages about the importance of marine conservation and marine protected area management. SEA provided over 400 students with field trips to the reef to experience the reef environment and discuss management issues.

## 2. Conservation Planning

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### 2.1 Identification of Conservation Targets

Conservation planning is a structured process that identifies and assesses the species and ecosystems of concern, the threats that impact them, and the strategies that can be used within the management of the area to mitigate these threats.

#### 3.1 Conservation Targets

Conservation targets are species, species assemblages or ecosystems that are selected as representing the biodiversity of a protected area – such that strategic actions, taken to ensure their continued viability and reduce the pressures impacting them, will adequately address the conservation needs of the system as a whole.

##### 3.1.1 Identification of Conservation Targets

An initial list of potential conservation targets was generated, to represent and encompass the biodiversity values of the area, and to provide a basis for setting goals, developing strategies and actions, and monitoring success.

These potential targets were then reviewed, combined or nested into a list of six conservation targets, each representing or capturing the array of ecological systems, communities and species of the Marine Reserve, incorporating those highlighted in the preliminary list.

#### Potential Conservation Targets for Gladden Spit and Silk Cayes Marine Reserve

- Whale sharks
- Spawning Aggregation Sites
- Coral reef
- Bird nesting
- No take zone – fish, coral, conch nursery
- Sandy beaches
- Seagrass beds
- Lobsters
- Lion fish – a concern
- Fish landing – fishermen (economic)
- Research survey/monitoring
- Tourism – diving
- Turtle nesting
- Mangrove – used to be present but no longer

#### Final Conservation Targets for Gladden Spit and Silk Cayes Marine Reserve

- Herbaceous Beach Vegetation / Sandy Beaches
- Seagrass
- Coral Reef Communities
- Whale Sharks
- Spawning Aggregation
- Commercial Species

<b>Gladden Spit and Silk Cayes Marine Reserve: Conservation Targets</b>		
<b>Conservation Target</b>	<b>Justification</b>	<b>Species / ecosystems nested in this target</b>
<p><b>Herbaceous Beach Vegetation / Sandy Beach</b></p>	<p>The sandy beaches of the three Silk Cayes are constantly shifting, with natural erosion and deposition occurring in response to tide, wind and storm actions. The beach and its associated herbaceous beach community are classified within the Belize Ecosystem Map as <b><i>Tropical Coastal Vegetation on recent sediments</i></b> (Meerman, 2004) - this herbaceous beach community is considered very important for the stabilization of the turtle nesting beach, and providing shelter for ground nesting birds.</p> <p>The cayes are reported to provide nesting sites for hawksbill and possibly green turtles. Numbers are considered stable, but decreased over historical levels (Smith et. al. 1989; Moll, 1985; Majil, 2007; SEA data, 2009). Recent reports suggest a maximum of three nests a year at South Silk Caye, and unknown numbers nesting on Middle Silk Caye. However the size of the beaches available for nesting has been impacted by tourism, particularly with un-monitored camping on Middle and South Silk Cayes.</p> <p>Middle Silk Caye, and to some extent the other two Silk Cayes, are also considered important for ground nesting birds such as laughing gulls, and osprey have also been known to nest on the barbecue grill in the past). Middle Silk Caye is closed to visitation during bird and turtle nesting season.</p> <p>In addition to the various plants and animals that utilize the sandy beaches of the Silk Cayes, the beaches are also an important aspect for visitors, who use the caye on a regular basis. Maintenance of the open sandy areas for tourism use can result in poor nesting conditions and beach erosion, reducing the value for the wildlife.</p>	<p>The sandy beaches of the three Silk Cayes provide nesting sites for marine turtles (green and hawksbill (Smith et. al. 1989; Moll, 1985; Majil, 2007; SEA data, 2009).</p> <p>No specific work has been conducted on birds on the Silk Cayes, the most recent data available being from a site visit in 1998 (Jones, 1998). At that point, a small number of species were reported in the vicinity of the cayes – brown booby, brown pelican, magnificent frigatebird, green heron, osprey, and bridled tern, eastern kingbird, and great tailed grackle.</p>

<b>Gladden Spit and Silk Cayes Marine Reserve: Conservation Targets</b>		
<b>Conservation Target</b>	<b>Justification</b>	<b>Species / ecosystems nested in this target</b>
<b>Coral Reef Communities</b>	<p>The reef building corals of Gladden Spit and Silk Cayes Marine Reserve are critical to the maintenance of local biodiversity. In the ‘no take’ areas of the MPA, the coral reef acts as a source, essential to the maintenance of the artisanal fishing industry, particularly for spiny lobster and finfish populations. It is also one of the more important tourism resources Belize has to offer, and supports a significant percentage of employment in Placencia, as well as contributing to incomes in other coastal communities in the area.</p> <p>According to the Healthy Reef Initiative: a healthy reef can be characterized by relatively high live coral cover, moderate cover of crustose corraline calcareous and short turf algae, and low covering of fleshy macroalgae. The regional live coral cover average is 14% (15% on forereefs and 11% on the reef crest).</p> <ul style="list-style-type: none"> <li>▪ GSSCMR 2008 average live coral cover: 10 - 19.9% (FAIR),</li> <li>▪ GSSCMR 2008 recent coral mortality: estimated at &lt; 2% (GOOD).</li> <li>▪ GSSCMR macroalgal cover: 16.6% (2006)</li> <li>▪ GSSCMR 2008 highest % coral bleaching: 30% in October, decreasing to 2% by February, 2009</li> <li>▪ GSSCMR Commercial fish biomass: 1400 - 2099 g-100m<sup>2</sup> (FAIR)</li> </ul> <p>Herbivores such as the large parrotfish (Scaridae – <i>Scarus coelestinus</i>, <i>Sparisoma chrysopteryum</i> and <i>S. virida</i>) are critical in maintaining a healthy reef by reducing macroalgal cover, ensuring coral recruitment sites are available for continued coral health, particularly in recovery following bleaching episodes. SCMR rates as FAIR for parrotfish.</p> <ul style="list-style-type: none"> <li>▪ GSSCMR Parrotfish fish biomass: 1250.01-4650 g/100m<sup>2</sup>(FAIR)</li> </ul>	<p>The reef ecosystems of the GSSCMR include forereef, back-reef, reef slope, and patch reef. These reef types are composed of many scleractinian coral species, including five listed species:</p> <p><b>Staghorn Coral <i>Acropora cervicornis</i> CR</b>  <b>Elkhorn Coral <i>Acropora palmate</i> CR</b>  <b>Fire Coral <i>Millepora striata</i> EN</b>  <b>Star Coral <i>Montastraea annularis</i> EN</b>  <b>Star Coral <i>Montastraea faveolata</i> EN</b></p> <p>This provides a diverse range of habitats for a multitude of fish species and invertebrates, including commercially important species, of which at least eleven are IUCN redlist:</p> <p><b>Goliath Grouper (<i>Epinephelus itajara</i>) CR</b>  <b>Nassau Grouper (<i>Epinephelus striatus</i>) EN</b>  <b>Great Hammerhead (<i>Sphyrna mokarran</i>) EN</b>  <b>Queen Triggerfish (<i>Balistes vetula</i>) VU</b>  <b>Hogfish (<i>Lachnolaimus maximus</i>) VU</b>  <b>Mutton Snapper (<i>Lutjanus analis</i>) VU</b>  <b>Cubera Snapper (<i>Lutjanus cyanopterus</i>) VU</b>  <b>Yellowmouth Grouper (<i>Mycteroperca interstitialis</i>) VU</b>  <b>Rainbow Parrotfish (<i>Scarus guacamaia</i>) VU</b></p>

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Coral Reef Community Indicators						
Category / Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Status
<b>Landscape Context</b> Connectivity among communities & ecosystems	Current IRHI of resilient sites identified in the 2006 WWF/ TNC rapid reef assessment : SE1 WR1 ▪ <b>SBRC Indicator</b>		<b>Site SE1:</b> IRHI 2.63 (2009)			<b>Current Status:</b> IRHI = Integrated Reef Health Index (Healthy Reefs, 2007)
		<b>Site WR1:</b> IRHI 2.17 (2009)				
<b>Landscape Context</b> Environmental Factors	Water quality  ▪ <b>SBRC Indicator</b>					<b>Current Status:</b> Unknown. In the MAR, optimal water temperature for corals is 25 - 29°C. Monthly averages that exceed 0.5°C above the historical average for that month may cause bleaching (Healthy Reefs, 2007).
<b>Condition</b> Population Structure and Recruitment	% Average live coral cover ▪ <b>SBRC Indicator</b> ▪ <b>SOPA Indicator</b>	<10%	10 - 19.9%	<b>20 - 39.9%</b> 32% (SEA data, 2010)	>40%	<b>Current Status:</b> 13.6% (SEA data, 2009)
<b>Condition</b> Presence / abundance of key species	% Recent coral mortality  ▪ <b>SBRC Indicator</b> ▪ <b>SOPA Indicator</b>	>4%	2-4%	<b>&lt; 2%</b>	0%	<b>Current Status:</b> SEA data, 2008. Healthy reefs goal is to maintain MAR average of below 2% recent mortality, 20% old mortality and standing dead below 5%.
<b>Condition</b> Presence / abundance of key species	Level of coral recruitment ▪ <b>SBRC Indicator</b> ▪ <b>SOPA Indicator</b>	> 2 / m <sup>2</sup>	<b>2 recruits /m<sup>2</sup> – 4.99/m<sup>2</sup></b>	5 recruits/m <sup>2</sup> – 9.99/m <sup>2</sup>	≥10 recruits/m <sup>2</sup>	<b>Current Status:</b> Figures range from 3.4/m <sup>2</sup> (SEA data, 2008) to 6.0/m <sup>2</sup> (Shanks, 2009)
<b>Condition</b> Presence / abundance of key species	Commercial fish biomass ▪ <b>SBRC Indicator</b> ▪ <b>SOPA Indicator</b>	<700 g/100m <sup>2</sup>	<b>700 - 1399 g/100m<sup>2</sup></b>	1400–2799 g/100m <sup>2</sup>	>2800 g/100m <sup>2</sup>	<b>Current Status:</b> SEA data, 2008 (MBRS); Healthy Reefs data differs on ratings - MAR averages about 4600g/100m <sup>2</sup> ; with about 1100g /100 m <sup>2</sup> for commercial fish. Target is a 20% increase.

Coral Reef Community Indicators						
Category / Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Status
<b>Condition</b> Presence / abundance of key species	Parrotfish biomass ▪ <i>SBRC Indicator</i> ▪ <i>SOPA Indicator</i>	1-1250g /100m <sup>2</sup>	1250.01 - 4650g /100m <sup>2</sup>	>4650g / 100m <sup>2</sup>		<b>Current Status:</b> SEA data, 2008
<b>Condition</b> Species Dominance	% Macroalgal cover ▪ <i>SOPA Indicator</i>			18.6%		<b>Current Status:</b> SEA data, 2010
<b>Condition</b> Coral Bleaching	Average % coral exhibiting bleaching per annum ▪ <i>SOPA Indicator</i>					<b>Current Status:</b> SEA data, 2008
<b>Condition</b> Coral Bleaching	% survey sites showing coral bleaching per annum ▪ <i>SOPA Indicator</i>	>10%	5-10%	<5		<b>Current Status:</b>



<b>Gladden Spit and Silk Cayes Marine Reserve: Conservation Targets</b>		
<b>Conservation Target</b>	<b>Justification</b>	<b>Species / ecosystems nested in this target</b>
<b>Seagrass</b>	<p>Seagrass meadows are essential for maintaining the ecological health of the shallow marine ecosystems, with an important role in nutrient cycling and sediment stabilization. They are also a critical ecosystem for many fish and invertebrate species, with an acre of sea grass being shown to support up to 40,000 fish and 50 million small invertebrates (Seagrass Ecosystems Research Laboratory, 2005).</p> <p>This target focuses on the seagrass beds of Gladden Spit and Silk Cayes Marine Reserve. 90 – 100% of the sea grass beds are considered to be intact, with only marginal impacts from tourism and boat impacts in the shallow waters around the cayes themselves, and in the anchoring point for boats waiting to access the spawning aggregation area.</p>	<p>Two species of seagrass are present at Gladden Spit and Silk Cayes – Turtle Grass (<i>Thalassia testudinum</i>) and Shoal Grass (<i>Syringodium filiforme</i>).</p> <p>Seagrass beds are essential for the <b>Queen Conch</b> (<i>Strombus gigas</i>), one of the most important commercial species extracted from the sea, and for the juveniles of many commercial fish species. <b>Parrotfish</b>, herbivores that play a critical role in maintaining the reef, also rely on the seagrass beds as juveniles.</p> <p>Nested targets also include the <b>West Indian Manatee</b> (<i>Trichechus manatus</i>), the largest of Belize’s herbivorous marine mammals, as well as marine turtles. These species play a role in the maintenance of the seagrass and increase the productivity of this ecosystem through grazing.</p>

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Seagrass Indicators						
Category / Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Status
<b>Size</b> Size / extent of characteristic community	Extent of seagrass				<b>90 – 100% Current status</b>	<b>Current Status:</b> > 95% - Some clearance from edge of cayes
<b>Size</b> Size / extent of characteristic community	% seagrass cover	< 50%	50% - 75%	75% - 90%	<b>90%- 100%</b>	<b>Current Status:</b> > 95% (SBRC, 2008). % cover = average of % of 1m <sup>2</sup> quadrat in seagrass monitoring sites within SCMR occupied by seagrass
<b>Landscape Context</b> Environmental Factors	Water quality  ▪ <b>SBRC Indicator</b>					<b>Current Status:</b> Unknown. <ul style="list-style-type: none"> <li>▪ Prefers salinities b/w 25-40 ppt. Begins to die when salinity reaches 20 ppt or lower, and will not grow in 17 ppt or less. Intolerant of salinities 45 ppt or higher for extended periods</li> <li>▪ Prefers temperature b/w 20-30°C. Temperature above 35°C will kill it</li> <li>▪ Prefers light levels 18 – 40.5 lumens/m<sup>2</sup></li> </ul>
<b>Condition</b> Community architecture	% seagrass impacted by anthropogenic activities					<b>Current Status:</b> Unknown
<b>Condition</b> Presence / abundance of key species	Abundance of green turtles within SCMR per annum / ha					<b>Current Status:</b> Unknown
<b>Condition</b> Primary Productivity	Seagrass density	0 - 29%	30-49%	50-79%	<b>80 - 100%</b>	<b>Current Status:</b> 80-90% (SBRC, 2008).

Gladden Spit and Silk Cayes Marine Reserve: Conservation Targets		
Conservation Target	Conservation Target	Conservation Target
<b>Commercial Species</b>	<p>Commercial and recreational species provide the basis for a fishing industry on which many people depend. The role of many of the target fin-fish species as top predators is also essential in reef community structure. Most commercially important marine species have complicated life cycles that rely on the health of the entire marine ecosystem – utilizing not just the reef, but also the seagrass beds and the mangroves at some point during their life cycles, and reflect the state of the reef.</p> <p>The two invertebrate species of highest commercial importance extracted from the GSSCMR are the <b>Caribbean Spiny Lobster</b> (<i>Panulirus argus</i>) and <b>Queen conch</b> (<i>Strombus gigas</i>), both of which are fished extensively throughout the General Use Zone. The lobster fishery is the largest capture fishery in Belize, with production representing approximately 42% of total capture fisheries production in 2008, and an export value of US\$7.4 million (Fisheries Department, 2009). Lobster landings (tails) peaked in 1981 at 2,204,622 lbs, stabilizing between 1985 and 1995, but fell to 470,485 lbs by 2008 (Fisheries Department, 2009). The general trend is a decline in stock (Fisheries Department, 2009), and there are concerns for the continued sustainability of the lobster fishing industry.</p> <p>Conch, too, have declined significantly, though strict regulations and quotas are being implemented towards more sustainable use of this resource. Commercial finfish species have also declined significantly across the entire reef system.</p>	<p>This target, commercial marine species, covers fin fish, lobster and conch – fished primarily by fishermen of the northern fishing communities (Sarteneja) and the more adjacent coastal communities such as Placencia, Seine Bight (including Riversdale) Hopkins, Sittee River and Monkey River.</p> <p><b>Caribbean spiny lobster</b> and <b>spotted lobster</b> (<i>Panulirus guttatus</i>) (to a much lesser extent), as well as <b>Queen conch</b>. Lobster density is low – 5 individuals per man hour in 2008, whilst conch density averaged 12 per man hour (SEA data, 2008 / Status of Protected Area report, 2009). SBRC averages 44/ha for conch in open fishing areas, and 255/ha in no take zones – population viability is thought to be above 50/ha (Stoner and Ray-Culp, 2000). The Healthy Reef target is 300 – 400 adults per hectare.</p> <p>Since the legislation protecting <b>Parrotfish</b> (Scaridae – <i>Scarus coelestinus</i>, <i>Sparisoma chrysopterum</i> and <i>S. virida</i>), numbers have gradually increased in both the Conservation and General Use Zones (SEA data, 2010). (NB: parrotfish are not considered commercial species, but are fished illegally)</p>

Gladden Spit and Silk Cayes Marine Reserve: Conservation Targets		
Conservation Target	Justification	Species / ecosystems nested in this target
Whale Sharks	<p>The world’s largest fish, the whale shark (<i>Rhincodon typus</i>) is the flagship species of Gladden Spit and Silk Cayes Marine Reserve, forming congregations at full moon each year to feed on spawn at the aggregation site during the ten days of the full moon in May, June and July. This vulnerable species (IUCN, 2008) is considered highly migratory, travelling 1000’s of kilometers, and occurs throughout tropical and warm temperate waters around the globe.</p> <p>Whale shark tourism is a highly lucrative industry based on an ecologically vulnerable species that is sensitive to anthropogenic impacts. The whale shark congregation at Gladden Spit provides a focus for tourism for adjacent communities – particularly Placencia – and is managed by SEA. In 2009, during the full moon period, the whale sharks attracted over 1,700 visitors, primarily during April, May and June (SEA, 2010). Whilst Gladden Spit is possibly the only site in the world that allows diving with the explicit aim of seeing whale sharks, access to the whale shark congregation area is strictly regulated by SEA, with a cap on the number of tours allowed to use the area at any one time or on any one day, to minimize impacts on whale shark behaviour, or on the behaviour of spawning fish at the aggregation site.</p> <p>Shark fishing incursions from Honduras / Guatemala. Used to be December / January but now starting earlier – stocking up for Lenten season. Taking smaller sharks as fished out large sharks</p>	<p>Whale sharks are the primary species for this target, though activities should also benefit other wide ranging shark species reported to use the Marine Reserve</p> <p>GSSCMR has a wider range of habitats than the other mpas, and is utilized for entire life cycle for lemon, nurse, and Caribbean reef sharks.</p> <p>Bull sharks - abundant</p> <p>Hammerhead...great and scalloped</p> <p>Mako</p> <p>Lemon shark (in shallow waters by Silk Cayes)</p> <p>Silky sharks (common)</p> <p>Tiger shark</p> <p>Thresher shark -about half mile from drop off....very uncommon</p> <p>Black tip shark</p> <p><b>Deep water sharks:</b> exist in waters, not confirmed for GSSCMR: Six gills, Seven gills, Smooth doghound, Cuban nightshark</p> <p><b>Rays</b></p> <p>Southern sting ray</p> <p>Spotted eagle ray</p> <p><i>Eurobates</i></p> <p><i>Manta</i></p> <p><i>Mobula</i></p> <p><i>Haemantura</i> (chuparay) – Caribbean whiptail ray</p>

## **2.2 Assessing Biodiversity Viability**

The Viability Assessment, as conducted under the Conservation Planning process, provides:

- A means for determining changes in the status of each focal conservation target over time, allowing SEA to measure success of its conservation strategies, compare the status of a specific focal target with future conditions, and with other projects in Belize / Central America that focus on that target
- A basis for the identification of current and potential threats to a target and identification of past impacts that require mitigation actions
- A basis for strategy design and the foundation for monitoring

Each Conservation Target was assessed using the following viability ratings:

- **Very Good** – The Indicator is considered to have an ecologically desirable status, requiring little or no intervention for maintenance.
- **Good** – The indicator lies within the acceptable range of variation, though some intervention is required for maintenance.
- **Fair** – The indicator lies outside the acceptable range of variation, and human intervention is required if the viability of the target is to be maintained
- **Poor** – Restoration of the conservation target is increasingly difficult, and impacts may result in extirpation from the conservation area

**Gladden Spit and Silk Cayes Marine Reserve – Management Plan  
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Gladden Spit and Silk Cayes Marine Reserve Conservation Target Assessment			
Conservation Target	Current Rating	Goal	Justification for Rating, Goal and Indicator
<b>Commercial and Recreational Species</b>	<b>FAIR</b>	<b>GOOD</b>	<b>Justification:</b> GSSCMR includes both General Use and No Take zones, and is considered to have effective enforcement. Populations of yellowtail, mutton, cubera and dog snappers are considered GOOD, but groupers are rated as POOR. Lobster and conch populations are lower than historical levels, and lower than the non-extractive Laughing Bird Caye National Park. Data for conch suggests that the No Take zone is working in GSSCMR, with higher densities of conch within the protected area than outside. (Finch et. al. 2008).
			<b>Goal:</b> To maintain and improve current population levels of commercial species
			<b>Indicators:</b> Densities of conch, lobster and specific finfish; Number of fishing incursions into No Take Zone
<b>Herbaceous Beach Vegetation / Sandy Beaches</b>	<b>FAIR</b>	<b>FAIR</b>	<b>Justification:</b> Anecdotal reports suggest a significant decline in the number of birds utilizing the terrestrial ecosystems – particularly the herbaceous beach vegetation, between 2009 and 2010 (SEA staff). The extent of the beach area has decreased, but this may be the result of a natural shifting of sand due to currents. Turtle nesting has decreased, and the increasing number of tourists (particularly camping on South Silk Caye) is considered to be affecting availability of turtle nesting sites.  Mangrove is rated as POOR – there used to be a remnant patch on North Silk Caye, but this has been removed by storms in the last two years.
			<b>Goal:</b> To maintain or increase the value of the terrestrial component of the Silk Cayes
			<b>Indicators:</b> Number of turtle nests; Number of successful turtle nest hatches; Level of beach erosion; Extent of natural vegetation



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Gladden Spit and Silk Cayes Marine Reserve Conservation Target Assessment			
Conservation Target	Current Rating	Goal	Justification for Rating, Goal and Indicator
Coral Reef Communities	FAIR	FAIR	<p><b>Justification:</b> The coral reef directly adjacent to the caye is impacted by tourists, with a need to implement better guide regulations to reduce impact. Climate change/ global warming is also having an impact on the condition of the reef, with live coral cover being estimated at between 10 and 19%, with 30% bleaching recorded in October 2008, reducing to 2% the following February. Recent mortality is rated as GOOD, at fewer than 2% for 2008 (State of Protected Area report, 2009).</p> <p>Populations of parrotfish - key herbivorous fish species – are considered to be FAIR.</p>
			<p><b>Goal:</b> Maintain coral reef communities at Fair, with implementation of strategies for reduction of impacts and increased resilience</p>
			<p><b>Indicators:</b> Live coral cover; Recent mortality; Parrotfish biomass; <i>Diadema</i> abundance</p>
Seagrass	VERY GOOD	VERY GOOD	<p><b>Justification:</b> There are very few impacts on seagrass extent and condition within the protected area; Commercial species (conch, lobster, sea cucumber) dependent on seagrass are present in good numbers, as are marine turtles.</p>
			<p><b>Goal:</b> To maintain seagrass as VERY GOOD</p>
			<p><b>Indicators:</b> Extent of seagrass; condition of seagrass; density of conch</p>
Spawning Aggregation Site	FAIR	GOOD	<p><b>Justification:</b> Whilst the number of species using the site is very high, the number of individuals per species is considered low in comparison with historical records. Whilst originally considered POOR, there has been an upward trend in the spawning populations of snapper species and the Nassau Grouper between 2002 and 2008 (Finch et. al. 2008). However, landing data for <i>Lutjanus analis</i> between 2000 and 2006 shows a significant decrease in mean size (Graham et. al. 2007), indicative of over-exploitation.</p>
			<p><b>Goal:</b> To maintain and improve the viability of the spawning aggregation site at Gladden Spit</p>
			<p><b>Indicators:</b> Number of species using spawning aggregation site; Number of individuals per species;</p>

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Gladden Spit and Silk Cayes Marine Reserve Conservation Target Assessment			
Conservation Target	Current Rating	Goal	Justification for Rating, Goal and Indicator
Whale Sharks	FAIR	GOOD	<b>Justification:</b> Whale shark numbers are thought to be declining, not just at Gladden Spit, but also in other marine protected areas, where they have been seen historically. At Gladden Spit, it is thought that the contributing factors include too many divers being in the water at once, with a need for better management of how divers interact with the whale sharks. Tagging of whale sharks has occurred in previous years, and is also cited as a potential contributing factor towards avoidance of the site by whale sharks
			<b>Goal:</b> Maintain and improve the whale shark population using Gladden Spit, through ensuring that impacts on whale sharks and the spawning aggregation are minimized
			<b>Indicators:</b> Number of whale sharks using Gladden Spit

The results of the workshop output on Conservation Target viability are summarized (Table 18).

Table 18: Conservation Targets – Current Ratings and Goals		
Conservation Target	Current Rating	Goal
Herbaceous Beach Vegetation / Sandy Beaches	FAIR	FAIR
Seagrass	VERY GOOD	VERY GOOD
Coral reef Communities	FAIR	FAIR
Commercial and Recreational Species	FAIR	GOOD
Spawning aggregation Sites	FAIR	GOOD
Whale Sharks	FAIR	GOOD

A threat assessment was conducted in 2010 for the conservation planning process, with input from a wide range of stakeholders – including protected area site management staff, researchers, tour guides and fishermen with local and technical knowledge of the area.

### 2.2.1 Identified Threats

Outputs from the threat assessment identified a total of ten impacts (Table 19), of which four were selected as primary threats:

- Climate Change
- Unsustainable Fishing Practices
- Tourism Impacts – Whale Shark Zone
- Tourism Impacts – Conservation Zone
- Poor Boating Practices

These were then assessed using a series of three criteria to allow prioritization of conservation actions and resources towards mitigating those identified as the most critical threats.

This assessment rated:

- the area affected by the threat
- the severity of the threat
- the urgency of actions needed to mitigate the threat

#### **Threats impacting Gladden Spit and Silk Cayes Marine Reserve**

- Climate change
- Unsustainable fishing practices:
  - Undersize / out-of-season / restricted species
  - Spear fishing / gill nets
- Inappropriate visitor use
  - Impacts on reef
  - Impacts on spawning aggregation
  - Impacts on cayes
  - Non catch and release sport fishing
- Poor Boating Practices
  - Anchor damage
  - Ship/boat grounding
  - Potential for oil spill
- Inappropriate cayes development
  - Within GSSCMR
  - Adjacent to GSSCMR
- Sedimentation
- Oil exploration and drilling
- Sewage pollution
- Insufficient enforcement

## Gladden Spit and Silk Cayes Marine Reserve – Management Plan 2011-2016

### Rating Critical Threats

The critical threats are assessed by Area, Severity and Urgency, using the following criteria:

**Area:** The area of the threat (how much of the conservation target area it affects)

Proportion of Area Affected <span style="float: right;">(adapted from WCS)</span>		
Criteria	Score	
<b>Area</b>	<b>4</b>	Will affect throughout >50% of the area
	<b>3</b>	Widespread impact, affecting 26 – 50% of the area
	<b>2</b>	Localized impact, affecting 11 – 25% of the area
	<b>1</b>	Very localized impact, affecting 1 – 10% of the area

**Severity:** The severity of the threat – how intense or great the impact is

Severity Ranking <span style="float: right;">(adapted from WCS)</span>		
Criteria	Score	
<b>Severity</b>	<b>3</b>	Local eradication of target possible
	<b>2</b>	Substantial effect but local eradication unlikely
	<b>1</b>	Measurable effect on density or distribution
	<b>0</b>	None or positive

**Urgency:** The likelihood of the threat occurring over the next five years

Urgency Ranking <span style="float: right;">(adapted from WCS)</span>		
Criteria	Score	
<b>Urgency</b>	<b>3</b>	The threat is occurring now and requires action
	<b>2</b>	The threat could or will happen between 1 – 3 years
	<b>1</b>	The threat could happen between 3 – 10 years
	<b>0</b>	Won't happen in > 10 years

**Gladden Spit and Silk Cayes Marine Reserve – Management Plan  
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<b>Threats to biodiversity of Gladden Spit and Silk Cayes Marine / 1</b>				
<b>Climate Change</b>	<b>Status:</b>	<b>Historical</b>	<b>Active</b>	<b>Potential</b>
	<b>Conservation Target(s):</b> All			
	<b>Threats (Direct):</b>			
	<ul style="list-style-type: none"> <li>▪ Reduced live coral cover</li> <li>▪ Erosion of beach</li> <li>▪ Removal of herbaceous beach vegetation forest</li> <li>▪ Ecological shifts in benthic communities</li> <li>▪ Reduced biodiversity</li> <li>▪ Reduced coral growth rates</li> </ul>			
	<b>Source (Indirect Threat):</b>			
	<ul style="list-style-type: none"> <li>▪ Increased water temperatures</li> <li>▪ Increased storm events / hurricanes</li> <li>▪ Sea level rise</li> <li>▪ Changes in currents</li> <li>▪ Ocean acidification</li> <li>▪ Removal of herbivorous species through illegal fishing practices</li> <li>▪ Other local anthropogenic threats</li> </ul>			
	<b>Area</b>	<b>4</b>	Climate change is a global phenomenon, and is affecting biodiversity throughout the Marine Reserve	
	<b>Severity</b>	<b>3</b>	The impacts of climate change are currently being felt at GSSCMR through increased bleaching and storm events, and it is expected that the severity and frequency of these events will increase over the coming years	
	<b>Urgency</b>	<b>3</b>	Although the effects of climate change are occurring over an extended time period the cumulative effect of this stressor poses significant risk to a wide range of species and ecosystems	
	<p><b>Management Goal:</b> Continue to implement adaptive management strategies which focus on identifying and maintaining resilient ecosystems</p> <p><b>Management Strategies:</b></p> <p><b>Strategy 1:</b> Identify resilient coral species and areas within GSSCMR</p> <p><b>Strategy 2:</b> Identify coral recruitment sources for GSSCMR, and identify mechanisms to ensure that these are adequately protected, if necessary</p> <p><b>Strategy 3:</b> Identify and understand water currents critical for coral and fish recruitment</p> <p><b>Strategy 4:</b> Ensure adequate protection of key herbivores to maintain live coral cover and ecological functions</p> <p><b>Strategy 5:</b> Reduce local anthropogenic threats through community engagement and awareness programs, and effective enforcement</p> <p><b>Strategy 6:</b> Work closely with national and international partners to monitor climate change effects and identify appropriate national and regional management strategies</p>			

<b>Threats to biodiversity of Gladden Spit and Silk Cayes Marine Reserve / 1</b>				
	<b>Status:</b>	<b>Historical</b>	<b>Active</b>	<b>Potential</b>
<b>Fishing Pressure</b>	<b>Conservation Target(s):</b> Commercial Species; Spawning Aggregation Site			
	<b>Threats (Direct):</b>			
	<ul style="list-style-type: none"> <li>▪ Unsustainable commercial fishing practices</li> <li>▪ Poorly regulated visitor fishing activities</li> </ul>			
	<b>Source (Indirect Threat):</b>			
	<ul style="list-style-type: none"> <li>▪ Low income in fishing communities</li> <li>▪ traditional occupation</li> <li>▪ Market demand from fishing coops</li> <li>▪ Increased local and tourist demand for local fresh fish</li> <li>▪ Increased need for enforcement of fishing regulations</li> <li>▪ Failure to obey zoning rules</li> <li>▪ Need for more effective demarcation of protected area boundary</li> </ul>			
	<b>Area</b>	<b>4</b>	Fishing happens throughout much of the General Use Zone, with incursions into the Conservation Zone	
	<b>Severity</b>	<b>2</b>	There is pressure, but it is considered to have a substantial effect	
	<b>Urgency</b>	<b>3</b>	It is an ongoing, active threat	
	<b>Management Goal:</b> Increase effective management of commercial species through more effective enforcement and increased conservation awareness			
	<b>Management Strategies:</b>			
<b>Strategy 1:</b> Investigate options for increasing size of no-take zone to enable fish to breed and replenish fish stocks that can spill over into fishing areas				
<b>Strategy 2:</b> Ensure GSSCMR has the human resources, equipment and training for effective surveillance and enforcement				
<b>Strategy 3:</b> Increase effective surveillance and enforcement through development and implementation of a comprehensive surveillance and enforcement strategy				
<b>Strategy 4:</b> Revision of licensing mechanism to regulate fishing at the spawning aggregation site for increased sustainability				
<b>Strategy 5:</b> Increase visitor awareness of fishing and zonation rules and regulations				
<b>Strategy 6:</b> Investigate the feasibility of implementing a seasonal closure zone to enable fish stocks to improve				
<b>Strategy 7:</b> Engage fishermen more effectively in management of fish stocks within the mpa, with better training and incentives				

<b>Threats to biodiversity of Gladden Spit and Silk Cayes Marine Reserve / 2</b>					
	<b>Status:</b>	<b>Historical</b>	<b>Active</b>	<b>Potential</b>	
<b>Visitor Impacts – Whale Shark Zone</b>	<b>Conservation Target(s):</b> Whale sharks, Spawning Aggregations				
	<b>Threats (Direct):</b>				
	<ul style="list-style-type: none"> <li>▪ Reduced numbers of whale sharks</li> <li>▪ Changing patterns for spawning aggregations, with potential reduced viability</li> </ul>				
	<b>Source (Indirect Threat):</b>				
	<ul style="list-style-type: none"> <li>▪ Increasing visitor numbers</li> <li>▪ Increased boat noise / traffic</li> <li>▪ Poor tourism practices</li> <li>▪ Poor tour guide practices</li> <li>▪ Weak enforcement of tourism violations</li> <li>▪ Limited visitor awareness of diving / snorkelling best practices around whale sharks</li> <li>▪ Invasive research / filming</li> </ul>				
	<b>Area</b>	<b>3</b>	It is happening across the spawning aggregation site, but is regulated to specific times		
	<b>Severity</b>	<b>2</b>	Unlikely to eradicate a species but it does have a measurable effect		
<b>Urgency</b>	<b>3</b>	It is happening now			
<p><b>Management Goal:</b> Better management of visitor impacts within the spawning aggregation/whale shark zone</p> <p><b>Management Strategies:</b></p> <p><b>Strategy 1:</b> Continuing training of guides in best practices for whale shark tourism</p> <p><b>Strategy 2:</b> Increase awareness of, and adherence, to tourism best practices for whale shark tourism through targeted visitor and tour guide education</p> <p><b>Strategy 3:</b> Review of past whale shark research and filming activities, with development a targeted strategic plan to guide future activities at the spawning aggregation site</p> <p><b>Strategy 4:</b> Effective surveillance and enforcement of visitor behaviour and clear mechanisms for enforcement, to reduce impacts on whale shark / spawning aggregation site</p> <p><b>Strategy 5:</b> Support and strengthen the Whale Shark Committee for continued effective management decision-making relevant to whale shark tourism</p>					



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<b>Threats to biodiversity of Gladden Spit and Silk Cayes Marine Reserve / 3</b>				
<b>Tourism Impacts in the Silk Cayes Conservation Zone</b>	<b>Status:</b>	<b>Historical</b>	<b>Active</b>	<b>Potential</b>
	<b>Conservation Target(s):</b> Terre			
	<b>Threats (Direct):</b>			
	<ul style="list-style-type: none"> <li>▪ Reduced viability of turtle nesting</li> <li>▪ Reduced viability of bird nesting</li> <li>▪ Reduced viability of fish populations</li> <li>▪ Reduced viability of coral</li> </ul>			
	<b>Source (Indirect Threat):</b>			
	<ul style="list-style-type: none"> <li>▪ Impacts from campers on caye               <ul style="list-style-type: none"> <li>▪ disturbance to turtle and bird nesting sites</li> <li>▪ fishing in Conservation Zone</li> </ul> </li> <li>▪ Impacts from Bareboat charters – Moorings and other passing yacht traffic – enter park, anchor and fish without a local captain/guide – unaware of rules and regulations</li> </ul>			
	<b>Area</b>	<b>4</b>	Impact is over 50% of the Conservation Zone area, including all of South Silk Caye , and, at times, middle silk caye	
<b>Severity</b>	<b>2</b>	Unlikely to eradicate a species but it does have a measurable effect		
<b>Urgency</b>	<b>3</b>	It is happening now		
<b>Management Goal:</b> Strengthen visitor management within the marine protected area				
<b>Management Strategies:</b>				
<b>Strategy 1:</b> Increase awareness of tour operators and guides of the impacts of camping on the silk cayes on the biodiversity, working towards shifting camping to Little Water Caye				
<b>Strategy 2:</b> Investigate the possibility of revising regulations to ensure that only boats and visitors with local guides / captains are permitted to use the marine reserve.				
<b>Strategy 3:</b> Development of specific tourism best practices and guidelines for Gladden Spit and Silk Cayes Marine Reserve, with participation of tour guides and rangers				
<b>Strategy 4:</b> Increased human resources within the park and training for more effective surveillance and enforcement of tourism best practices and guidelines– more boats / more rangers (more funding)				

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<b>Threats to biodiversity of Gladden Spit and Silk Cayes Marine Reserve / 4</b>				
	<b>Status:</b>	<b>Historical</b>	<b>Active</b>	
<b>Poor Boat Practices</b>	<b>Conservation Target(s):</b> Coral Reef Communities, Seagrass			
	<b>Threats (Direct):</b>			
	<ul style="list-style-type: none"> <li>▪ Coral mortality - mechanical damage</li> <li>▪ Coral mortality – sedimentation impacts</li> <li>▪ Increased algae growth</li> </ul>			
	<b>Source (Indirect Threat):</b>			
	<ul style="list-style-type: none"> <li>▪ Mechanical damage from improper anchorage</li> <li>▪ Mechanical damage from boat groundings – inexperienced boat captains / poor practices</li> <li>▪ Increased nutrient from organic waste disposal by live aboards</li> <li>▪ Increased number of boats using the area</li> <li>▪ Potential for oil and other pollutants</li> </ul>			
	<b>Area</b>	<b>2</b>	Restricted primarily to access the front of the Cayes, areas associated with whale shark activities, and specific dive sites	
	<b>Severity</b>	<b>2</b>	The impacts are measurable	
<b>Urgency</b>	<b>3</b>	This threat is occurring now		
<b>Management Goal:</b> Better management of boats within the Marine Reserve				
<b>Management Strategies:</b>				
<p><b>Strategy 1:</b> Revise regulations - no anchoring by fishermen anywhere within the Conservation Zone (at the moment they anchor at the boundary of the Conservation Zone).</p> <p><b>Strategy 2:</b> Investigate feasibility of regulations stipulating that chartered boats must be accompanied by a local guide/captain when entering the reserve. Private boats/charter boats should have to check in and out of the marine reserve by radio contact to the rangers station.</p> <p><b>Strategy 3:</b> Investigate inclusion of a Preservation Area with stricter restrictions and no boat access. Included in this preservation zone should be key areas of scientific interest e.g. conch restoration zone that is already present.</p> <p><b>Strategy 5:</b> Increase publicity and focus in schools/general public to increase awareness of the local marine reserves – their importance, the resources they offer and how people can help protect them.</p>				

### 2.2.2 Other Impacts

Also identified under the Southern Belize Reef Complex were a number of additional threats within the seascape. These included caye development outside of the National Park boundaries, agricultural and industrial runoff from watersheds

- **Caye Development in the wider Southern Belize Reef Complex**

Human activities on adjacent cayes will impact the long term viability of the biodiversity of Gladden Spit and Silk Cayes Marine Reserve. Habitat loss through caye development for tourism has resulted in the removal of mangroves, littoral forest and coastal strand communities throughout the Southern Belize Reef Complex. In addition, shoreline structures such as piers, dredged access routes, marinas and seawalls have lead to loss and/or alteration of habitats. In cases of poor development practices, live and dead coral have been used as land fill (Table 19).

Table 19: Caye Development in the Wider SBRC	
<b>Clearance of Mangrove</b>	Removal of important marine nursery areas
	Removal of important habitat for migrating birds
	Erosion of caye soils
	Removal of important habitat for lizards
	Removal of important nutrient source within the marine system
<b>Destruction of Coral</b>	Live and dead coral used as land fill in poorly planned caye development (eg. Bread and Butter Caye (SWCMR) and Tom Owen’s Caye (SCMR))
	Destruction of coral to provide boat access, and impacts of boat access on corals within seagrass beds
<b>Human Impacts on Sandy Beaches</b>	Removal of herbaceous beach vegetation – an ecosystem that is under-represented within the national protected areas system, and which is essential for good turtle nesting success
	Removal of critical turtle nesting habitats
	Light pollution – impacting turtle nesting and hatching success rates
	Presence of introduced predators - dogs and cats, reducing hatching success
<b>General Human Impacts</b>	Use of insecticides and herbicides and associated impacts on natural biodiversity and water quality
	Increased nutrient and sediment runoff into water, with associated accelerated algal growth and coral loss
	Reduction and pollution of freshwater lenses beneath cayes
	Increased impacts from human activity immediately adjacent to cayes
	Introduction of exotics – <i>Casuarina</i> , coconuts

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Red mangrove, littoral forest and herbaceous beach communities play a critical role in stabilizing island structure, reducing coastal erosion, beach loss and sedimentation as well as providing nursery functionality for many marine species. Among the most threatened ecosystems within the protected area system of Belize, their loss is accelerating as the developmental value and demand for beach frontage escalates. The sandy beaches are critical for nesting sea turtles and American Crocodiles, and the littoral forest for numerous migratory bird species.

Clearance of herbaceous beach vegetation on the cayes greatly reduces connectivity within an already seriously fragmented ecosystem, reducing the scope for gene-flow and recolonization after natural and anthropogenic impacts. It also greatly undermines the stability of the islands themselves, making them, and any infrastructure thereon, a great deal more susceptible to the impacts of hurricanes and sea level rise. The long-term sustainability of caye-based tourism and residential developments can be made significantly more financially viable through the maintenance of these natural ecosystems.

### **Recommendations:**

- Development / adoption and distribution of ‘Best Practices’ guidelines to caye-based establishments, with a ‘best practices’ recognition for those that follow required criteria (see Glover’s Reef / WCS guidelines)
- Increase surveillance and monitoring of identified turtle nesting beaches outside of the SEA managed mpas, and address human impacts, following WIDECASST guidelines

### ▪ **Agricultural and Industrial Runoff from watersheds**

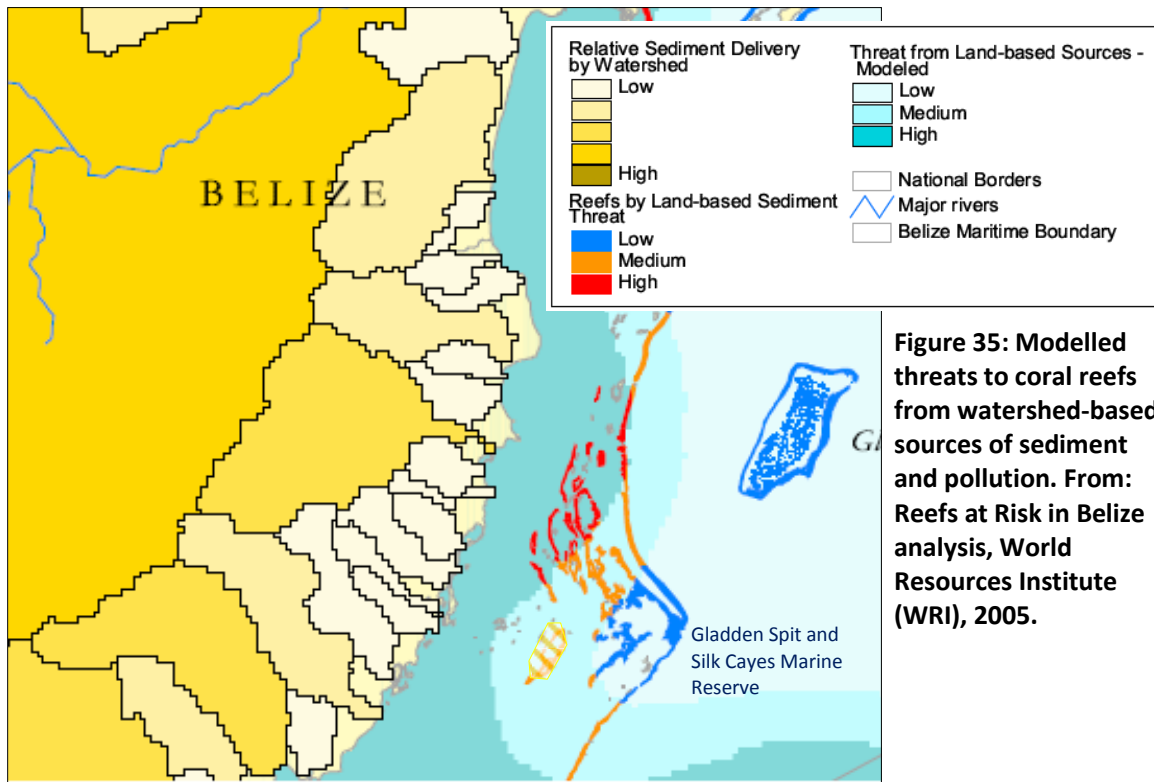
CZMAI and the WRIScS project both conducted water quality testing in coastal waters in the late 1990’s and early 2000’s (CZMAI, 1999; WRIScS, 2002) and concluded that agricultural runoff was not a significant impacting stress to the SBRC at that time. The WRIScS project was investigating the transport of fine sediments and associated contaminants through the river systems and coastal zone of the Stann Creek district, and concluded that

*“...there is no evidence to suggest that changed sedimentary processes resulting from farming activity to date in the Stann Creek area are having a negative impact on the Barrier Reef. The natural coastal system would appear to be effective in dealing with the impact of increased sediment yield and sediment contaminant loading produced by current land usage.”*

However, both studies emphasized the need for monitoring of future agricultural activities and impacts, with the predicted increase in agriculture, and the decreasing ability of the coastal zone to provide a buffer with the current accelerating land-use change, particularly for coastal tourism development.

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A more recent assessment of risks from land based sources of pollution highlighted the reefs of Gladden Spit and Silk Cayes Marine Reserve as at low risk from runoff from mainland agricultural areas, manifested in the form of sediment-laden river plumes rich in nutrients (effluents) that have at times extended as far as the Silk Cayes, with the potential to cause algal blooms and coral death. Definitive research to characterize the effects of pesticides and nitrate and phosphate nutrients from agriculture and aquaculture is in its early stages, but initiatives under WWF and YCT are focusing on identifying and mitigating agrochemical impacts Belize, both on terrestrial and marine ecosystems, with concerns associated with the use of agrochemicals on the banana and citrus plantations and shrimp farms in the Stann Creek area, due west of Gladden Spit and Silk Cayes Marine Reserve. There have also been growing concerns, given prevailing water currents, that the vast banana and pineapple plantations in Honduras are introducing pesticide and nitrification pollutants in the Belize Reef system (Figure 35; WRI, 2005).



### **Recommendations:**

- Priorities monitoring of agrochemical content in water and of fish tissue samples to identify key contaminants and current levels of contamination
- Support key research that identifies the land based sources of contamination
- Partner with organizations seeking to mitigate agrochemical contamination of water bodies through better practices for agricultural chemical use

▪ **Pollution**

<b>Pollution</b>	Contamination of waters near developed cayes throughout SBRC due to inappropriate sewage and grey water treatment, leading to eutrophication
	Inappropriate solid waste disposal
	Contamination of waters with runoff containing herbicides, insecticides or detergents from both the cayes and the
	Contamination from international shipping
	Garbage from the mainland and from international shipping

**Solid Waste:** Some types of garbage have been shown to be very detrimental to marine wildlife, such as plastics to sea turtles. Solid waste is a concern, with increasing levels accumulating on the reef crest and caye beaches within the SBRC, originating from international shipping, particularly with the increase in cruise shipping and freight shipping destined for, and departing from, Belize.

**Liquid Waste & Sewage:** A more insidious impact is the leaching of nutrients and chemicals into the ground water or fresh water lens of the cayes within the SBRC, which then percolate through the sandy soil into the sea. Groundwater is an important source of freshwater on the cayes, maintaining natural vegetation, and supplying the mangrove areas and coral reefs with fresh water. If the groundwater becomes polluted, these ecosystems are affected. The leakage of sewage from island resorts can cause algal blooms, visible as a ring around the cayes or patches of increased algal growth near the highest impacted areas, due to nutrient enrichment. Currently, this impact is considered to be relatively low due to the current small scale of operations and low level of visitation, as well as the general adoption of closed sewage systems.

Development activities are growing in the SBRC area, but there is currently little guidance given in areas such as herbicides and pesticides, wood preservatives etc. Contamination of waters by biocides and detergents is likely to become an increasing problem as more tourism accommodation is developed on the cayes, affecting not only the waters adjacent to these cayes, but potentially all the fragile ecosystems of the reef system. Very few resorts in Belize have adequate training in chemical storage, use, and spill response, or attempt to find environmentally friendly alternatives to more toxic options - availability of alternatives in Belize is also a limiting factor. Little thought, too, is generally given to problems of chemical contamination following flooding through storm events...such as pre-empting the problem by storing bulk chemicals on the mainland, ensuring only minimal amounts are kept on the cayes.

**Oil Pollution:** The offshore area of Belize has been divided into oil blocks that are given out on concession to various oil exploration companies, with past and future oil exploration planned.

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Whilst Gladden Spit itself is not located within one of the exploration blocks, the impact of oil spills and drilling muds is still a potential threat if there is any future active exploration in adjacent areas of the SBRC. Additionally, any oil spills from passing ships due to accidental spillage or bilge clearing is a concern.

### **Recommendations**

- Develop baseline and monitor environmental impacts of use of Middle and South Silk Cayes and Little Water Caye has on the adjacent ecosystems
- Develop an Environmental Sustainability Plan for the Silk Cayes and Little Water Caye to mitigate current impacts, and look at synergies for reducing ecological footprint
- Encourage caye based operations within the SBRC to adopt best practices guidelines
- Develop closer links with Department of the Environment for rapid response to pollution events
- Ensure all EIAs are adequately vetted and approved, and that Forest Department plays a vocal part in NEAC in relation to environmental sustainability of any development adjacent to Gladden Spit and Silk Cayes Marine Reserve
- Monitor development activities on adjacent cayes

### ▪ **Dredging**

<b>Dredging and Associated Sedimentation</b>	Destruction of seagrass habitat, supporting many vertebrate and invertebrate species
	Sedimentation of coral, reducing coral viability
	Sedimentation of seagrass, reducing seagrass viability
	Re-suspension of pollutants

Dredging and mining of sand for use in construction and landfill associated with development on the cayes has resulted in the removal of seagrass beds, siltation on the reef, water quality degradation and smothering of benthic flora and fauna by excessive sedimentation in the wider SBRC. If inappropriately managed, dredging activities within the SBRC will impact areas of conservation importance including Gladden Spit and the Silk Cayes.

### **Recommendations**

- Ensure adequate surveillance of caye developments within the SBRC
- Develop closer links with Department of the Environment for rapid response to pollution events



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- Ensure all EIAs are adequately vetted and approved, and that Forest and Fisheries Departments play a vocal part in NEAC in relation to environmental sustainability of development within the SBRC
- Investigate potential of environmental levies on caye development within SBRC towards monitoring costs

### ▪ Threats from adjacent Shipping Lanes

Threats from adjacent shipping lanes cannot be ignored. The shipping lane between Belize and Honduras passes close to Gladden Spit and Silk Cayes Marine Reserve, and directly through the SBRC, with an ever-increasing flow of cargo and passenger vessels, from oil tankers to cruise ships. The latter are a component of the passenger vessel category, which make up 13% of the world shipping fleet - with the rapid rate of increase of cruise ship visitation to Belize, this sector

#### **MARPOL**

(International Convention for the Prevention of Pollution from Ships, 1973/1978)

This convention concerns the prevention of pollution from oil, bulk chemicals, dangerous goods, sewage, garbage and atmospheric pollution, and includes provisions such as requiring certain oil tankers to have double hulls.

has started to receive far more attention in terms of the threats they pose to the environment. Any vessel travelling in the shipping lane, whether cruise ship or not, is a potential threat, though it is recognized that cruise ships tend to concentrate their activities within coastal areas, and have a higher volume of waste. A number of recent groundings, including that of the *Westerhaven* in January,

2009, highlight this problem. The cargo vessel was passing through the English Caye Channel, the shipping route from Belize City to Guatemala, and went off course, with the destruction of an estimated 10,000 square meters of healthy reef, resulting in an estimated US \$20 million in damages to the reef, based on an internationally accepted average of US\$2,000 per square meter.

The mechanical and physical impacts of groundings are not the only threats faced from vessels passing by in the shipping lane. During a typical one-week voyage, a large cruise ship (3,000 passengers and crew) is estimated to generate 210,000 gallons of sewage, 1 million gallons of greywater (wastewater from sinks, showers and laundries); more than 130 gallons of hazardous waste; 8 tons of solid waste; and 25,000 gallons of oily bilge water (Copeland, 2005). Whilst there are international laws in place to regulate pollution of the open seas by vessels such as these (principally the 1973 International Convention for the Prevention of Pollution from Ships – MARPOL), there are also known infringements of these regulations that suggest that ships will dump waste at sea – for example, in April 2002, Carnival Corporation was fined US\$18 million for the deliberate falsification of oily bilge record books, whilst Royal Caribbean Cruises Ltd. was fined US\$9 million and US\$18 million during 1998 and 1999 respectively for discharging oil

contaminated bilge waste. Incidents such as these, whether through human error, mechanical failure, negligence or deliberate, lead to skepticism about the waste handling of large ocean-going vessels. Cruise ships are self-regulated to a certain extent by the expectations of the passengers to be able to sail in unpolluted waters. Other components of international shipping have no such internal controls. Impacts can be from a variety of recognized sources from regular operations, and are normally characterized as blackwater, greywater, hazardous waste, solid waste and bilge water.

### ***Blackwater***

Sewage, waste water from toilets and medical facilities. Release of untreated or inadequately treated sewage close to the reef can cause bacterial and viral contamination of fisheries and shellfish, and excess nitrogen and phosphorus can promote excessive algal growth, leading to eutrophication and great algal cover, reducing coral colonization.

#### **Blackwater**

A larger cruise ship (3,000 passengers and crew) generates an estimated 15,000 to 30,000 gallons per day of blackwater waste

### ***Graywater***

Wastewater from sinks, showers, galleys, laundry and cleaning activities, containing a variety of contaminants such as detergents, oil, grease, metals petroleum hydrocarbons, nutrients etc. This, as with blackwater, can cause excessive algal growth and eutrophication.

#### **Greywater**

A larger cruise ship (3,000 passengers and crew) generates an estimated 90,000 to 255,000 gallons per day of greywater waste

### ***Hazardous Waste***

A number of on-board activities can produce hazardous waste from photo-processing, dry-cleaning and repainting. A wide range of substances are included within this category – hydrocarbons, heavy metals, solvents, fluorescent and mercury vapour light bulbs, and batteries included, which whilst small in volume can be extremely toxic to marine organisms if they find their way into greywater, bilge water or solid waste.

### ***Solid Waste***

This category includes glass, paper, cardboard, aluminium, steel cans and plastics, much of which is incinerated on board, and the ash discharged at sea - it is estimated that 24% of solid waste generated by vessels worldwide comes from cruise ships. Inadequate incineration can lead to entanglement of marine mammals, fish sea turtles and birds with plastics and other solid waste.

#### **Solid Waste**

A larger cruise ship (3,000 passengers and crew) generates an estimated 8 tons of solid waste during a one-week cruise.

### ***Bilge Water***

A frequent problem on a ship is oil leakage, or oil by-products from engines or from engine maintenance activities which, even in minute quantities, can kill fish or cause chronic effects. Much of this ends up in the bilge water, which may also contain other chemical contaminants. The bilge space, where this contaminated water accumulates, needs to be flushed out at regular

intervals to maintain the vessels stability and eliminate potentially dangerous flammable vapours. To do so, the oil needs to be extracted, and then reused, offloaded at port or incinerated, using a separator or similar mechanism – failure to do so, or mechanical faults can result in untreated bilge water being emptied directly into the sea.

#### **Bilge Water**

A larger cruise ship (3,000 passengers and crew) generates an estimated 25,000 gallons of oily bilge water every week of operation

### ***Ballast Water***

Ballast water, used to stabilize vessels during transport, is often taken on in coastal waters in one region, then released in another, as cargo or passengers are loaded or unloaded, resulting in changes in the amount of compensating ballast required. This has resulted in the transport of plants, animals, viruses and bacteria into areas they would not normally occur, and is considered to be the major source of invasive species in US waters (Copeland, 2005), and is also considered a problem in Belize.

#### **Invasive Crabs**

Within the last few years, native populations of large *Mithrax*, *Menippe*, *Callinectes* and *Panulirus* have been reported as being replaced by the non-indigenous portunid crab, *Charybdis helleri* in rocky habitats of the Twin Cayes, thought to have arrived in ballast water (CCRE, 2008).

This threat from current-borne pollution from international shipping will be insignificant in comparison to the devastation that would occur should an oil tanker break up in the Barrier Reef lagoon.

### ***Recommendations***

- Develop an emergency response plan with the input of DoE, in case a major incident should occur
- Work closely with Port Authority, Coast Guard and DoE towards mitigation of potential groundings

### 2.2.3 Prioritizing Threats

Once the threat assessment has been completed, the threats are prioritized, to effectively focus financial and human resources. This occurs through a standard prioritization process, with the threat scores being transferred from the threat assessment (Table 19).

Table 19: Prioritization of Identified Threats					
Threat	Criteria Ratings			Total AxSxU	Rank
	Area	Severity	Urgency		
<b>Climate Change</b>	4	3	3	36	1
<b>Unsustainable Fishing Practices</b>	4	2	3	24	2
<b>Tourism Impacts (Conservation Zone)</b>	4	2	3	24	2
<b>Tourism Impacts (Whale Shark Zone)</b>	3	2	3	18	3
<b>Poor Boating Practices</b>	2	2	3	12	4

The threat with the highest total threat score is ranked as the highest threat. This places ***Climate Change*** as the highest priority, as an active threat, with the potential to reduce the viability of all conservation targets of Gladden Spit and Silk Cayes Marine Reserve.

***Unsustainable Fishing Practices*** is highlighted as the second highest active threat, equal with the threat of ***Tourism Impacts in the Conservation Zone***, followed by the ***Tourism Impacts in the Whale Shark Zone*** and ***Poor Boating Practices***.

### 2.3 Strategies to Reduce Threats

The primary cross cutting mitigation strategies were identified during the threat assessment, and the targets each strategy addressed were identified (Table 20).

<i>Strategies</i>	Seagrass	Commercial Species	Herbaceous Beach Vegetation / Beach	Coral Reef Communities	Spawning Aggregation Sites	Whale Sharks	Score
Reduce local anthropogenic threats through community engagement and awareness programs, and effective enforcement							6
Develop and implement a 'Limits of Change' programme for effective visitor management at GSSCMR							6
Work closely with national and international partners to monitor climate change effects and identify appropriate national and regional management strategies							6
Development of specific tourism best practices and guidelines for Gladden Spit and Silk Cayes Marine Reserve, with participation of tour guides and rangers							6
Increase publicity and focus in schools/general public to increase awareness of the local marine reserves – their importance, the resources they offer and how people can help protect them.							6
Ensure GSSCMR has the human resources, equipment and training for effective surveillance and enforcement							6
Increase effective surveillance and enforcement through development and implementation of a comprehensive surveillance and enforcement strategy							6
Increase visitor awareness of fishing and zonation rules and regulations							4
Increase awareness of tour operators and guides of the impacts of camping on the silk cayes on the biodiversity, working towards shifting camping to Little Water Caye							3
Investigate feasibility of regulations stipulating that chartered boats be accompanied by a local guide/captain when entering the reserve. Private boats/charter boats should have to check in and out of the marine reserve by radio contact to the rangers station.							3
Investigate potential to increase size of no take zone for greater sustainability of fish stocks							3
Revision of licensing mechanism to regulate fishing at the spawning aggregation site for increased sustainability							2

**Table 20: Cross cutting strategies**

## **2.4 Monitoring of Success of Conservation Strategies**

The series of indicators allocated to each conservation target provides a framework for site level monitoring, which has been incorporated into the Science and Monitoring Programme. A system level monitoring programme has also been developed under the SBRC to measure the success of conservation strategies, as an integrated component of the conservation planning process (SBRC, 2010).

## **2.5 Planning for Climate Change**

### **2.5.1 Site Resilience Assessment**

An assessment was conducted of the three protected areas managed under SEA and their resilience to climate change. The following attributes were highlighted for each protected area within the SBRC:

#### **Laughing Bird Caye National Park**

- Considered one of the best examples of faro formation in the Caribbean
- Supporting extraordinarily high biological diversity
- Wide range of habitats
- At least twenty two species of international concern (critically endangered, endangered or vulnerable)
- An important source for conch, with high densities of reproductive adults
- Critical nesting grounds for hawksbill turtles
- Significant damage to the corals during the earth tremors in 2009

#### **Gladden Spit and Silk Cayes Marine Reserve**

- One of the best formed examples of barrier reef structure in the region
- Unique geological promontory dropping to a depth of 250m to the east, resulting in conditions for highest priority spawning aggregation site in Belize. And the largest in the ecoregion
- Acts as an important source for national and regional populations of commercial finfish species
- Important seagrass beds
- One of the largest predictable whale shark congregations in Belize - an important tourism resource for coastal communities.

#### **Sapodilla Cayes Marine Reserve**

- Distinctive, unique hook-shaped reef formation
- Highest coral biodiversity in Belize
- Littoral forest provides an important connectivity point for migrating birds
- At least twenty two species of international concern (critically endangered, endangered or vulnerable)
- Three spawning aggregation sites (Nicholas Caye, Rise and Fall Bank and Seal Caye), important for national and regional viability of several commercial fish species
- Nesting sites for hawksbill and green turtles



### 2.5.2 Identified Resources of SBRC

Identified Resources of SBRC	
<p><b>The Fisheries Sector</b> (including aquaculture) ranks 4<sup>th</sup> in its contribution to the national GDP (Ministry of Agriculture and Fisheries, 2008). Belize’s traditional fishing industry provides employment for over 2,240 fishers, reliant primarily on free diving for lobster and conch, or catching finfish on hand lines.</p>	
<ul style="list-style-type: none"> <li>▪ Conch, Lobster</li> </ul>	Laughing Bird Caye National Park – no-take recruitment source Rocky Head (conch nursery). All no-take zones assist with maintenance of these species; presence of mangroves at Sapodilla Cayes Marine Reserve – important nursery ecosystem for lobster
<ul style="list-style-type: none"> <li>▪ Snapper / Grouper</li> </ul>	Gladden Spit (regionally important spawning aggregation site) Sapodilla (three spawning aggregation sites - Nicholas Caye, Rise and Fall Bank and Seal Caye ) Upwelling areas, bringing nutrient rich waters
<ul style="list-style-type: none"> <li>▪ Sea Cucumber</li> </ul>	Newly exploited marine product - Laughing Bird faro – no take area known for good populations of sea cucumbers
<ul style="list-style-type: none"> <li>▪ Starfish (dried, for tourism – Guatemala)</li> </ul>	New marine product marketed as a tourism curio in Guatemalan coastal communities
<p><b>The Tourism Sector</b> ranks 3<sup>rd</sup> in its contribution to the national GDP, and is one of the fastest growing industries, rapidly becoming the major foreign exchange earner, with over 840,000 tourists arriving in Belize in 2008 (BTB, 2009). Laughing Bird Caye National Park and Gladden Spit and Silk Cayes Marine Reserve in particular, are important tourism resources for communities in southern Belize.</p>	
<ul style="list-style-type: none"> <li>▪ Healthy reef</li> </ul>	Sapodilla Cayes Marine Reserve – highest live coral cover and coral diversity Laughing Bird Caye National Park – highest recruitment
<ul style="list-style-type: none"> <li>▪ Whale sharks</li> </ul>	Gladden Spit and Silk Cayes Marine Reserve
<ul style="list-style-type: none"> <li>▪ Sandy beaches</li> </ul>	All three MPAs
<ul style="list-style-type: none"> <li>▪ Fly-fishing / sport fishing</li> </ul>	Sapodilla Cayes Marine Reserve
<ul style="list-style-type: none"> <li>▪ Sea turtles</li> </ul>	Nesting Beaches – Sapodilla Cayes, Laughing Bird Caye, Silk Cayes
<p><b>Ecosystem Service:</b> The health of the marine environment is critical to the social and economic health of Belize. The ecosystem services provided by the coral reefs and mangroves, in particular, cannot be over-estimated. The protection they provide coastal communities of southern Belize from tropical storms and their support of the traditional artisanal fishing industries have been important in the development of Belize. Climate change places these ecosystem services at risk.</p>	
<ul style="list-style-type: none"> <li>▪ Mangroves</li> </ul>	Sapodilla Cayes Marine Reserve (Frank’s Caye, Seal Caye)
<ul style="list-style-type: none"> <li>▪ Seagrass</li> </ul>	All MPAs
<ul style="list-style-type: none"> <li>▪ Corals</li> </ul>	Sapodilla Cayes Marine Reserve / Laughing Bird Caye National Park
<ul style="list-style-type: none"> <li>▪ Littoral forest</li> </ul>	Cayes of Sapodilla Cayes Marine Reserve

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2.5.3 Climate Change Impacts	Current Status	25 – 50 yrs	100 yrs
<b>Sea level rise</b>	Increased global average sea level rise rate of 1.8mm per year from 1961 – 2003. Current average increase in sea level rise in the Mesoamerican region is estimated at 2mm per year		Predicted increase of between 0.6m and 1.0m over next 100 years
<b>Sea surface temperature rise</b>	Water temperature has increased by 0.75°C between 1906 and 2005		Predicted regional increase of temperature by up to 5°C by 2080, with the greatest warming being experienced in the north-west Caribbean (including Belize) (WWF, 2009).
<b>Increased frequency of storms</b>	Increased storms from 1999 onwards, with annual fluctuations. More storms during El Nina, fewer El Nino. Stronger storms >Cat 4 / 5		
<b>Ocean acidification (corals, lobster / conch)</b>	Atmospheric CO <sub>2</sub> concentration has increased from 280 parts per million (ppm) in 1880 to nearly 380 ppm in 2005 – 30% of all atmospheric CO <sub>2</sub> resulting from burning of fossil fuels has been taken up by the ocean (IPCC 2007).	Predicted 30% decrease in pH Predicted decrease in calcification rate by 20 – 50% by 2050	Decrease of 0.5 unit pH for 100 years (UNDP, 2009)
<b>Decreased Precipitation</b>	Mean annual rainfall over Belize has decreased at an average rate of 3.1mm per month per decade since 1960 (UNDP)	Predicted ecological shifts up the altitudinal gradient of the Maya Mountains Massif may remove the cloud forest, and the catchment functionality important for maintaining rivers in dry season in the south of Belize, and providing nutrients to the reef environment.	Predicted decrease in precipitation of 9% by 2099 (IPCC, 2007), with significant fluctuations, attributed to El Niño
<b>Air Temperature</b>	Mean annual temperature has increased in Belize by 0.45°C since 1960, an average rate of 0.10°C per decade. Average number of 'hot' days per year in Belize (days exceeding 10% of current average temperature) has increased by 18.3% between 1960 and 2003 (NCSP/UNDP).		Predicted mean annual temperature increase is 3.5° by 2099 (UNDP, 2009)

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Climate Change Impacts	Ecosystem		
	Coral Reef	Seagrass	Mangrove
<b>Sea level rise</b>	Coral reefs should be able to keep up with sea level rise, barring other impacts (bleaching/mortality and erosion). Change in dispersal / recruitment routes / sources. There may be a loss of deeper corals, shift in distribution, as light availability decreases. Increased sedimentation and reduced light availability due to shore erosion. Possible reduction in water temperature with increased water exchange between deep water and coastal lagoon.	Increases in water depths above present meadows will reduce light availability and changes in currents may cause erosion and increased turbidity of water column. Shifts in distribution of seagrass beds.	Greatest climate change challenge that mangrove ecosystems. Inundation, habitat loss, distribution shift. Inundation of lenticels in the aerial roots can cause the oxygen concentrations in the mangrove to decrease, resulting in death. Damage to coral reefs may adversely impact mangrove systems that depend on the reefs to provide shelter from wave action. Where inland migration cannot occur (ie. Low lying cayes), mangroves may disappear.
<b>Sea surface temperature rise</b>	Increased coral bleaching, potential mortality and erosion, and eventual loss of ecosystem functionality. Increased prevalence of coral disease. Possible impacts from new invasive species and algal blooms. A shift towards more tolerant, opportunistic species, and reduced biodiversity.	Temperature stress on seagrasses will result in distribution shifts, changes in patterns of sexual reproduction, altered seagrass growth rates, metabolism, and changes in their carbon balance. When temperatures reach the upper thermal limit for individual species, the reduced productivity will cause plants to die (above 35°C for <i>T. Testudinum</i> ). Higher temperatures may increase epiphytic algal growth, increasing shading and reducing available sunlight.	Loss of reef may reduce protection from erosion and storm events, increasing risk to mangroves.
<b>Increased frequency and intensity of storms</b>	Increased mechanical damage of corals, increased sedimentation. Reduced ability of colonies to re-establish after storm events.	Massive sediment movements that can uproot or bury seagrass. Increased frequency of storms may increase annual turbidity, reducing light availability for deeper water seagrasses beyond their limits. It may also become harder for seagrasses to become re-established. Decreased salinity from increased storm events may adversely affect seagrass	Destruction, inundation, changes in sediment dynamics. Possible increase in nutrients / growth. Large storm impacts result in mass mortality. Projected increases in the frequency of high water events could affect mangrove health and composition due to changes in salinity, and inundation. Inundation is also projected to decrease the ability of mangroves to photosynthesize

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Climate Change Impacts	Ecosystem		
	Coral Reef	Seagrass	Mangrove
<b>Ocean acidification (corals, lobster / conch)</b>	Decreases in coral calcification rates, growth rates and structural strength	Possible direct positive effect on photosynthesis and growth, as in some situations, seagrass is carbon limited. Higher CO <sub>2</sub> levels may also increase the production and biomass of epiphytic algae on seagrass leaves, which may adversely impact seagrasses by causing shading. The acidification of seawater could counter the high pH formed by photosynthesis in dense seagrass stands, thus increasing seagrass photosynthesis and productivity.	Increase in growth. However, damage to coral reefs may adversely impact mangrove systems that depend on the reefs to provide shelter from wave action.
<b>Decreased Precipitation</b>			Reduction of freshwater lens, affect on carbon uptake, photosynthesis. Decreased precipitation results in a decrease in mangrove productivity, growth, and seedling survival, and may change species composition favouring more salt tolerant species. Projected loss of the inner caye to unvegetated hypersaline flats
<b>Air Temperature</b>			May alter phenological patterns – timing of flowering and fruiting. At temperatures above 25°C, some species show a declining leaf formation rate. Above 35°C have led to thermal stress affecting. Mangrove root structures and establishment of mangrove seedlings. At leaf temperatures of 38-40°C, almost no photosynthesis occurs (IUCN, 2006)

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Climate Change Impacts	Resource		
	Conch	Lobster	Snappers / Groupers
<b>Sea level rise</b>	May experience shift in range or habitat loss linked to changes in seagrass – critical habitat	Shift in range / habitat loss of both adult and juvenile lobster – linked to inundation of mangrove, shift in seagrass distribution, changes in coral reef	Shift in range / habitat loss of both adult and juvenile fish (inundation of mangrove, shift in seagrass distribution, changes in coral reef). Potential changes in water currents affecting viability of spawning aggregation sites
<b>Sea surface temperature rise</b>	Reproduction in seagrass is temperature-driven, so may be affected. Temperature may affect spawning, which increases as a linear function of bottom water temperature, but declines once a temperature threshold is reached. Possible impacts from new invasive species and algal blooms. Disease may become more prevalent.	Reproduction in seagrass is temperature-driven, so may be affected. Possible effects of increased water temperature on larval and adult lobsters and reproduction. Possible impacts from new invasive species and algal blooms. Disease may become more prevalent.	Habitat loss (impacts on reef). Reproduction in seagrass is temperature-driven, so may be affected Thermo-tolerance...possible effect on juveniles and larger species. Decrease of upwelling currents – decrease in ocean productivity with potential loss of spawning aggregation sites. Possible impacts from new invasive species. Disease may become more prevalent.
<b>Increased frequency and intensity of storms</b>	Habitat destruction and increased sedimentation; possible impacts on larval dispersal / survival	Habitat destruction - seagrass and mangroves; sedimentation, possible impacts on larval dispersion / survival	Habitat destruction - seagrass and mangroves; sedimentation, possible impacts on larval dispersion / survival
<b>Ocean acidification (corals, lobster / conch)</b>	Habitat loss (impacts on reef). Impacts on larval viability and adult growth rates. Possible increase in seagrass productivity	Habitat loss (impacts on reef). Impacts on larval viability and adult growth rates. Possible increase in seagrass productivity	Habitat loss (impacts on reef). Potential impacts on larval viability and adult growth rates
<b>Decreased Precipitation</b>	Possible changes in salinity impacting larval dispersal	Possible changes in salinity impacting larval dispersal	Possible changes in salinity impacting larval dispersal
<b>Air Temperature</b>		Impacts on mangrove productivity	Impacts on mangrove productivity

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Climate Change Impacts	Resource		
	Sea Turtles	Parrotfish	Whale Sharks
<b>Sea level rise</b>	Inundation of nesting beaches	Shift in range / habitat loss of both adult and juvenile parrotfish – linked to inundation of mangrove, shift in seagrass distribution, changes in coral reef	Potential changes in water currents affecting viability of spawning aggregation sites, and therefore presence of whale sharks
<b>Sea surface temperature rise</b>	Effects on food sources – shifts in distribution / abundance of seagrass, decreased health of coral reef. Extended nesting season, with earlier onset of nesting. Higher incidence of disease	Shifts in distribution / abundance of seagrass, decreased health of coral reef, Distribution shift into deeper, cooler waters	Decrease of upwelling currents – decrease in ocean productivity with potential loss of spawning aggregation sites. Changes in migration routes. Disease may become more prevalent.
<b>Increased frequency and intensity of storms</b>	Habitat destruction and increased sedimentation; possible impacts on dispersal / survival. Inundation of nests from higher groundwater	Habitat destruction - seagrass and mangroves; sedimentation, possible impacts on larval dispersion / survival	During storm events, feeding areas may shift – shift of salinity and nutrient content
<b>Ocean acidification (corals, lobster / conch)</b>	Habitat loss (impacts on reef). Possible increase in seagrass productivity.	Habitat loss (impacts on reef). Impacts on larval viability and adult growth rates. Possible increase in seagrass productivity	Potential impacts to food availability
<b>Decreased Precipitation</b>			
<b>Increased Air Temperature</b>	Female biased sex ratio >31°C females; 29 – 30°C 50:50; <29°C males. Warming of beaches, resulting in increased egg mortality, shorter hatching time with smaller average hatching size, reducing survival potential.		

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2.5.4 Socio Economic Impacts		
Fisheries	Tourism	Key Environmental Services
<p><b>Current Status:</b> The traditional industry provides employment for over 2,240 fishers and over 120 processing plant personnel in Belize (Ministry of Agriculture and Fisheries, 2008). Capture fisheries export earnings totalled approximately Bz\$20.5 million dollars in 2008, primarily from the traditional lobster and conch capture fisheries (Ministry of Agriculture and Fisheries, 2008).</p>	<p><b>Current Status:</b> Tourism is the third ranking productive sector in Belize, contributing 28.2% (BZ\$816.3mn) in 2009, with projections suggesting that this will increase to 31.4% (BZ\$1,601.2mn) by 2020. The tourism sector provided an estimated 34,000 jobs in 2009, 28.3% of total national employment or 1 in every 3.5 jobs. This is predicted to increase to 53,000 jobs, 31.6% of total employment or 1 in every 3.2 jobs by 2020 (WTTC, 2010).</p>	<p><b>Current Status:</b> Reefs and mangroves also protect coastal and cay properties from erosion and wave-induced damage, providing an estimated US\$231 to US\$347 million in avoided damages per year.</p>
<p><b>Predicted Impacts:</b> Loss of revenues generated from fisheries resources through loss of fishing grounds and of reef-associated species (eg. lobster, conch and finfish). Potential shift to off shore species, requiring more sophisticated equipment / greater economic investment. Increase in illegal activities due to lack of viable employment opportunities. Some community economies will be more vulnerable than others – but all will be affected.</p> <p><b>Limitations/Barriers:</b> The financial market is not favourable to small scale entrepreneurs making access to the level of capital investment required for off shore fisheries inaccessible. Lack of capital limits fishers' ability to invest in livelihood diversification. No national strategies exist to address increased unemployment.</p>	<p><b>Predicted Impacts:</b> Tourism (Diving and snorkeling): Loss in revenues caused by loss of aesthetics of reef and charismatic reef species through loss of coral habitats and reef-associated species (eg. parrotfish, corals, colourful fish). Loss in revenue due to loss of sandy beaches which could result in increased dredging pressures or land reclamation. Declining tourism industry affecting local economies, and resulting in increasing fishing pressures, with increased conflict. Shift of sport fishing to deep sea species. Will result in illegal activities with the reduction of viable employment opportunities available. Some community economies will be more vulnerable than others – but all will be affected.</p> <p><b>Limitations /Barriers:</b> No national strategies exist to address increased unemployment. Limited current market demand for inland tours. Limited capacity to conduct inland tours.</p>	<p><b>Predicted Threat:</b> Increased risk to coastline and caye infrastructure due to inundation, potential long term loss of coastal protection functionality if reef can't keep up with sea level rise. Potential increased wave action on central barrier reef with reduction of wave shadow functionality of atolls with increased sea level.</p> <p>Possible increased lagoon - open sea water exchange, with reduced sea water temperature.</p> <p><b>Limitations / Barriers:</b> Limited scientific knowledge / experience of climate change impacts – few models available for successful adaptation.</p>



### **2.5.5 General Strategies**

#### **General Strategies**

Because of the global nature of climate change, the strategies needed to address impacts go beyond the level of intervention available to SEA. Successful interventions will require collaboration with government and civil society partners to address a wide range of socio-economic issues. However SEA also needs to adapt to local changes through identified general strategies.

- Increase institutional expertise and capacity for addressing climate change issues and management of adaptation strategies.
- Active participation in national and regional planning for climate change adaptation
- Strengthen coastal protection through participation in and support of coastal zone development planning for southern Belize
- Increase stakeholder awareness and understanding of climate change and the potential to increase reef resilience, by reducing impacts of identified threats.
- Increase stakeholder capacity to participate in climate change adaptation strategies.
- Identify, build and strengthen partnerships with organizations targeting reduction of watershed threats (including transboundary efforts)
- Establish a policy framework and identify a funding mechanisms specific to implement climate change adaptation strategies
- Identify and partner with major climate change focused organization for skills transfer and mentoring

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2.5.6 Targeted Strategies		
Fisheries	Tourism	Key Environmental Services
<ul style="list-style-type: none"> <li>▪ Increase surveillance and enforcement effort against fisheries infractions, particularly hotspots identified using SEA's enforcement data</li> <li>▪ Implement managed access for traditional fishermen to address fishing impacts</li> <li>▪ Collaborate with partners to develop supplemental / complimentary income generation opportunities for fishing stakeholders</li> <li>▪ Develop and strengthen partnerships with the Ministries of Human Development, Health, Education and Agriculture and Fisheries to identify and implement climate change adaptation strategies for SEA stakeholder communities</li> </ul>	<ul style="list-style-type: none"> <li>▪ Ensure infrastructure is in place to minimize tourism impacts on the reef – signs, mooring buoys, designated dive sites</li> <li>▪ Increase surveillance and enforcement effort against tourism infractions, particularly in identified hotspot threat and resilient areas</li> <li>▪ Engage BTB and BTIA in climate change adaptation planning</li> <li>▪ Educate visitors about the impacts of climate change</li> <li>▪ Conduct market survey to determine the feasibility of promoting more inland based tourism</li> <li>▪ Based on outputs of market study, diversify focus of training to include inland tourism destinations, reducing dependence on reef resources</li> <li>▪ Promote and facilitate marketing for diversification of tourism focus – away from dependence solely on the reef</li> <li>▪ Collaborate with partners in lobbying for passing the revised mangrove legislation.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Identify resilient areas within the SEA's marine protected areas in the context of the greater Southern Belize Reef Complex</li> <li>▪ Review and re-evaluate MPA boundaries and zoning in the Southern Belize Reef Complex</li> <li>▪ Identify and increase protection of resilient reefs, source populations and key larval dispersal routes</li> <li>▪ Establish monitoring protocols that inform management for building reef resilience</li> <li>▪ Engage coastal / caye landowners in climate change adaptation strategies – including shoreline protection through conservation / re-planting of mangroves</li> <li>▪ Investigate mechanisms for direct interventions – eg. coral nurseries, shading of key sites, promoting higher herbivore densities</li> <li>▪ Strengthen protection of trophic structure - maintenance of top predators (eg. feasibility of declaring SBRC as a shark sanctuary)</li> </ul>

### 3. Management Planning

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#### 3.1 Management Goals

Gladden Spit and Silk Cayes Marine Reserve was established under the Fisheries Act of 1948 (amended 1987) which states that the purpose of a Marine Reserve is to:

*“afford special protection to the aquatic flora and fauna ...and to protect and preserve the natural breeding grounds and habitats of aquatic life”.*

The overall goal of the Marine Reserve is *“the protection of the key reef ecosystems, the idyllic Silk Cayes, the spawning aggregation and whale sharks of Gladden Spit, within the multi-zoned marine reserve”*, to be achieved through the following objectives:

1. Effectively manage the natural resources of Gladden Spit and Silk Cayes Marine Reserve, with the participation of all stakeholders.
2. Ensure adaptive management decisions are informed by research and monitoring outputs
3. Effectively manage the commercial marine resources for sustainability, and for the benefit of traditional users of the Marine Reserve
4. Effectively manage recreational opportunities for environmental sustainability, visitor appreciation and socio-economic benefit to local stakeholders
5. Effectively manage the spawning aggregations for sustainability of commercial fish stocks and individual species
6. Provide opportunities for interpretation, education and increased awareness of the Marine Reserve, its environmental services.

***Adapted from Gladden Spit and Silk Cayes Management Plan, FoN, 2003***

The management goal of the marine protected area is also aligned with the vision for the Southern Belize Reef Complex:

*A collaborative stewardship of the internationally recognized Southern Belize Reef Complex, through strategic partnerships to conserve and improve the integrity of these socio-economically and biologically important ecosystems for the benefit of future generations*

***A collective Vision for the Southern Belize Reef Complex,  
Belize CAP Workshop, May, 2008***

### **3.2 Management and Organizational Background**

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Whilst legislative responsibility is held by the Fisheries Department, Gladden Spit Silk Cayes Marine Reserve is managed through a collaborative partnership with the Southern Environmental Association (SEA). SEA is responsible for day-to-day management of the reserve, including activities such as patrols, fee collection, and scientific monitoring. This is supported by the Protected Area Management Programme under the Fisheries Department Ecosystem Management Unit

The Southern Environmental Association (SEA) was established in 2008 through the merging of two existing non-Governmental organizations – Friends of Nature (FoN), based in Placencia, and the Toledo Association for Sustainable Tourism and Empowerment (TASTE), in Punta Gorda, Toledo District. Friends of Nature, established in 1991 as Friends of Laughing Bird Caye, originally had co-management responsibility for Gladden Spit and Silk Cayes Marine Reserve (GSSCMR), under agreement with the Fisheries Department and Laughing Bird Caye National Park (LBCNP) (through an agreement with Forest Department). TASTE, established in 2001, provided the science/monitoring and educational component management for the Sapodilla Cayes Marine Reserve (SCMR), in partnership with the Fisheries Department.

In 2006, an assessment was conducted to determine the feasibility of merging of the two organizations to increase management effectiveness by optimizing the organizational synergies and strengths, and reduce overlaps, particularly in the areas of operational processes, community stakeholder footprint and engaging funding partners. The Southern Environmental Association (SEA) was officially incorporated in December 2008 as the new management organization, and has offices in both Placencia and Punta Gorda.

The Southern Environmental Association undertakes a wide range of tasks from law enforcement to community outreach and scientific research. It works closely with the eight stakeholder communities of Hopkins, Sittie River, Seine Bight, Placencia, Independence, Monkey River, Punta Negra and Punta Gorda, and is starting to engage Sarteneja, its most northern stakeholder community. Under the co-management agreements with the Government

#### **Southern Environmental Association**

**Vision:** The Southern Environmental Association will be a leader in effective resource management and responsible stewardship for southern Belize’s strategically important marine areas thus creating benefits for all stakeholders

**Mission:** The Southern Environmental Association is a non-governmental organization that continuously works towards improving stewardship and the environmental integrity of key marine areas in southern Belize through effective, collaborative protected areas management, community involvement, and strategic partnerships for the benefit of all stakeholders

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of Belize, SEA assumes control of zoning enforcement and visitor behaviour, and is authorized to police within and between protected areas of the Southern Belize Reef Complex.

SEA currently has a staff of seventeen, including rangers, administrative, outreach, and science staff (Figure 30). SEA's Board of Directors consists of fourteen members, including seven community leaders, other key stakeholder representatives, and technical members, and assists in the formulation of policy for the management of the Marine Reserve (Figure 36).

The Board of Directors has ultimate responsibility for all aspects of SEA, including:

- Safeguarding the vision, integrity, objectives and policies of SEA;
- Ensuring high standards of planning, operation, administration, evaluation and reporting in SEA;
- Ensuring that statutory obligations are met;
- Ensuring that adequate resources are available to SEA for all aspects of its work and administration;
- Ensuring that resources provided to SEA are used for their intended purpose and are properly accounted for.

### SEA Board of Directors

Hopkins Village Chairperson  
Seine Bight Village Chairperson  
Placencia Village Chairperson  
Independence Village Chairperson  
Monkey River Village Chairperson  
Punta Negra Village Chairperson  
Punta Gorda Town Council Representative  
Northern Fisherman Representative  
Southern Fisherman Representative  
Northern Tour Guide Representative  
Southern Tour Guide Representative  
Educational Institutions Representative  
Financial expert  
Marine expert  
Executive Director (*ex officio*)

**Figure 36:** Board Structure

For the past eighteen years, SEA, (or as its two constituent organizations), has been working, and continues to work with, community members to improve management of the marine resources, with a focus on effective enforcement, and involvement and participation of community stakeholders in programs such as science and monitoring, enforcement, environmental education, community development and outreach.

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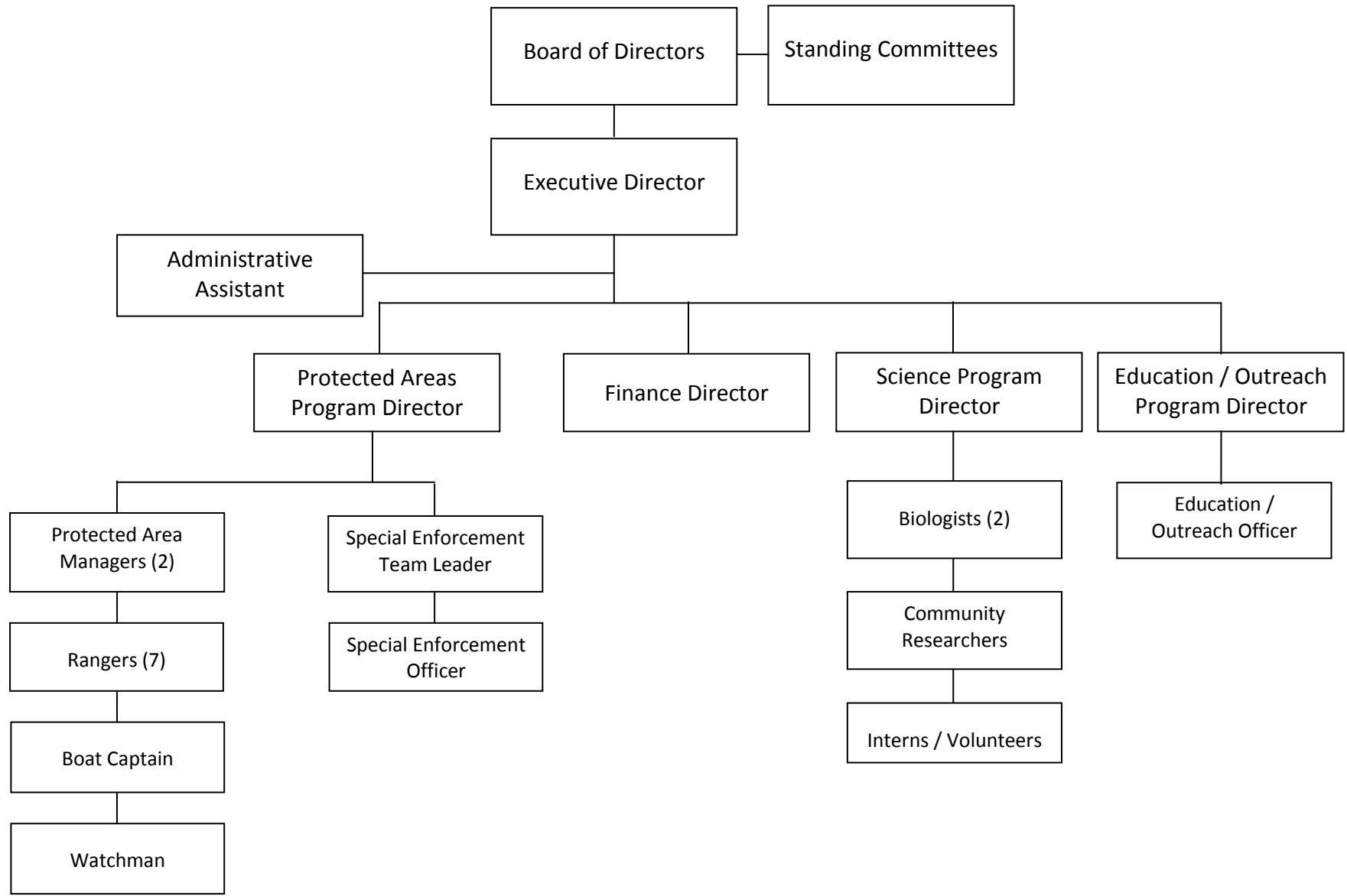
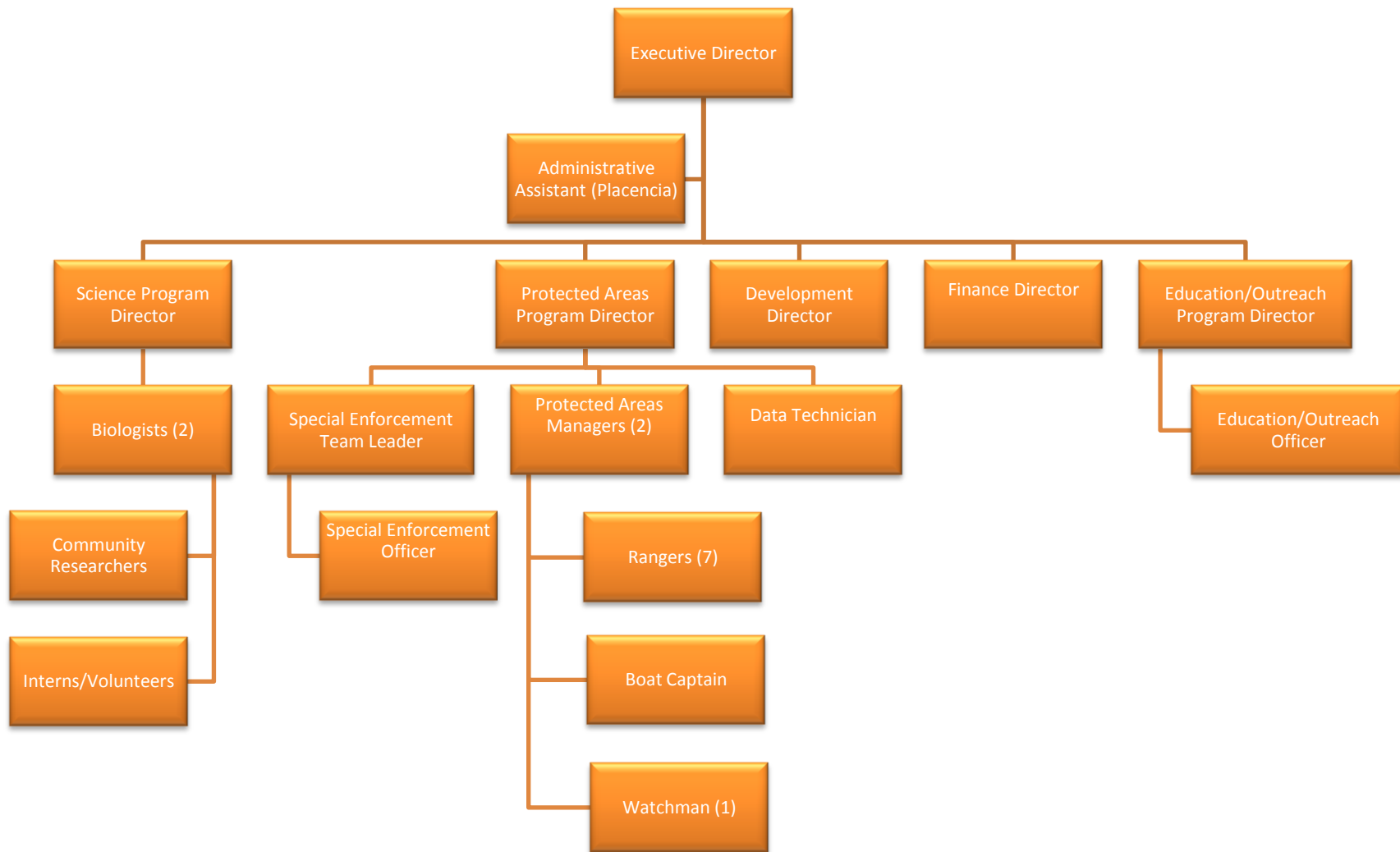


Figure 37: SEA Organizational Structure (December, 2010)

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**Figure 38: SEA Organizational Structure (Optimal) (SEA Strategic Plan / Salas et. al., 2008)**



### 3.3 Review of Previous Management Effectiveness

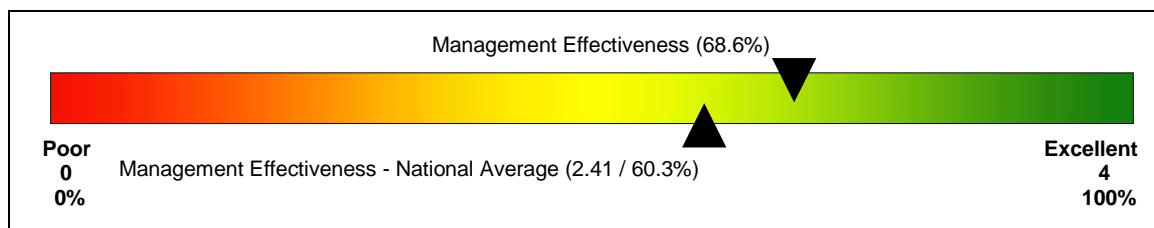
A national assessment of management effectiveness was conducted in 2009, under the Association of Protected Area Management Organizations (APAMO). This included a site-level self-assessment of Gladden Spit and Silk Cayes Marine Reserve and provides a snapshot of the state of the Marine Reserve in mid-2009, with site-level recommendations for use by protected area managers for adaptive management (Walker and Walker, 2009).

It should be noted that since the assessment, which was conducted whilst SEA was in a transitional stage, between Executive Directors, the organization has been strengthened considerably, with a new Executive Director, an active Board of Directors, and motivated management and operational staff.

**National Indicator Categories:** Under the National Protected Areas Policy and System Plan, management effectiveness is evaluated through the **Monitoring Package for Assessing Management Effectiveness of Protected Areas** (Young et. al. 2005), based on 64 indicators (Figures 33 and 34), and divided between seven indicator categories:

1. Resource Information
2. Resource Administration, Management and Protection
3. Participation, Education and Socio-economic Benefits
4. Management Planning
5. Governance
6. Human Resources
7. Financial and Capital Management

The current management effectiveness of Gladden Spit and Silk Cayes Marine Reserve is rated as **MODERATE**, with an overall Management Effectiveness of score of 2.74 out of 4.00 (68.6%).

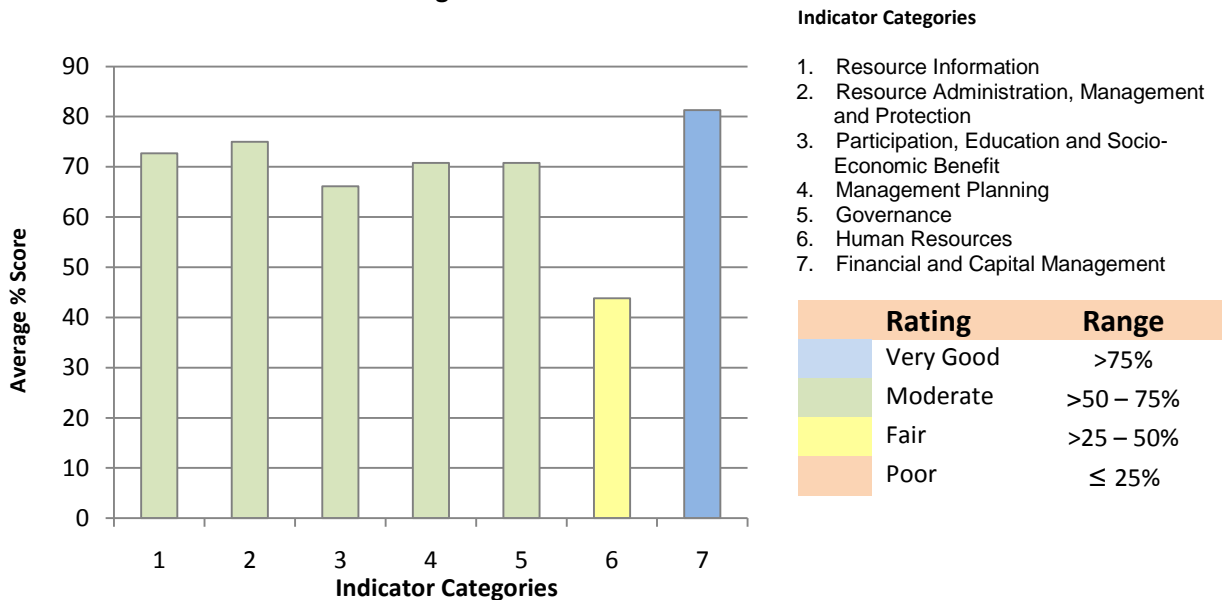


Management Effectiveness, 2009

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Indicator Categories		
Indicator Category	Average Score 2009	
1. Resource Information	72.7	Moderate
2. Resource Administration, Management and Protection	75.0	Moderate
3. Participation, Education and Socio-Economic Benefit	66.1	Moderate
4. Management Planning	70.8	Moderate
5. Governance	70.8	Moderate
6. Human Resources	43.8	Fair
7. Financial and Capital Management	81.3	Very Good
<b>Overall</b>	<b>68.6%</b>	<b>Moderate</b>
<b>Poor:</b> 0 – 25%	<b>Fair:</b> >25% - 50%	<b>Moderate:</b> > 50% - 75%
<b>Very Good:</b> > 75%		

**Table 21: Results for indicator Categories**



**Figure 39: Results per Indicator Category**

**Indicator Category 7: Financial and Capital Management** rates as **VERY GOOD** - the strongest Indicator Category, and reflects the ability of SEA to generate and manage funds from visitation to the Marine Reserve (particularly Gladden Spit, when the whale sharks are congregating), and the financial planning that has strengthened the organization in the past. This also ensures that on-site staff have adequate infrastructure and equipment.

**Indicator Category 2: Resource Administration, Management and Protection** is the second highest scoring Indicator Category, rating as **MODERATE**, reflecting the well established structure of SEA and its partnership with the Fisheries Department for monitoring and surveillance activities.

**Indicator Category 6: Human Resources** rates as **FAIR**, the weakest Indicator Category, with strengthening of human resource management highlighted as a critical requirement. Team building activities, a change in leadership, more active human resource management, and increased staff are assisting in strengthening this Indicator Category.

Of the 64 national indicators, fifteen show particular strength, scoring 4, whilst eight demonstrate areas that would benefit from strengthening, with scores of 1.

Two indicators were not considered relevant for the Marine Reserve by the staff, and were therefore not included within the assessment:

- 1.6 Inventory: Tenure and Claims
- 2.4 Tenure claim and conflict resolution

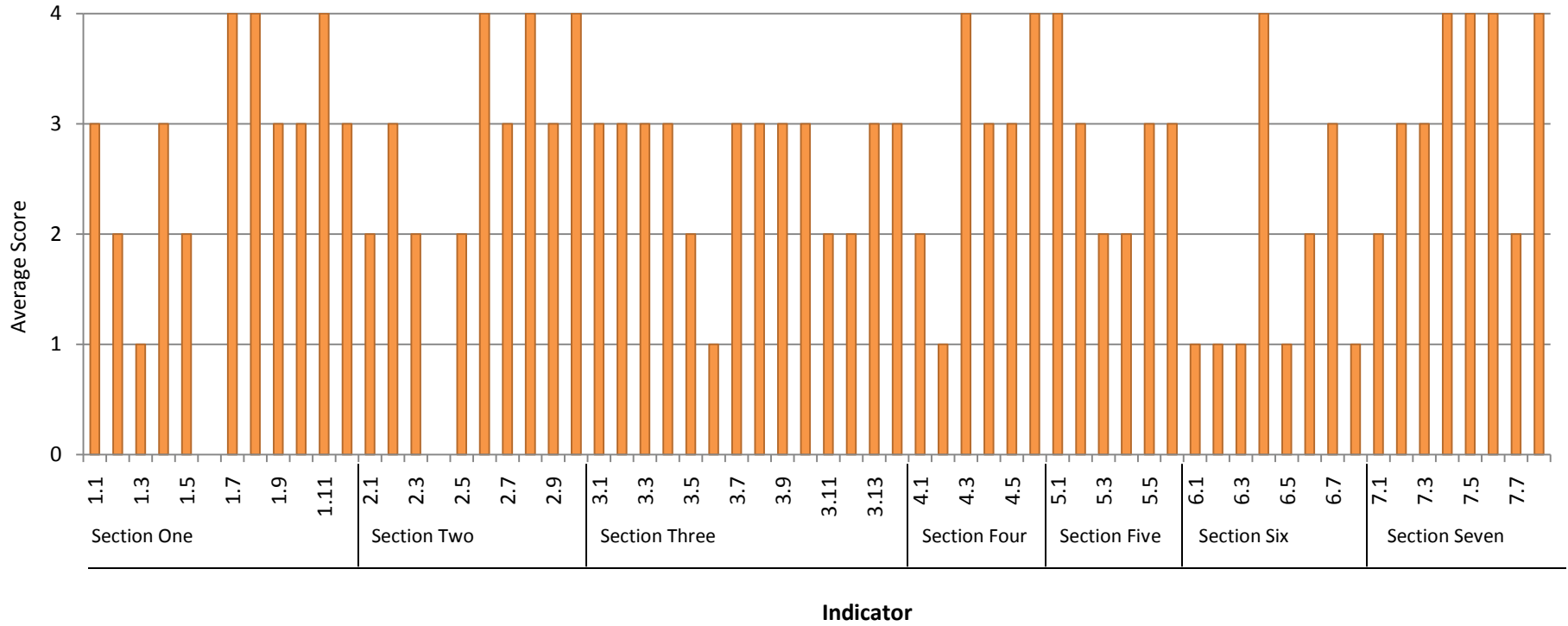
**Strengths (Score of 4.00)**

- 1.7 Site Assessment: Conservation Target
- 1.8 Site Assessment: Systematic Threat Assessment
- 1.11 Environmental Monitoring Activities
- 2.4 Tenure Claim Conflict Resolution
- 2.6 Natural Resource Management
- 2.8 Protection: Enforcement Activities
- 2.10 Visitor and Tourism Monitoring Activities
- 4.3 Regulation and Implementation of Management Zones
- 4.6 Research Planning
- 5.1 Protected Areas Objectives
- 6.4 Technical, Scientific, and Professional Staff Availability
- 7.4 Infrastructure Adequacy
- 7.5 Equipment Adequacy
- 7.6 Internal Access Adequacy
- 7.8 Maintenance Adequacy

**Weaknesses (Score of 1.00)**

- 1.3 Inventory: Cultural and Archaeological Resources
- 3.6 Participation: Local Actors Leading Management
- 4.2 Operational Plan
- 6.1 Site Manager Preparation
- 6.2 Site Manager Availability
- 6.3 Admin Staff Availability
- 6.5 Operations Staff Availability
- 6.8 Staff Satisfaction

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**Figure 40: Mean score by indicator – sorted by Indicator Category**

## **Non-Biodiversity Indicators (Young et. al. 2005)**

### **1. Resource Information**

- 1.1 Physical Environment
- 1.2 Biotic Environment
- 1.3 Cultural and Archaeological Resources
- 1.4 Social, Cultural, and Economic Context
- 1.5 Resource Use and Occupancy
- 1.6 Tenures and Claims
- 1.7 Conservation Target
- 1.8 Systematic Threat Assessment
- 1.9 Traditional Knowledge
- 1.10 Information Management Systems
- 1.11 Environmental Monitoring Activities
- 1.12 Functional Scientific Research Activities

### **2. Resource Management**

- 2.1 Legal: Legal Status
- 2.2 Legal: Boundary Survey and Demarcation
- 2.3 Legal: Permit, and Approval Processes
- 2.4 Tenure Claim Conflict Resolution
- 2.5 Guidelines and Best Management Practices
- 2.6 Natural Resource Management
- 2.7 Protection: Surveillance Activities
- 2.8 Protection: Enforcement Activities
- 2.9 Visitor and Tourism Management Activities
- 2.10 Visitor and Tourism Monitoring Activities

### **3. Community Participation and Benefits**

- 3.1 Communication Activities
- 3.2 Stakeholder Engagement
- 3.3 Educational Activities
- 3.4 Dissemination of Knowledge and Information
- 3.5 Level of Stakeholder Participation in Management Benefits
- 3.6 Local Actors Leading Management
- 3.7 Volunteer Activities
- 3.8 Strength of Social Capital
- 3.9 Capacity Building Strategies
- 3.10 Socio-Economic Benefits Strategy
- 3.11 Extent of Local Economic Benefits
- 3.12 Sustainable Use for Economic
- 3.13 Employment in activities related to the protected area
- 3.14 Local Recognition of Protected Area Benefits

### **4. Management Planning**

- 4.1 Management Plan Implementation
- 4.2 Operational Plan Implementation
- 4.3 Regulation and Zoning Implementation
- 4.4 Guidelines and Best Management Practices
- 4.5 Long Term Management Needs Identification
- 4.6 Program Monitoring and Evaluation

### **5. Governance**

- 5.1 Protected area objectives
- 5.2 Co-management agreements
- 5.3 Administrative autonomy
- 5.4 Advisory Committee
- 5.5 Board of Directors
- 5.6 Inter-organizational mechanisms

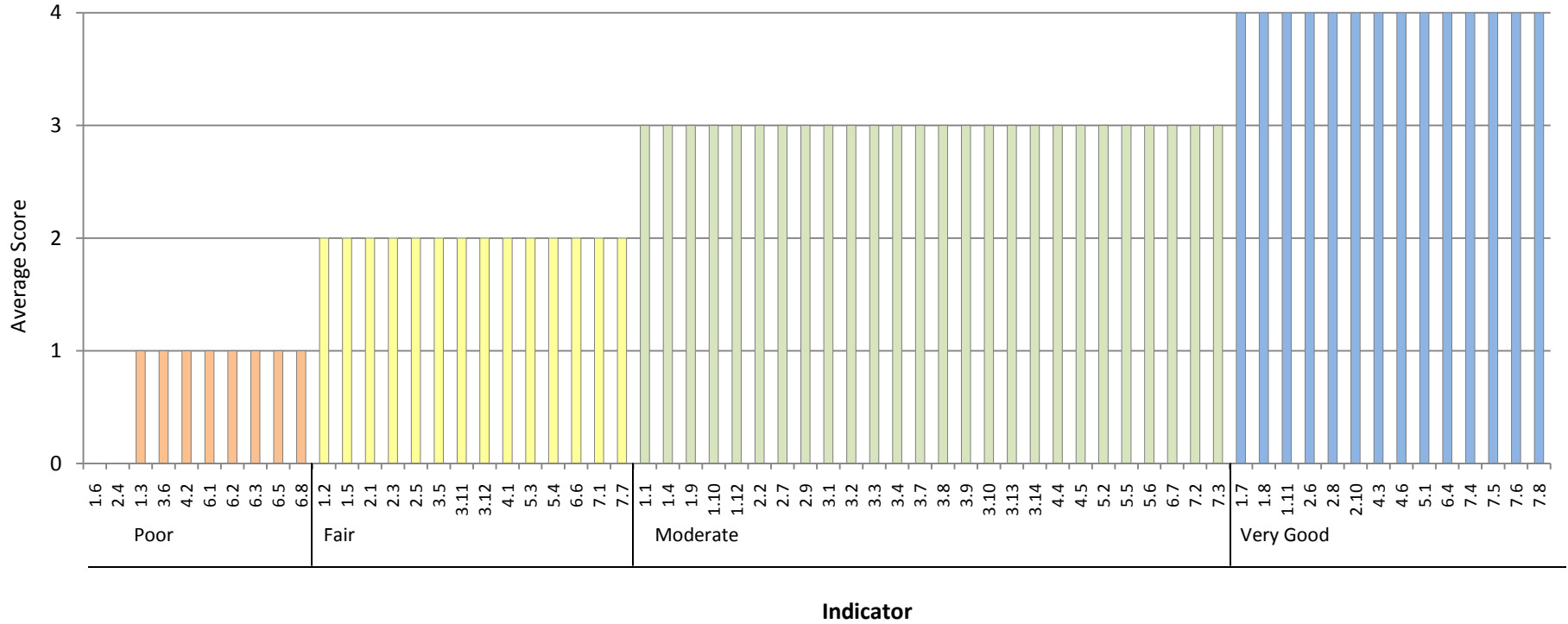
### **6. Human Resources**

- 6.1 Qualified Site Manager
- 6.2 Site Manager Availability
- 6.3 Administrative Staff Availability
- 6.4 Technical, Scientific, and Professional Staff Availability
- 6.5 Operations Staff Availability
- 6.6 Human Resource Assessment
- 6.7 Training and Development
- 6.8 Staff Satisfaction

### **7. Financial and Capital Management**

- 7.1 Funding Adequacy
- 7.2 Revenue Generation
- 7.3 Financial Management
- 7.4 Infrastructure Adequacy
- 7.5 Equipment Adequacy
- 7.6 Internal Access Adequacy
- 7.7 Signage Adequacy
- 7.8 Maintenance Adequacy

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**Figure 41: Mean score by – sorted by Score**

**Indicator Category One: Resource Information**

Gladden Spit and Silk Cayes Marine Reserve rates as **MODERATE** for Section One: Resource Information, with a mean score of 2.91 out of a possible 4.00 (72.7%), higher than the average for the National Protected Areas System, which scores 2.31 (57.7%).

The scores per indicator for Gladden Spit and Silk Cayes for Section One range from 1.00 for the weakest indicator (**Indicator 1.3: Inventory of cultural and archaeological resources**), to 4 for the three strongest indicators, which rate as **VERY GOOD**. The indicator **1.6: Tenures and Claims** was not considered applicable by the assessor, and is therefore not included. All other indicators rate as **FAIR** or **MODERATE**, with scores of either 2 or 3, suggesting that resource information is available for management, though a number of information gaps still exist.

***Recommendations:***

- 1.1 Seek and consolidate information on the cultural and archaeological resources of the protected area
- 1.2 Ensure baseline information is adequate for effective management, especially for management of climate change impacts
- 1.3 Continue to maintain ongoing records on resource use

**Indicator Category Two: Resource Administration, Management and Protection**

Belize is considered to have a strong legal framework for the effective establishment and management of protected areas within the system, and protected area legislation provides a framework of policies and permits within which protected areas can operate effectively.

Gladden Spit Silk Cayes Marine Reserve rates at the top end of **MODERATE** for Section Two, with a mean score of 3.00 out of a possible 4.00 (75.0%).

Scores within this section range from 2.00 (**FAIR**) to 4.00 (**VERY GOOD**), reflecting the strength of administration management capacity within the SEA and Fisheries Department structures. One indicator (**2.4: Tenure Claim Conflict Resolution**) is not considered relevant by the assessor, and is therefore not included in the assessment.

***Recommendations:***

- 2.1 Resolve any legal status issues for the Silk Cayes, which are currently not stipulated as being part of the Marine Reserve

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- 2.2 Ensure clear guidelines exist and are available to staff, and that best management practices are clearly defined and implemented for Gladden Spit and Silk Cayes Marine Reserve
- 2.3 Ensure clear permit and approval processes are in place, with communication between SEA, Forest Department and Fisheries Department where permission is required for activities (fishing at the spawning aggregation site, research etc.)

### Indicator Category 3: Participation, Education and Socio-Economic Benefits

Gladden Spit and Silk Cayes Marine Reserve rates as **MODERATE** for Indicator Category Three, with a mean score of 2.64 out of a possible 4.00 (66.1%) – above the overall system average of 2.13 (53.4%).

One indicator scores 1.00 out of 4.00 (**POOR**) - **Indicator 3.6: Local actors leading protected area management**) – this is currently being addressed through strengthening of community representation on the Board of Directors. No indicator rates as **VERY GOOD**, the majority scoring 2.00 or 3.00.

- 3.1 Ensure that there is balanced representation of local stakeholders on the Board of Directors
- 3.2 Identify mechanisms to increase stakeholder capacity and increase stakeholder benefit
- 3.3 Continue engaging fishermen towards more sustainable use of the marine resources

### Indicator Category 4: Management Planning

Gladden Spit and Silk Cayes Marine Reserve rates as **MODERATE** for Section Four, with a mean score of 2.83 out of 4.00 (70.8%), higher than the national average of 2.20 (55.1%).

Gladden Spit and Silk Cayes Marine Reserve rates as **VERY GOOD** for **Indicator 4.3: Regulation and Zoning Implementation**, and **4.6 Research Programme**, but less well on planning – with no strong management planning framework on which to base management activities. This is now being **One** indicator, **Indicator 4.2: Operational Planning** – scores 1 (**POOR**), reinforcing the need for an improved planning framework. It should be noted that since the evaluation, SEA has revised its internal planning framework, building capacity of its staff to follow planning frameworks and effectively use monitoring and evaluation to keep on track. It should also be noted that SEA is currently developing management plans for all three of its protected areas (including Gladden Spit and Silk Cayes Marine Reserve).

### **Recommendations:**

- 4.1 Strengthen management through use of Operational Planning / annual workplans, with integrated monitoring and evaluation



### **Indicator Category 5: Governance**

Overall, Gladden Spit and Silk Cayes Marine Reserve scores an average of 2.83 out of 4.00 (70.8%), rating as **MODERATE** for Indicator Category Five: Governance, higher than the national average of 2.75 (68.8%).

Under Indicator Category 5, Gladden Spit and Silk Cayes Marine Reserve has one indicator rating as **VERY GOOD (Indicator 5.1 Protected Area Objectives)** and no indicator rating as **POOR**. The remaining five indicators lie between 2 (**FAIR**) and 3 (**MODERATE**). The two weakest indicators are **Indicator 5.3: Administrative Autonomy** and **Indicator 5.4: Advisory Committee**, both rating as **FAIR**.

Since the evaluation, the SEA Board has been significantly strengthened, providing improved mechanisms for advisory input from stakeholders. There is also the recognition for increased communication between SEA and Fisheries Department – the first step towards improving Governance of the marine protected area overall.

### **Indicator Category Six: Human Resources**

Gladden Spit and Silk Cayes Marine Reserve rates as **FAIR**, scoring an average of 1.75 out of a possible 4.00 (43.8%), lower than the national average across the protected area system, of 2.51 (62.8%)

Under Section 6, one indicator scores 4.00 (**VERY GOOD**) – **Indicator 6.4: Technical, scientific and professional staff**, reflecting the strong science team SEA has. Five indicators rate as **POOR**, with a score of 1.00, reflecting the transition period SEA is going through, following the merging of TASTE and FoN, and the limited finances available to maintain staffing levels in the current economic climate.

Low commitment and high staff turnover are of concern across the entire marine protected areas system – this has been exacerbated by financial constraints during the current economic climate, the transition period following the merging of FoN and TASTE, the lack of an Executive Director, and lack of dedicated site managers. It should be noted that since the evaluation, this has been rectified.

### ***Recommendations:***

- 6.1 Identify and recruit qualified staff for all vacant positions
- 6.2 Investigate the potential for using international volunteers to fill identified technical skills gaps
- 6.3 Identify non-monetary mechanisms for increasing staff satisfaction

**Indicator Category 7: Financial and Capital Management**

Gladden Spit and Silk Caye Marine Reserve scores 3.25 out of a possible 4.00 (81.3%) for Financial and Capital Management, rating as **VERY GOOD**, higher than the average protected areas system score of 2.49 (62.4%).

Under Section 7, no indicator rates as **POOR**, though **Indicator 7.1: Funding Adequacy** and **Indicator 7.7 Signage Adequate for Management** both rate as **FAIR**. Four indicators rate as **VERY GOOD**, reflecting the structured financial management systems that SEA has in place, and the extensive past investment in infrastructure.

**Recommendations**

- 7.1 Fully implement the Financial Plan (Bravo, 2010) for greater financial sustainability
- 7.2 Investigate the potential for using international volunteers to fill identified technical skills gaps
- 7.3 Identify, source and install essential pa signs, marker and mooring buoys

## **3.4 Management Strategies**

### **3.4.2 Rules and Regulations**

Gladden Spit and Silk Cayes Marine Reserve (GSSCMR) is a multi-use Marine Protected Area, and is zoned for management purposes (General Use Zone, Conservation Zone I and Conservation Zone II), to allow regulated tourism and commercial fishing activities. SEA has designated a Whale Shark Zone during the whale shark season (March to July, for about 10 days after the full moon) that is carefully monitored for any infractions (Annex Three).

#### **Park Rules**

- Whale Shark fees shall be applied 1 March to 31 July, 2009.
- Any person who wishes to conduct whale shark tours must have a valid tour guide license, dive master certification (for SCUBA), skin diver certification (for snorkelers) and a certification for graduation from an approved whale shark course.
- Do not touch, walk, or anchor on the reef.
- Take your garbage with you.
- Dive, snorkel and fishing boats should maintain a distance of at least 200 (two hundred) feet between each other.
- No gloves or fishing are allowed when SCUBA diving.
- No destruction of natural habitat.
- No netfishing.
- No spearfishing.
- All boats must use the mooring buoys were provided.
- Read and Follow all signs and directions from the reserve.
- All local Fisheries, Wildlife, Forestry, Tourism, and Archaeological Laws apply.
- Do not tamper with posted signs, buoys or notices.
- Non– extractive recreational activities allowed such as snorkeling, diving, kayaking and sightseeing.

### **3.4.1 Management Constraints and Limitations**

During recent assessments of the organization over 2009 /2010, the transition period from FoN/TASTE to SEA (Walker, 2010), a number of management limitations and constraints were identified, and have been addressed within the management programmes. These include:

- The high staff turnover associated with the transition in management during and immediately after the merger provided challenges in maintaining continuity in some programme areas, and in reporting.
- Communication between Programmes is weak, with programme managers being unaware of other Programme activities, and limited sharing of information and collaboration between Programmes. This is particularly evident between the Education and Outreach and Science and Research Programmes.
- Stakeholder recognition of SEA as an organization was still relatively low. Primary stakeholders – fishermen, tour guides and the educational sector now recognize the new organization and its management and staff members. However, the wider local stakeholder community is not so familiar with the amalgamation, change in name, and roles and responsibilities. Even within Placencia, where the SEA office is located, many of the secondary stakeholders interviewed were unaware of the new organization.
- Dissemination of results was a weak area, with the delay of both the 2009 Annual Report and the State of Parks report. Dissemination of research, monitoring and management results to local community stakeholders, whilst flagged as an area requiring strengthening during management planning and management evaluation in 2009, still needs to be integrated effectively into the management framework.

### **3.4.2 Management Zones**

#### ***Boundaries***

The Gladden Spit and Silk Cayes Marine Reserve encompasses a total area of 26,000 acres (10,523 ha), with boundary demarcation by marker buoys (Map 12). The SI lays out the Rules and Regulations for each zone:

#### ***Zones***

The Marine Reserve currently has two zones, defined by SI 68 of 2000 (General Use Zone and Conservation Zone (Silk Cayes) (Annex 1), and a further Restoration Zone / Conservation Zone referred to in SI 95 of 2003 (Annex 2).

- General Use Zone;
- Conservation Zone I; and
- Conservation Zone II (Restoration Area and Spawning Area).

Overlapping this is the Spawning Aggregation Site, protected under SI 162 of 2003. The regulations for each zone are spelt out in the Statutory Instrument (Annex 2).

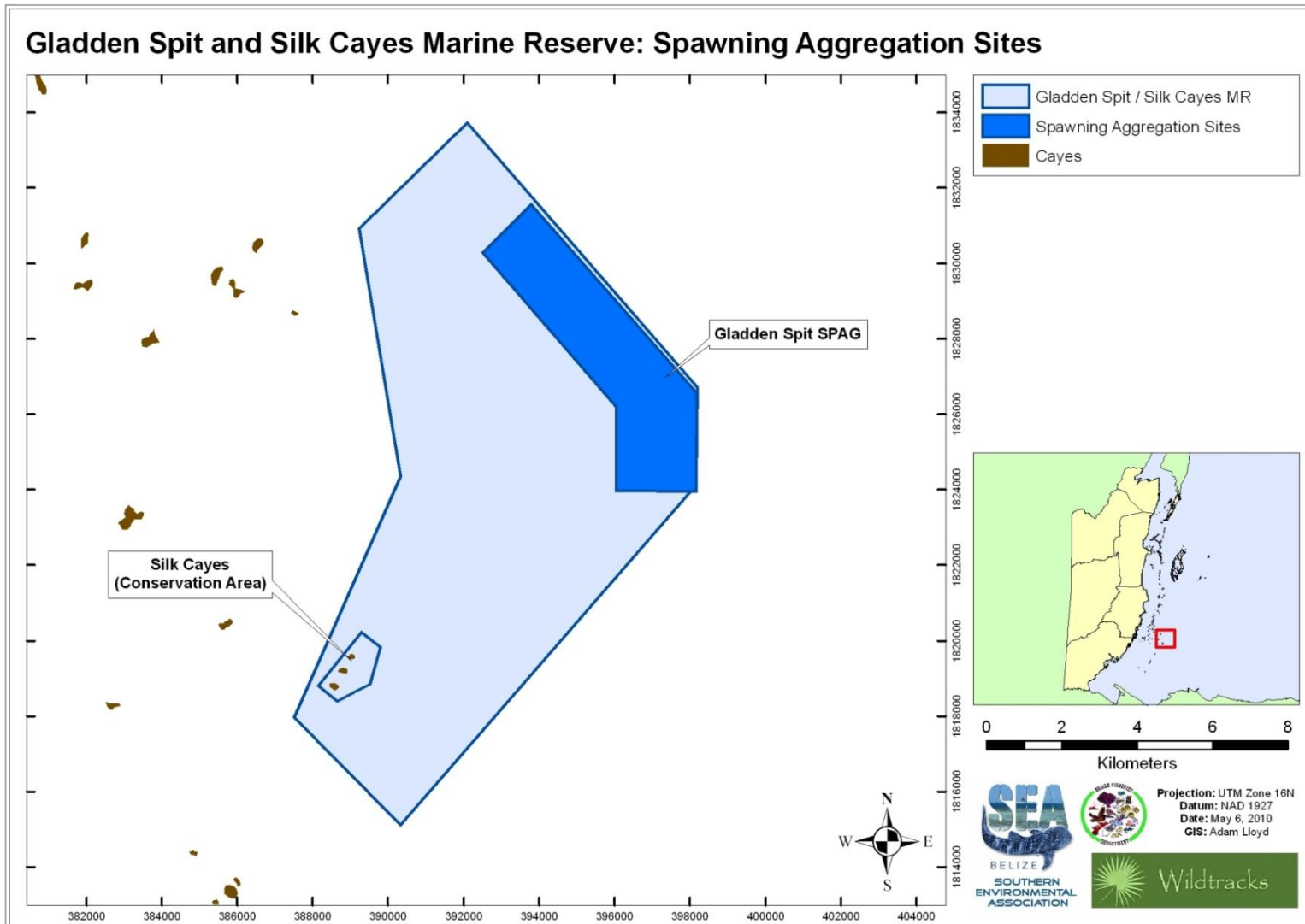
In 2006 an expansion of the entire protected area was proposed to include areas to the west and south of the existing protected area including the area around the Ranger Station at Little Water Caye. Although the legislative authority has not been finalized since that period this expanded area has been patrolled and enforced as if it was a part of the protected area.

Originally established to manage tourism and commercial fishing, the existing zones are now considered in need of review. The small size of the conservation zone is now considered by most to be insufficient to ensure adequate protection of key commercial and recreationally valuable species and habitat. A 2007 proposal was made to the fisheries department to expand the no-take area from 1.4% of the MPA area to closer to 40% (Map 13), to ensure the no-take Conservation Zone included the much larger range of habitats and ecosystems needed to fully protect biodiversity, promote viability, and assure maximum connectivity through larval and adult linkages (Carne, 2007). This expansion would provide the higher level of protection, something of increasing importance for successful mitigation of climate change impacts. The proposed extension of the no-take area would also include marine area around the Ranger Station on Little Water Caye increasing enforcement capabilities.

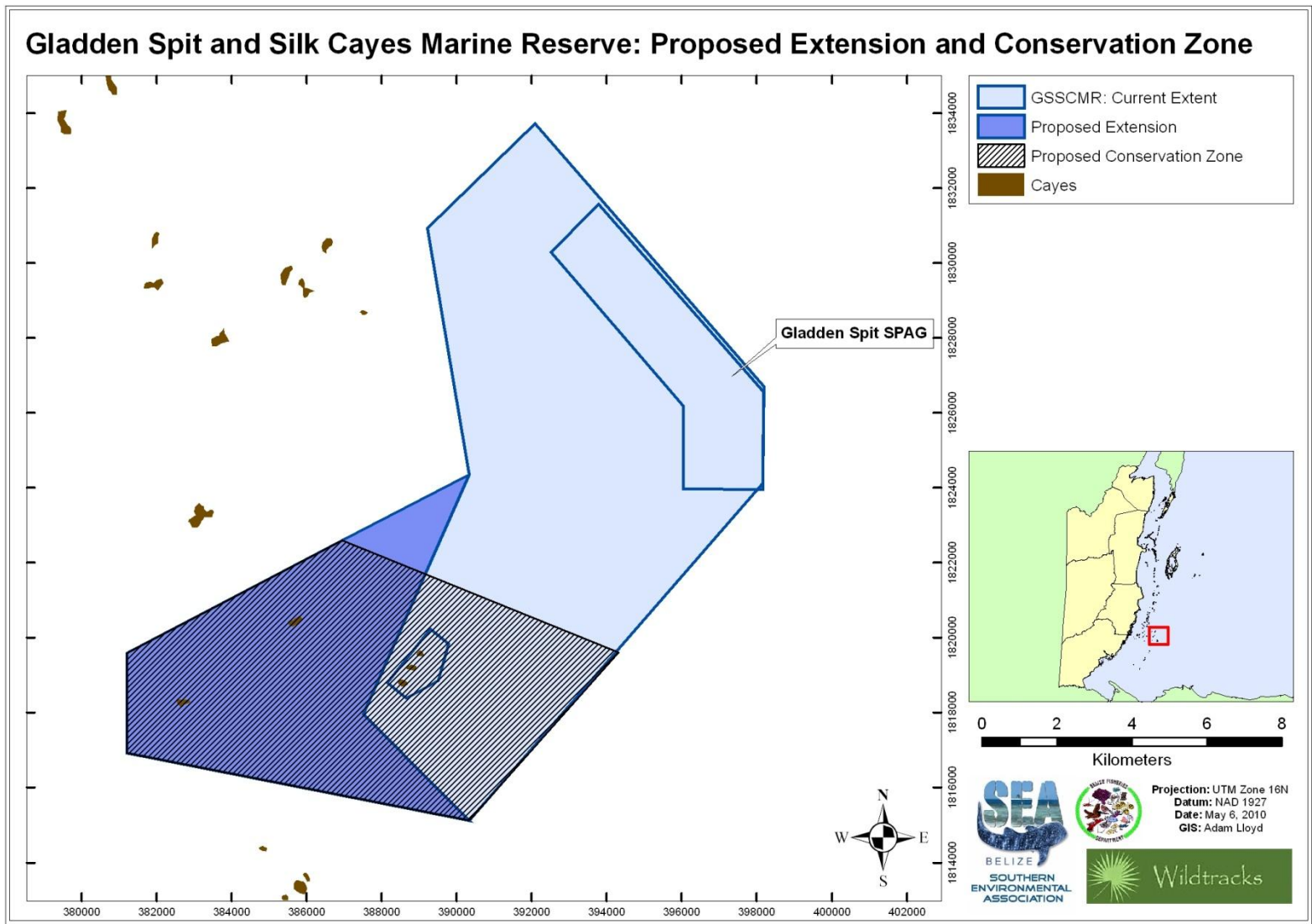
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***Recommendations:***

- The existing 2007 proposal should be reviewed and, if necessary, revised
- High resilience reef areas, source populations and key larval dispersal routes should be identified within and associated with the GSSCMR, and integrated into the decision making process
- The assessments required should be as participatory as possible, to engage stakeholders, increase their awareness of climate change, and develop support for any zone changes of mpa extension



Map 12: Gladden Spit and Silk Cayes Marine Reserve: Zones



Map 12: Gladden Spit and Silk Cayes Marine Reserve: Proposed Extension (Carne, 2007)



### **3.4.3 Limits of Acceptable Change**

At present there are no carrying capacities set for tourism activities within Laughing Bird Caye National Park. It has been recognized that this needs to be addressed, particularly in key dive sites and on the caye itself. Funding has been identified for limits of acceptable change planning, with strategies and monitoring activities to be defined during 2011.

### **3.5 Management Programmes and Objectives**

Management programmes are a means of grouping management objectives within related areas – for example, those related to natural resource management, or to public use. The strength of the combined programmes is greater than the sum of the individual programmes, as each supports the others over space and time, with areas of overlap that strengthen the overall management of the protected area. Also important are a number of strategies needed to be included to strengthen communication and collaboration between programme areas, inter-programme collaboration mechanisms for greater adaptive management effectiveness.

Six Management Programmes are identified under the National Protected Areas Policy and System Plan framework (NPAPSP, 2005):

- A. Natural Resource Management Programme**
- B. Research and Monitoring Programme**
- C. Education and Outreach Programme**
- D. Public Use Programme**
- E. Site and Infrastructure Management Programme**
- F. Administration Programme**

The conservation strategies outlined for Gladden Spit and Silk Cayes Marine Reserve in the conservation planning section of this management plan are integrated into the management programmes, as are the outputs of the climate change planning, contributing towards the adaptive management process. The strategies of the Southern Belize Reef Complex (of which GSSCMR is a component) are also integrated, to ensure that the GSSCMR fulfils its role in the seascape, assisting Fisheries Department, Forest Department and the Southern Environmental Association in ensuring the long-term conservation of the SBRC.

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Gladden Spit and Silk Cayes Marine Reserve Management Programmes					
Natural Resource Management Program	Research and Monitoring Programme	Education and Outreach Program	Public Use Program	Site and Infrastructure Management Program	Administration Program
Surveillance and enforcement	Research	Engagement and participation	Visitor management	Infrastructure	Communication and liaison
Reporting	Monitoring	Environmental education	Visitor education and interpretation	Equipment	Accounting
Stakeholder awareness of regulations	Training	Outreach and dissemination of information	Visitor safety	Maintenance	Human resource management
Impact mitigation	Communication and collaboration	Sustainable livelihoods and training	Visitor facilities		Financial sustainability
Conservation target management					

**Table 25:** Gladden Spit and Silk Cayes Marine Reserve Programme Areas

### **3.5.1 Natural Resource Management Programme**

The Natural Resource Management Programme focuses on ensuring the maintenance of healthy, functional ecosystems in the face of transboundary impacts and climate change, through surveillance and enforcement, and direct biodiversity management interventions where required. This Programme comes under the responsibility of the Protected Areas Manager and rangers, and deals with direct management of the marine environment, surveillance and enforcement. It is administered under three sub-programmes:

- **Effective Surveillance and Enforcement**
- **Impact Mitigation**
- **Conservation Target Management**

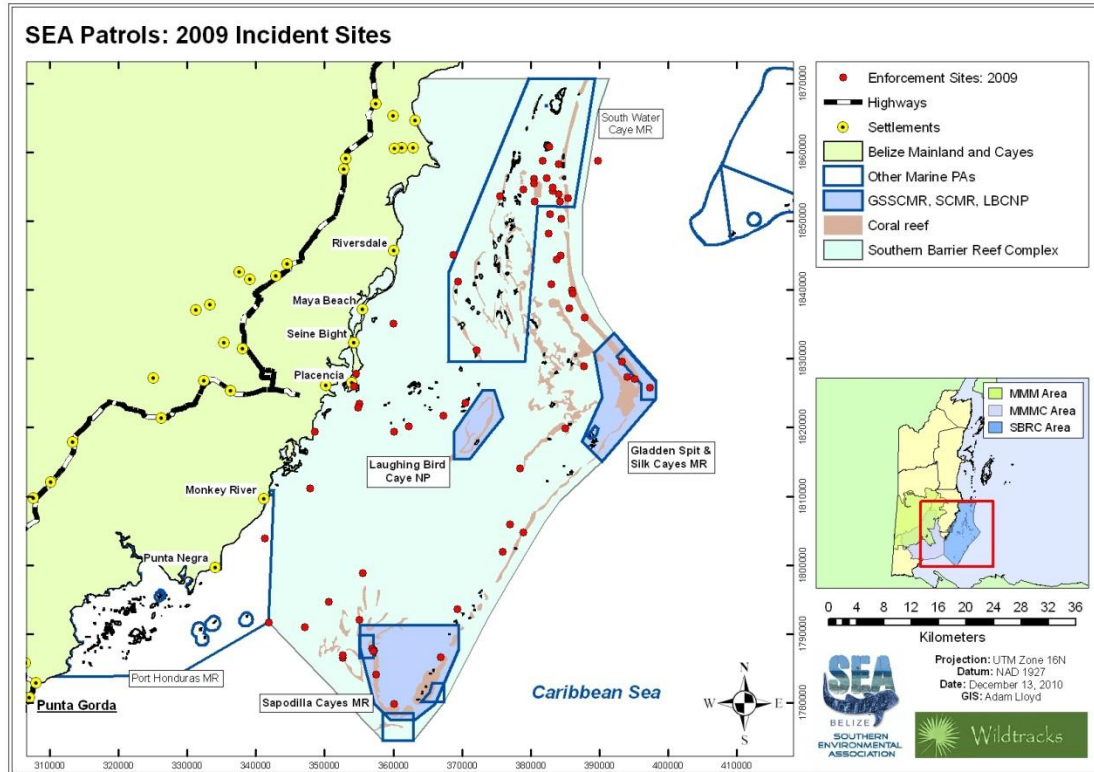
The Surveillance and Enforcement sub-programme at Gladden Spit and Silk Cayes Marine Reserve is managed by SEA, and is focused on supporting and upholding the Marine Reserve legislation, and to ensure fishing and tourism rules and regulations are enforced. This is supported by the Belize Fisheries Department.

Surveillance and enforcement efforts are also supported by the SEA Special Enforcement Unit, which is guided by mapping of enforcement hotspots (Map 13) within the wider SBRC, in collaboration with Fisheries Department and the Belize Coastguard, and focused on enforcing the Fisheries Legislation (Figure 36).

Specific activities to address identified limitations under this programme include:

- Increased surveillance and enforcement presence in the adjacent SBRC through doubling the current Special Enforcement Unit (a second boat, crew and fuel allowance)
- Effective management and enforcement of whale shark tourism
- Visitor impact mitigation within Gladden Spit and Silk Cayes Marine Reserve
- Implementation of more effective mechanisms for management of the invasive lionfish and other invasive species within the MPA and adjacent waters
- Identification of specific management strategies for addressing climate change
- Implement management activities for specific conservation targets

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**Map 13:** 2009 Patrol Incident Sites (SEA data)

Physical management of the natural resources, particularly those highlighted as conservation targets, is the responsibility of both the Natural Resource Management Programme staff (the on-site rangers and surveillance and enforcement teams) and the Science Programme staff, with both programs depending on collaboration and the integration of information collected to ensure adaptive management. Natural Resource Management staff implementing management activities targeted at maintaining and improving the viability of conservation targets need to have a clear understanding of the reasons behind these activities, with these activities being guided by the Science Programme, in close collaboration with the PA Director.

**CORAL:**

- It is illegal for any person to take, buy, sell or have in his possession any type of coral.
- An exception is made in the case of Black Coral (Order ANTIPATHARIA) which may only be bought, sold or exported with a licence from the Fisheries Administrator.

**BONE FISH (*Albulba vulpes*) locally known as MACABI:**

- No person should buy or sell, any Bone Fish.

**CONCH (*Strombus gigas*):**

- Shell length should exceed 7 inches.
- Market clean and fillet weight should exceed 3 and 2.75 ounces respectively.
- Closed season is from 1st July to 30th September.
- No fisherman shall buy, sell or possess diced conch meat

**LOBSTER (*Panulirus argus*):**

- Minimum cape length is 3 inches.
- Minimum tail weight is 4 ounces.
- Closed season is from 15th February to 14th June.
- No fisherman shall buy, sell or possess fillet or diced lobster tail, soft shell berried lobster or lobster with tar spot

**MARINE TURTLES:**

- No person should interfere with any turtle nest
- No person should take any species of marine turtle
- No person shall buy, sell, or have in his possession any turtle or articles made of turtle parts.

**NASSAU GROUPER:**

- No person shall take in the waters of Belize, buy, sell, or have in his possession any Nassau Grouper (*Epinephelus striatus*) between 1<sup>st</sup> December and 31<sup>st</sup> March
- No person shall take, buy, sell, or have in his possession any Nassau Grouper which is less than 20 inches and greater than 30 inches
- All Nassau Grouper are to be landed whole

**GRAZERS:**

- No person shall take in the waters of Belize, buy, sell, or have in his possession any grazer (*Scarus* and *Sparisoma*) and *Acanthuridae* Family, commonly known as parrot fish, angel fish and tangs.

**FISH FILLET**

- All fish fillet shall have a skin patch of at least 2 inches by 1 inch.

**SEA CUCUMBER:**

- No person shall fish for sea cucumber (donkey dung) without a special permit issued by the Fisheries Administrator and from July 1<sup>st</sup> to December 31<sup>st</sup> in any one year

**GENERAL**

- No person shall set traps outside the reef or within 300 feet of the Barrier Reef
- No spear fishing within marine reserves
- No fishing without a valid fisher folk or fishing vessel license
- No one should fish with scuba gear

**Figure 36:** Fisheries Legislation Regulations

**Gladden Spit and Silk Cayes Marine Reserve – Management Plan  
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Natural Resource Management Programme	
Effective Surveillance and Enforcement	
<b>Surveillance and Enforcement</b>	<ul style="list-style-type: none"> <li>▪ Ensure GSSCMR has the human resources, equipment and training for effective surveillance and enforcement</li> <li>▪ Ensure ongoing demarcation of mpa boundaries, for visual recognition of boundaries at all points by fishermen, with replacement of buoys when necessary</li> <li>▪ Ensure infrastructure is in place to minimize tourism infractions - signs, mooring buoys etc.</li> <li>▪ Ensure all GSSCMR staff are aware of the rules and regulations of the marine protected area, and trained for effective surveillance and enforcement</li> <li>▪ Ensure continued implementation / enforcement of non-extractive regulations within no-take zones of GSSCMR, with particular focus on:               <ul style="list-style-type: none"> <li>▪ Illegal fishing in Conservation Zones and spawning aggregation site</li> <li>▪ Illegal fishing of conch in Conservation Zone by tour guides</li> <li>▪ Illegal transboundary fishing incursions</li> </ul> </li> <li>▪ Strengthen visitor management, and enforcement of visitor rules and regulations</li> <li>▪ Implement policies and regulations for all tour boats:               <ul style="list-style-type: none"> <li>▪ Requirement for local guides and boat captains,</li> <li>▪ Use of mooring points,</li> <li>▪ Removal of garbage</li> </ul> </li> <li>▪ Enforce recreational policies and regulations in all zones:               <ul style="list-style-type: none"> <li>▪ Divers / snorkelers : licensed guide ratio (in collaboration with BTB)</li> <li>▪ Exclusion of jet ski and water-ski use within Marine Reserve</li> <li>▪ Mooring buoy-use regulations at dive sites and near cayes</li> <li>▪ Whale shark regulations for visitors, film crews and researchers</li> <li>▪ Overnight camping regulations</li> <li>▪ Sport fishing regulations</li> </ul> </li> <li>▪ Identify hotspot areas, times and visiting fishing boats requiring increased enforcement effort, using SEA enforcement data, and implement surveillance and enforcement times and locations accordingly</li> <li>▪ Identify hotspot areas, times and visiting boats / tour operators requiring increased enforcement effort, using SEA enforcement data, and implement enforcement of visitor regulations accordingly</li> <li>▪ Increase night patrols within GSSCMR</li> <li>▪ Support and uphold Fisheries regulations relevant to maintenance of commercial species within GSSCMR and the SBRC</li> <li>▪ Strengthening the permit process for fishermen using the Marine Reserve and the spawning aggregation sites, in collaboration with Fisheries Dept.</li> </ul>

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Natural Resource Management Programme	
Effective Surveillance and Enforcement	
<b>Surveillance and Enforcement</b>	<ul style="list-style-type: none"> <li>▪ Investigate the potential for increasing effectiveness of enforcement through use of on-the-spot automatic fines for violations, development of specific site-level policies and regulations (modelled on those of LBCNP) and better management of data to be able to identify and penalise repeat offenders, with ticketing system (3 tickets revokes site level license)</li> <li>▪ Ensure enforcement of research regulations within protected area</li> <li>▪ Continue to ensure effective management of local anthropogenic threats through community engagement and awareness programs, with increased awareness of best fishing and tourism practices among immediate resource users</li> <li>▪ Ensure effective surveillance and reporting of illegal development activities on cayes adjacent to the Marine Reserve, and in the wider SBRC generally</li> </ul>
<b>Staff</b>	<ul style="list-style-type: none"> <li>▪ Ensure adequate surveillance and enforcement staff on site at GSSCMR at all times</li> <li>▪ Ensure adequate surveillance and enforcement staff for SEA Special Enforcement Unit</li> <li>▪ Continue to engage and train local fishermen and tour guides as Fisheries Officers and Special Constables, to increase enforcement presence</li> </ul>
<b>Equipment and Training</b>	<ul style="list-style-type: none"> <li>▪ Ensure patrols are fully equipped and rangers fully trained for surveillance and enforcement activities (including night patrols and reliable radios installed on boats)</li> <li>▪ Ensure ranger station on Little Water Caye is equipped for effective enforcement activities – adequate communications, high staff satisfaction with facilities</li> <li>▪ Ensure staff are trained and equipped for enforcement of tourism regulations</li> </ul>
<b>Reporting</b>	<ul style="list-style-type: none"> <li>▪ Maintain patrol log books for GSSCMR</li> <li>▪ Maintain logs of boat presence within GSSCMR</li> <li>▪ Maintain logs of visitor data and recording of entrance fees</li> <li>▪ Produce quarterly reports, and submit to Fisheries Department and SEA</li> <li>▪ Produce annual reports and submit to Fisheries Department and SEA Board</li> <li>▪ Continue to strengthen mechanisms to monitor and track infractions, including incorporation of GIS into patrol reports – both extraction and tourism</li> </ul>



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Natural Resource Management Programme	
Effective Surveillance and Enforcement	
<b>Collaboration</b>	<ul style="list-style-type: none"> <li>▪ Work closely with Port Authority, Coast Guard and DoE towards mitigation of potential groundings including the installation of marker and mooring buoys where necessary for reducing boat impacts on reef</li> <li>▪ Strengthen collaboration of SEA and Fisheries Department and strengthen effective enforcement – application of laws and regulations</li> <li>▪ Strengthen collaborative enforcement (fishermen, SEA, Fisheries Dept., TIDE Coastguard, BDF, police dept etc.) against incursions, both within and outside the MPA – with strengthening of Special Enforcement Team</li> <li>▪ Strengthen collaboration with Belize Tourism Board for effective enforcement of Tourism Legislation within GSSCMR</li> </ul>
<b>Awareness of Regulations</b>	<ul style="list-style-type: none"> <li>▪ Increase staff awareness of the benefits of marine protected areas – and specifically GSSCMR</li> <li>▪ Ensure all tour guides and fishermen are aware of location, rules and regulations and rationale for the Marine Reserve</li> <li>▪ Increase awareness of visiting live-aboard boats on the rules and regulations of Gladden Spit and Silk Cayes Marine Reserve - specifically the non extractive designation</li> <li>▪ Increase community awareness of the benefits of marine protected areas - particularly GSSCMR</li> <li>▪ Engage fishing stakeholders of the SBRC, increasing stakeholder awareness and participation, and understanding of the function of no-take zones and spawning aggregation site of GSSCMR as source areas, increasing respect for the no take regulations</li> <li>▪ Engage and partner with tourism stakeholders, increasing stakeholder awareness and participation</li> <li>▪ Inform all visitors of general rules and regulations when visiting the Marine Reserve through installation of an information board on Silk Cayes, distribution of brochures, and handouts and other educational material</li> <li>▪ Ensure all tour operators and tour guides are fully aware of the whale shark regulations</li> <li>▪ Outreach to stakeholder communities increasing awareness of the importance of marine protected areas, with dissemination of data on densities of conch and lobster inside and outside functional reserves</li> </ul>

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Natural Resource Management Programme	
Impact Mitigation	
<b>Solid Waste and Water Contamination</b>	<ul style="list-style-type: none"> <li>▪ Ensure effective waste management through design and implementation an effective waste management plan for the Silk Cayes and Little Water Caye rangers station</li> <li>▪ Ensure visitors facilities at Silk Cayes, staff facilities on Little Water Caye have a septic system designed, located and maintained to minimize risk of water contamination</li> <li>▪ Develop ‘Best Practice Guidelines’ for caye developers, owners and residents of cayes adjacent to GSSCMR and in the wider SBRC, to advise on wastewater management, chemical use and storage, etc.</li> <li>▪ Ensure all ships passing through SBRC are following anti-pollution regulations whilst in Belize territorial waters, in collaboration with Port Authority and DoE</li> <li>▪ Strengthen links with Department of the Environment for rapid response to pollution events</li> <li>▪ Develop and implement strategies to regulate the waste generated by visiting boats (solid / grey water waste) in collaboration with Port Authority and DoE</li> <li>▪ Partner with organizations seeking to mitigate agrochemical contamination of water bodies from land-based sources through promotion of better practices in agrochemical use</li> <li>▪ Ensure safe storage of oil and chemicals on Little Water Caye, especially during storm events, and lobby for adoption of best practices in fuel and chemical storage on the other cayes of within the SBRC</li> </ul>
<b>Development and Best Practices</b>	<ul style="list-style-type: none"> <li>▪ Promote guidelines and best management practices among staff, resource users, and visitors</li> <li>▪ Engage landowners of adjacent cayes in management, protection and restoration of littoral forest, mangrove and beach vegetation</li> <li>▪ Collaborate with Forest Dept and DoE to ensure compliance with development legislations on cayes adjacent to GSSCMR</li> <li>▪ Work closely with DOE, Forest Department, etc. to ensure enforcement of all relevant policies and regulations for development activities on the cayes adjacent to the Marine Reserve (dredging of sand/coral, clearance of mangroves, water quality and sedimentation)</li> <li>▪ Work with developers and government agencies to ensure effective monitoring of environmental impacts from developments and compliance with guidelines on cayes adjacent to GSSCMR and in the wider SBRC</li> <li>▪ Develop general guidelines to assist in review of environmental assessments and EIAs for future developments proposed for the SBRC</li> </ul>

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Natural Resource Management Programme	
Impact Mitigation	
<b>Development and Best Practices</b>	<ul style="list-style-type: none"> <li>▪ Identify and implement best means of liaising with caye developers and landowners of cayes adjacent to the GSSCMR / in the wider SBRC - areas of conflict and mutual assistance</li> <li>▪ Raise awareness of role of mangroves, littoral forest, seagrass, corals, and methods of limiting development impacts (sedimentation - erosion following land clearance; wastewater, sewage and solid waste disposal) targeted at cayes adjacent to GSSCMR and in the wider SBRC</li> </ul>
<b>Petrochemical Issues</b>	<ul style="list-style-type: none"> <li>▪ Lobby for exclusion of marine protected areas – including GSSCMR - from oil exploration concession areas</li> <li>▪ Maintain close communication with Department of Geology and petroleum concession holders to provide accurate information to inform management</li> <li>▪ Develop a proactive strategy to address imminent implementation of oil exploration activities within or adjacent to the Marine Reserve</li> <li>▪ Lobby for creation / adoption of navigation and oil exploration / extraction standards as needed, and enforce all such regulations</li> <li>▪ Work with local and national partners to develop an oil spill response plan in collaboration with DoE for mitigation of oil or chemical spills within the SBRC</li> </ul>
<b>Invasive Species</b>	<ul style="list-style-type: none"> <li>▪ Work with national partners to develop and implement a comprehensive plan for management of lionfish</li> <li>▪ Increase awareness in staff, and tour guides of the potential impacts of lionfish</li> <li>▪ Strengthen stakeholder and staff engagement, support and participation in lionfish removal and use</li> <li>▪ Promote lionfish as a marketable species</li> <li>▪ Increase staff and tourism stakeholder awareness of invasive nature of <i>Casuarina</i>, and remove any individuals of this species from GSSCMR, particularly on identified turtle nesting beaches</li> </ul>
Conservation Target Management	
<b>General</b>	<ul style="list-style-type: none"> <li>▪ Strengthen mechanisms to ensure consistent communication between programmatic areas to support overall adaptive management of GSSCMR and the SBRC</li> <li>▪ Ensure clear communication, liaison and collaboration between rangers and science staff for the effective management of conservation targets</li> <li>▪ Ensure staff are aware of the conservation targets and the role of enforcement and surveillance in ensuring their effective management</li> </ul>

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Natural Resource Management Programme	
Conservation Target Management	
<b>General</b>	<ul style="list-style-type: none"> <li>▪ Strengthen collaboration with partners towards implementation of coral reef and mangrove restoration programs in GSSCMR and the wider SBRC</li> <li>▪ Identify and protect key nursery grounds (for all priority marine species) from extraction / damage</li> </ul>
<b>Coral Reef</b>	<ul style="list-style-type: none"> <li>▪ Identify and increase protection of high resilience reef areas, source populations and key larval dispersal routes within and associated with the GSSCMR, in response to climate change research outputs</li> <li>▪ Designate and enforce specific mooring sites and boat access channels to reduce mechanical impacts on corals by boats</li> <li>▪ Ensure adequate protection of key herbivores to maintain live coral cover and ecological functions</li> <li>▪ Develop initiatives to increase awareness of the importance of parrotfish to the health of the reef among key stakeholders</li> </ul>
<b>Commercial Species</b>	<ul style="list-style-type: none"> <li>▪ Continue to develop and implement effective mechanisms to ensure a sustainable fishing industry in Belize with close collaboration between SEA and Fisheries Department</li> <li>▪ Investigate and implement managed access, quotas and other mechanisms for increasing gain for traditional users within GSSCMR, where feasible</li> <li>▪ Investigate feasibility of extending the GSSCMR to include Little Water Caye, with a increased no take zone</li> <li>▪ Investigate feasibility of declaration of SBRC as a managed access traditional fishing area</li> <li>▪ Investigate the feasibility of implementing a seasonal closure zone to enable fish stocks to improve</li> <li>▪ Collaborate with NGO and GoB partners to develop potential supplemental / complimentary income generation opportunities for fishing stakeholders</li> <li>▪ Investigate certification system for local restaurants that follow best practices in purchasing lobster, conch and fin-fish species (size, season and species regulations), with information for tourists on how to dine 'ethically' in Punta Gorda, Placencia and coastal resorts</li> <li>▪ Engage fishermen more effectively in management of fish stocks within the mpa</li> </ul>
<b>Spawning Aggregation</b>	<ul style="list-style-type: none"> <li>▪ Ensure clear permit and approval processes are in place for traditional fishermen using the spawning aggregation site</li> <li>▪ Revision of licensing mechanism to regulate fishing at the spawning aggregation site for increased sustainability</li> <li>▪ Ensure adequate surveillance and enforcement of the spawning aggregation site and fishermen active at site, including license checks, night patrols etc.</li> </ul>

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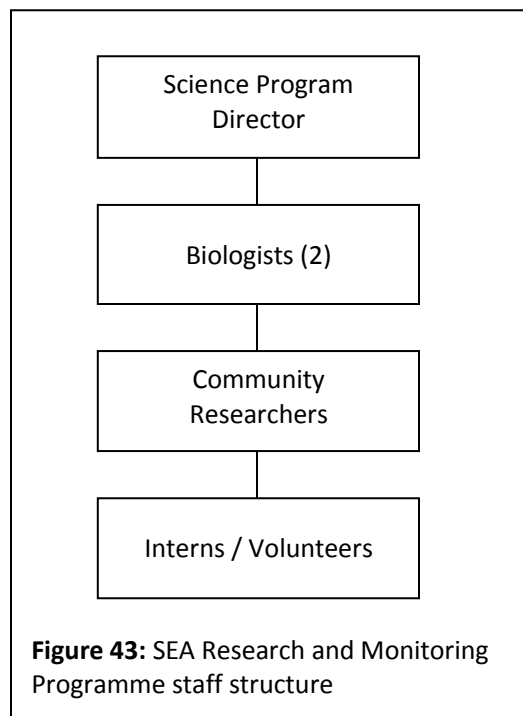
Natural Resource Management Programme	
Conservation Target Management	
<b>Herbaceous Beach Vegetation / Mangroves</b>	<ul style="list-style-type: none"> <li>▪ Protect nesting and roosting bird populations through engagement of rangers, tour guides, control of visitor access and effective surveillance and enforcement</li> <li>▪ Ensure maintenance of natural vegetation on Middle and North Silk Cayes within the GSSCMR</li> <li>▪ Investigate potential of purchasing littoral forest / mangrove area of little Water Caye and place into protection</li> </ul>
<b>Sandy Beaches</b>	<ul style="list-style-type: none"> <li>▪ Identify, adopt and implement guidelines for managing marine turtle nesting on the Silk Cayes and Little Water Caye, with training for rangers, visitor awareness, and demarcation of turtle nesting areas, to prevent direct impacts from tourism (WIDECASST Technical Report No. 9: Best Practices for Sea Turtle Nesting Beaches)</li> <li>▪ Ensure all external lights used at the GSSCMR facilities on Little Water Caye are turtle-friendly - low pressure sodium lights, with a wavelength of between 560 - 620nm</li> <li>▪ Engage land owners, leaseholders and developers within the wider SBRC, and lobby for stakeholder management of turtle nesting beaches, with implementation of WIDECASST Best Practices</li> <li>▪ Liaise with regional and international turtle conservation initiatives</li> </ul>
<b>Sharks</b>	<ul style="list-style-type: none"> <li>▪ Strengthen protection of trophic structure through maintenance of top predators, with targeted surveillance and enforcement</li> <li>▪ Investigate feasibility of declaring SBRC as a shark sanctuary</li> <li>▪ Ensure regulations on no feeding of sharks are fully enforced</li> </ul>

### **3.5.2 Research and Monitoring Programme**

Research and monitoring are essential activities to ensure informed, effective management, and to assess the effectiveness of the Marine Reserve in achieving its objectives. The Research and Monitoring Programme (or Science Programme) comes under the responsibility of the Science Program Director, and is administered under four sub-programmes:

- **Research**
- **Monitoring**
- **Training**
- **Collaboration and Communication**

The Programme is guided in part by the SEA Marine Monitoring Manual (SEA, 2010) which standardizes monitoring strategies to improve SEA's monitoring efforts, and provides the biological monitoring strategy for all three of the SEA managed protected areas. It identifies monitoring protocols and responsibilities for the MPA, and incorporates the monitoring and research goals of the Southern Belize Reef Complex Conservation Action Plan (Wildtracks, 2008). Whilst this is comprehensive in terms of current monitoring protocols, there is still a need to incorporate a mechanism to assess the resilience of the three marine protected areas and the wider SBRC to climate change and identify critical source areas, and ensure the integration of these into future planning.



Many of the methods in the Monitoring Plan were developed under the Mesoamerican Barrier Reef System (MBRS) synoptic monitoring programme, the Belize Fisheries Department and the 'LAMP' protocols developed by Wildlife Conservation Society. SEA is an active member of the Spawning Aggregation Working Group and Belize Coral Reef Monitoring Network, both of which work to improve standardized data collection and collaboration between organizations working in the marine protected area system.

Management of the conservation targets is not just the responsibility of the Science Programme - it also depends on effective communication and collaboration between the science team and the other programmes and stakeholders, to ensure clear understanding of the reasons behind targeted management or enforcement strategies. This includes active

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engagement by the science team in the activities of the education and outreach programs to ensure increased public awareness and involvement in management of Gladden Spit and Silk Cayes Marine Reserve.

Several areas have been identified as priorities for research and monitoring activities, either through the development of conservation planning actions, or in response to specific research or monitoring requirements:

1. To develop specific research and monitoring activities and strategies to address climate change issues
2. To develop standards for the Limits of Acceptable Change (LAC) Programme and implement a dedicated LAC monitoring programme
3. To communicate and collaborate effectively with other SEA programmes, for sharing of information and to link enforcement activities and environmental impacts
4. To increase communication, cooperation and coordination with other conservation organizations and research partners involved in management, research and monitoring on the Belize reef – particularly in the Southern Belize Reef Complex
5. To ensure effective dissemination of results in formats that are accessible to a wide variety of stakeholders

Gladden Spit and Silk Cayes Marine Reserve has been the focus of a number of independent research initiatives, particularly on the whale sharks and spawning aggregation site. For independent researchers, research proposals are reviewed by the Fisheries Departments, and SEA, and if approved, a research license is granted, valid for one year.

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Research and Monitoring Programme	
<b>General</b>	
<b>General</b>	<ul style="list-style-type: none"> <li>▪ Ensure the SEA Research and Monitoring Programme is equipped and staffed for effective programme management and strategy implementation</li> <li>▪ Ensure integration of SEA Science team and national monitoring priorities for effective coordination of research and monitoring activities</li> <li>▪ Increased communication and sharing of information through inter-programme collaboration mechanisms for strategy integration and greater adaptive management effectiveness</li> <li>▪ Consolidate information on the cultural and archaeological resources of the protected area</li> </ul>
<b>Research</b>	
<b>General Research</b>	<ul style="list-style-type: none"> <li>▪ Ensure collaboration and liaison between Fisheries Department and SEA during the process of granting research licenses</li> <li>▪ Develop a written agreement for research use of the area, including rules, regulations and guidelines, to be signed by all researchers using the Marine Reserve – including SEA staff</li> <li>▪ Ensure all research conducted within Gladden Spit and Silk Cayes Marine Reserve keeps to the rules and regulation and agreed research protocols, including research conducted by SEA and its research partners,</li> <li>▪ Integrate monitoring and research results into the adaptive management process</li> <li>▪ Ensure information on cultural and archaeological resources within the GSSCMR and SBRC generally are collated and accessible, including position and condition of wrecks</li> </ul>
<b>Priority Research</b>	<ul style="list-style-type: none"> <li>▪ Ensure adequate baseline is available for management decisions – especially related to climate change adaptation</li> <li>▪ Update ecosystem mapping for the Marine Reserve</li> <li>▪ Identify priority research activities in the GSSCMR from conservation planning and adaptive management requirements, and identify partners / locate funding for implementation</li> <li>▪ Identify priority research activities in the GSSCMR from climate change assessment and planning, and identify partners / locate funding for implementation</li> <li>▪ Continue to update baseline species lists for fish, whale sharks, corals, birds and other vertebrates and invertebrates of the protected area</li> <li>▪ Disseminate list of priority research activities to research stakeholders active within the SBRC</li> <li>▪ Assessment of shark species and populations within GSSCMR, as part of a larger SBRC initiative</li> </ul>



**Gladden Spit and Silk Cayes Marine Reserve – Management Plan  
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Research and Monitoring Programme	
Research	
<b>Priority Research</b>	<ul style="list-style-type: none"> <li>▪ Support research that investigates lionfish impacts on coral reef ecosystems and fish populations</li> <li>▪ Continue to train fishermen for more effective collection of landings data</li> <li>▪ Investigate incentives system to encourage fishermen to participate in monitoring of landings data (e.g. fuel coupons, as used at Glover’s Reef)</li> </ul>
Monitoring	
<b>General</b>	<ul style="list-style-type: none"> <li>▪ Continue implementing an effective, standardized monitoring and data management program for the GSSCMR and wider SBRC area, as outlined by the SEA Monitoring Plan</li> <li>▪ Engage SEA rangers in monitoring and research activities wherever possible</li> <li>▪ Integrate monitoring of Conservation Planning indicators into the existing SEA monitoring framework</li> <li>▪ Integrate monitoring for climate change within the SEA monitoring framework</li> <li>▪ Integrate monitoring for SBRC indicators within the SEA monitoring framework</li> <li>▪ Integrate monitoring of Acceptable Change parameters within the SEA monitoring framework</li> <li>▪ Integrate monitoring of turtle activity within the marine environment of GSSCMR within the SEA monitoring framework</li> <li>▪ Strengthen monitoring of birds (nesting / resident and migratory) with integrated training in species recognition for SEA biologists and rangers</li> <li>▪ Ensure mechanisms are in place for easy access to monitoring data and quarterly data summaries</li> <li>▪ Implement effective water quality monitoring programme in GSSCMR, Little Water Caye and the wider SBRC</li> <li>▪ Implement effective water quality monitoring of ground water on Silk Cayes and Little Water Caye</li> </ul>
<b>Monitoring of Impacts</b>	<ul style="list-style-type: none"> <li>▪ Develop rapid assessment mechanisms that engage staff and stakeholders, for assessing and monitoring impacts such as ship groundings, disease outbreaks, oil spills etc.</li> <li>▪ Ensure post impact assessments are conducted and reports produced and disseminated for all impact events – eg. earthquakes, hurricanes, boat groundings</li> </ul>

**Gladden Spit and Silk Cayes Marine Reserve – Management Plan  
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Research and Monitoring Programme	
Monitoring	
<b>Monitoring of Impacts</b>	<ul style="list-style-type: none"> <li>▪ Monitor run-off from the central and southern coastal plain, and northern Honduras / Guatemala during extreme storm events using remote sensing information (NOAA website / SERVIR, ICRAN-MAR), and assess impacts on GSSCMR</li> <li>▪ Prioritize monitoring of agrochemical contamination in water / tissue samples</li> <li>▪ Monitor nutrient levels and relative algal growth on a regular basis to monitor anthropogenic impacts, particularly in high visitor-use areas - adjacent to the Silk Cayes, mooring buoys and popular dive</li> <li>▪ Monitor presence and density of lionfish population</li> <li>▪ Develop indicators for Limits of Acceptable Change monitoring of visitor impacts</li> </ul>
<b>Research and Monitoring for Climate Change</b>	<ul style="list-style-type: none"> <li>▪ Continue monitoring for coral bleaching, with input into Mesoamerican Coral Reef Watch Programme (through ECOMAR) for early reporting of bleaching episodes</li> <li>▪ Identify resilient areas within the SEA's marine protected areas in the context of the greater Southern Belize Reef Complex</li> <li>▪ Review and re-evaluate MPA boundaries and zoning in the Southern Belize Reef Complex</li> <li>▪ Identify coral recruitment sources for GSSCMR, and identify mechanisms to ensure that these are adequately protected, if necessary</li> <li>▪ Characterize water currents critical for coral recruitment at GSSCMR</li> <li>▪ Establish monitoring protocols that inform management for building reef resilience</li> <li>▪ Investigate mechanisms for direct interventions – eg. coral nurseries, shading of key sites, promoting higher herbivore densities</li> <li>▪ Work closely with national and international partners to monitor climate change effects and identify appropriate national and regional management strategies</li> <li>▪ Integrate collection of coral fragments into post-impact (hurricane, boat grounding) assessment activities for incorporation into coral restoration programme</li> </ul>
<b>Socio Economic Monitoring</b>	<ul style="list-style-type: none"> <li>▪ Effectively access and use baseline information from Conservation International (MMAS) on the socio-economic context of the protected area (CI / Catzim et. al. 2009)</li> <li>▪ Maintain and update accurate socio-economic data on GSSCMR stakeholder communities</li> </ul>

**Gladden Spit and Silk Cayes Marine Reserve – Management Plan  
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Research and Monitoring Programme	
<b>Monitoring</b>	
<b>Monitoring of Conservation Action Planning Indicators</b>	<ul style="list-style-type: none"> <li>▪ Extent of natural vegetation</li> <li>▪ Number of <i>Casuarina</i> trees</li> <li>▪ Number of turtle nests</li> <li>▪ Number of successful turtle hatches</li> <li>▪ Extent of seagrass</li> <li>▪ Condition of seagrass</li> <li>▪ Densities of conch</li> <li>▪ Live coral cover</li> <li>▪ Recent mortality</li> <li>▪ Recent coral recruitment</li> <li>▪ Herbivorous fish density</li> <li>▪ <i>Diadema</i> density</li> <li>▪ Abundance of sharks</li> <li>▪ Number of whale sharks using Gladden Spit</li> <li>▪ Densities of lobster</li> <li>▪ Densities of target finfish species</li> <li>▪ Number of fishing incursions / violations in not-take zone</li> <li>▪ Number of species using spawning aggregation site</li> <li>▪ Number of individuals per species using spawning aggregation site</li> <li>▪ Number of shark species and individuals using GSSCMR</li> </ul>
<b>Training</b>	
<b>Training</b>	<ul style="list-style-type: none"> <li>▪ Ensure all staff (particularly rangers) understand the reasons behind research and monitoring</li> <li>▪ Ensure all staff are aware of, and can articulate, major research and monitoring outputs (state of reef, state of fish resources etc.)</li> <li>▪ Ensure any new biologists are trained in monitoring protocols, species identification and data management</li> <li>▪ Train staff and rangers in identification of key species (particularly nesting birds)</li> </ul>
<b>Data Management and Dissemination</b>	
<b>Data management</b>	<ul style="list-style-type: none"> <li>▪ Maintain database of GIS data, research and monitoring information in order to enhance the level of coordination between researchers, help identify gaps in information, and to provide a platform from which the results can be communicated to a wider audience</li> <li>▪ Improve mechanisms to integrate surveillance and enforcement and biological monitoring information</li> <li>▪ Strengthen mechanisms for accessing monitoring and research outputs</li> </ul>

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Research and Monitoring Programme	
Communication and Collaboration	
<b>Communication</b>	<ul style="list-style-type: none"> <li>▪ Continue presenting monitoring results in annual reports, and integrate into the adaptive management cycle</li> <li>▪ Use available forums for dissemination of results (eg. workshops, conferences, school visits, tour guide meetings.</li> <li>▪ Develop digital library of all published work on Gladden Spit and Silk Cayes Marine Reserve and make available, where feasible, for download on line</li> <li>▪ Ensure results of monitoring and research outputs are available to staff at GSSCMR and to other SEA Program Managers</li> </ul>
<b>Collaboration</b>	<ul style="list-style-type: none"> <li>▪ Strengthen communication and collaboration between the Science Programme and other SEA programme areas</li> <li>▪ Strengthen communication and collaboration with coral restoration / reef resilience partners</li> <li>▪ Strengthen communication and collaboration with other current and future research partners</li> <li>▪ Develop / strengthen mechanisms for tour guides and other stakeholders to participate in monitoring activities of turtles, coral bleaching and lionfish management</li> <li>▪ Engage BTB and BTIA in climate change adaptation planning</li> </ul>

### **3.5.3 Education and Outreach Programme**

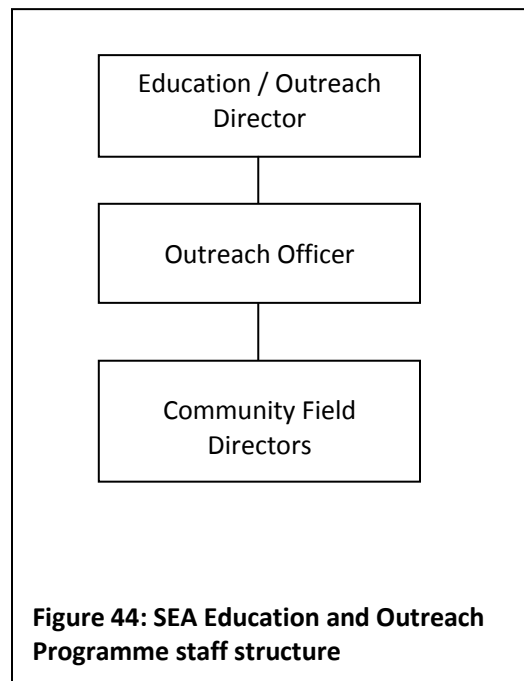
Community engagement through outreach, education and participation is a critical component of protected areas management in Belize, and has been incorporated into the management of the Gladden Spit and Silk Cayes Marine Reserve since the first co-management agreement between Friends of Nature and the Belize Fisheries Department. This is now continuing under SEA, with the SEA Education and Outreach and Education Programme focused on stakeholder engagement and increased awareness, to address the need to develop a comprehensive understanding among stakeholders of all ages about the importance of marine conservation and marine protected area management. The Education and Outreach Programme falls under the responsibility of the Education and Outreach Program Director, and is administered under four sub-programmes:

- **Engagement and Participation**
- **Environmental Education**
- **Outreach and Dissemination of Information**
- **Sustainable Livelihoods and Training**

Effective management of Gladden Spit and Silk Cayes Marine Reserve will depend on informed and engaged stakeholder groups. SEA has worked closely with stakeholder communities to raise awareness of priority issues relating to marine protected areas management, and address the need for alternative livelihood options and increased community capacity.

Engagement of tour guides, fishermen and the educational sector has been a key focus of management strategies since the establishment of the Marine Reserve, with stakeholder representation and participation in management decisions at Board level, and training for participation in management activities such as surveillance and enforcement, and monitoring and research, increasing stakeholder support for the management activities of Gladden Spit and Silk Cayes Marine Reserve.

This has been largely through project-based funding for isolated projects - the development of an integrated, five year Community Participation and Engagement Plan will support management and enhance SEA's capacity to implement and support a variety of projects.



## **Gladden Spit and Silk Cayes Marine Reserve – Management Plan 2011-2016**

A comprehensive understanding of local needs will allow for better adaptive management. This will also include the development of alternative economic incentives for local stakeholders and other programs targeted at increasing the sustainability of natural resources within Belize.

Environmental education has always been a core component of the activities of both FoN and TASTE, and has illustrated the impact that hands-on experience of the coral reefs can have on participants of all ages – but particularly for upper primary level students. In 2010, SEA trained 60 Field Directors, and took over 400 students from twelve schools to the reef. School activities within the Marine Reserve, and with stakeholder schools, provide students with valuable hands-on experiences and an increased understanding of marine resource management. These activities build supportive stakeholder components within the community, motivated towards a more positive impact on the environment. Built on the successes of past initiatives to strengthen understanding of marine ecology and stewardship, the programme increases collaboration with stakeholder schools, and builds the understanding and capacity of local teachers and parents. SEA has been successful in developing a cadre of trained adult “field directors” in the schools and communities who have the capacity to participate in field visits to the Marine Reserve, increasing SEAs capacity to reach out to its younger stakeholders, and to other community members.

**Gladden Spit and Silk Cayes Marine Reserve – Management Plan  
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Education and Outreach Programme	
Engagement and Participation	
<b>General</b>	<ul style="list-style-type: none"> <li>▪ Develop a Community Participation and Engagement Plan to guide activities within a framework of goals, objectives and targets aligned to target audiences, with input from other SEA programme managers</li> <li>▪ Engage tourism and fishing stakeholders from key communities through increased awareness, participation and communication</li> <li>▪ Engage schools in key stakeholder communities through increased awareness activities, participation and communication</li> <li>▪ Identify and implement mechanisms that will increase stakeholder economic benefits from the protected area – both national and transboundary – added value to trips etc.</li> </ul>
<b>Participation</b>	<ul style="list-style-type: none"> <li>▪ Encourage active participation of Board members in management activities and events</li> <li>▪ Identify and implement mechanisms to increase stakeholder involvement in management and participation in decision making</li> <li>▪ Continue to engage and train tour guides and fishermen in surveillance activities</li> <li>▪ Develop and implement mechanisms for participation of tour guides in monitoring activities of turtles, coral bleaching and lionfish</li> <li>▪ Engage new sectors – the hotel industry, restaurants, and other businesses, within the stakeholder footprint</li> <li>▪ Develop certification of best practices system for companies...tour operators, restaurants, live aboard operators etc....and highlight these at promotional events, through SEA information flyers and other mechanisms</li> </ul>
Environmental Education	
<b>Primary and Secondary Schools</b>	<ul style="list-style-type: none"> <li>▪ Give presentations targeting primary and secondary schools in stakeholder communities on the SEA marine protected areas and their environmental and socio economic benefits</li> <li>▪ Liaise and collaborate with local NGOs and other SBRC partners (SWCMR, TIDE, Fisheries Dept) for joint educational outreach to schools in stakeholder communities</li> <li>▪ Ensure continued communication and collaboration with schools, to build on past successes</li> <li>▪ Provide ongoing field trips for students to the reef, to invest in the engagement of future decision-makers</li> </ul>

**Gladden Spit and Silk Cayes Marine Reserve – Management Plan  
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Education and Outreach Programme	
Outreach and Dissemination of Information	
<b>Public Awareness</b>	<ul style="list-style-type: none"> <li>▪ Continue raising awareness in all stakeholders of the benefits of Gladden Spit and Silk Cayes Marine Reserve</li> <li>▪ Encourage greater visitation by local visitors and school groups through organized and guided day trips, school visits and other mechanisms</li> <li>▪ Ensure continued production and distribution of brochures on Gladden Spit and Silk Cayes Marine Reserve, incorporating key biodiversity and ecosystem values, goals and rules and regulations</li> <li>▪ Develop and implement targeted public awareness programmes that address specific issues including, but not limited to:               <ul style="list-style-type: none"> <li>▪ Goals and Objectives of Gladden Spit and Silk Cayes Marine Reserve</li> <li>▪ Goals and Objectives of the Southern Environmental Association</li> <li>▪ Whale sharks</li> <li>▪ Lionfish</li> <li>▪ Coral Bleaching</li> <li>▪ Climate Change</li> <li>▪ Mangroves</li> <li>▪ Manatee Conservation</li> <li>▪ Marine protected areas and maintenance of sustainable fish stocks</li> <li>▪ Value of GSSCMR no-take zones</li> <li>▪ Managed access and no-take areas</li> <li>▪ Sharks</li> <li>▪ Sea turtles</li> </ul> </li> <li>▪ Ensure there is awareness of Gladden Spit and Silk Cayes Marine Reserve and the environmental services and benefits it provides to the general public through use of ongoing media opportunities and posters (focusing particularly on biodiversity protection, fisheries production and tourism)</li> <li>▪ Increase awareness among stakeholders of the biodiversity value and importance of mangrove, and encourage protection – especially in areas identified as important nursery sites for GSSCMR</li> <li>▪ Increase awareness among fishermen on proper disposal of oil / lube containers, and effects of pollution on the marine environment</li> <li>▪ Continued education and awareness activities in stakeholder communities, focusing on the value of GSSCMR no-take zoning and its ability to help maintain the sustainability of commercial species</li> <li>▪ Increase general awareness of SEA and Gladden Spit and Silk Cayes Marine Reserve through participation in national events - displays and exhibits at events such as the Agriculture &amp; Trade Show, Earth Day, etc.</li> </ul>



**Gladden Spit and Silk Cayes Marine Reserve – Management Plan  
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<b>Education and Outreach Programme</b>	
<b>Outreach and Dissemination of Information</b>	
<b>Dissemination of Information</b>	<ul style="list-style-type: none"> <li>▪ Ensure all awareness documents relevant to Gladden Spit and Silk Cayes Marine Reserve are available for download from the website (brochures, leaflets, regulations, posters etc.)</li> <li>▪ Produce an annual summary flier summarizing activities and achievements to be distributed to residents, tour guides, tour operators and fishermen, and include income and expenditures for increased awareness and transparency</li> <li>▪ Strengthen communication and collaboration between the Education and Outreach Programme and the other SEA programme areas – particularly to increase effective enforcement, and dissemination of science outputs</li> </ul>
<b>Sustainable Livelihoods and Training</b>	
<b>Training</b>	<ul style="list-style-type: none"> <li>▪ Identify and implement effective mechanisms for decreasing incursions through reducing local community dependence on marine resources, through skills training for other occupations and facilitation of opportunities and incentives</li> <li>▪ Training of local fishermen and tour guides for participation as Fisheries Officers / Special Constables in surveillance and enforcement activities</li> <li>▪ Provision of training opportunities to enhance stakeholder skills in areas of:             <ul style="list-style-type: none"> <li>▪ First Aid / CPR</li> <li>▪ Project Management</li> <li>▪ Skills for tour guide for leading in-land tours</li> <li>▪ Small business start-up and management</li> <li>▪ Capture and preparation of lionfish</li> </ul> </li> <li>▪ Conduct a needs assessment with local community based organizations and associations, to see how SEA may best partner and / or assist them</li> </ul>

### 3.5.4 Public Use Programme

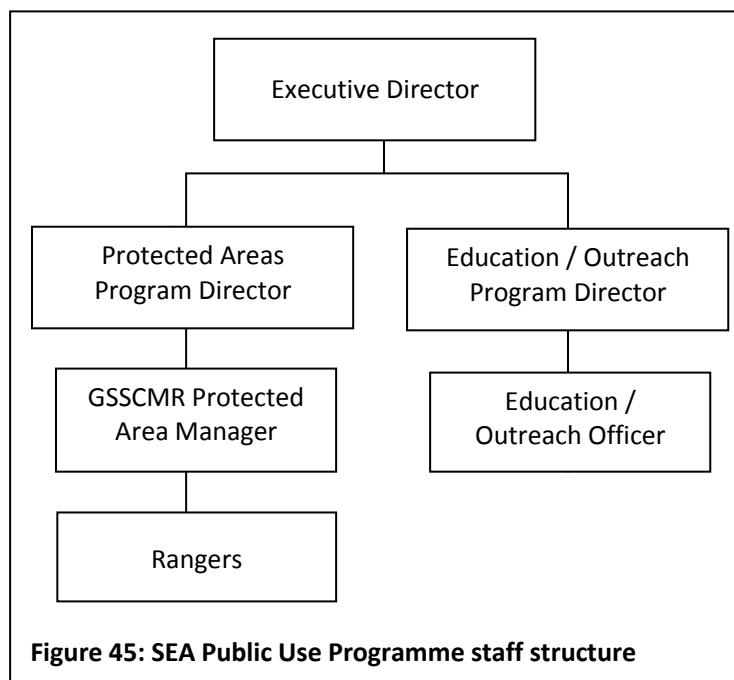
Gladden Spit and Silk Cayes Marine Reserve was established based on its value as a spawning aggregation site, as a traditional fishing area, for the Silk Cayes, and most famously, for the whale sharks. It is of great socio-economic importance, attracting whale shark and reef-based tourism that supports tour-based operations in Placencia, Seine Bight, Hopkins and a number of other communities.

The Public Use Programme covers a number of different responsibilities, focused on recreational use of the area, and is administered largely under the Protected Areas Programme Director, through enforcement of visitor regulations, with input from the Education and Outreach Programme (for provision of visitor information) and the Science Programme (for monitoring visitor impacts and developing limits of acceptable change).

The Public Use Programme is implemented under four sub-programmes:

- **Visitor Management**
- **Visitor Education and Interpretation**
- **Visitor Infrastructure**
- **Visitor Safety and Protection**

Under current legislation, visitor management and safety is, to some extent, the responsibility of the tour guides and tour operators, with regulations covering the need for certified guides and dive instructors, and the requirement for boat captains and dive guides to explain the rules of the Reserve to a diver within the Reserve (CORAL Guidelines), and ensure that all visiting divers are adequately qualified.



A recent assessment conducted in a number of marine protected areas demonstrated that lower visitation impacts are achieved when tour guides have received site-level training, as shown at Laughing Bird Caye National Park, following training through SEA, mitigating visitor damage to the reef. However it is also recognized that this needs to be ongoing, and that there still needs to be

## **Gladden Spit and Silk Cayes Marine Reserve – Management Plan 2011-2016**

greater education of visitors and tour guides as to Best Practices for tourism use of the marine resources for sustainability, as outlined in the CORAL guidelines.

There are strict guidelines in place regulating access to the seasonal Gladden Spit whale shark zone, and all tourists - divers, watchers and snorkelers - must pay a fee: a mandated fee of \$15US per person, during whale shark season (1 March to July 31).

**Whale Shark Tourism Interaction Guidelines (SEA, 2010)**

- Tour guides and Captains wishing to conduct whale shark interaction tours within the Whale Shark Zone must be Whale Shark Certified and carry their valid Tour Guide ID and/or Captains License along with their valid Whale Shark ID.
- All whale shark tours must operate from boats that are properly licensed. All boats will have the "diver down" flag on board.
- Dive and snorkel tours are limited to one and one half hour (1 ½) time slots and these will be allocated by lottery, for the entire whale shark season, before the March moon.
- A maximum of six dive and/or snorkel boats will be permitted inside the larger buoyed area known as the Whale Shark Zone.
- Each boat will carry a maximum of 12 clients - divers and/or snorkelers, and/or watchers.
- For SNORKEL tours a maximum ratio of 8 snorkelers to each licensed snorkel guide is permitted.
- For SCUBA tours, a maximum ratio of 8 divers to each licensed dive master is permitted.
- All boats should check-in with SEA Rangers stationed inside the reef before proceeding to the Whale Shark Zone. All boats will fly the "diver down" flag when they have divers in the water.
- Entry in the water should be no later than 4:00PM and all divers and snorkelers should be out of the water by 5:00 PM and out of the reserve by 5:30 PM.
- Dive, snorkel and fishing boats should maintain a distance of at least 200 feet between each other.
- Dive and snorkel boats must approach all whale sharks at idle speed (not exceeding 2 knots) and maintain idle speed in the vicinity of whale sharks.
- Boats should remain at least 50 feet from any whale shark.
- Dive and snorkel guides are required to provide briefing on regulations to tourists before entering the area.
- Divers and snorkelers should remain at least 15 feet away in any direction from any whale shark. No touching, chasing, or molesting whale sharks will be permitted.
- For safety purposes this dive is for advanced divers or experienced open water divers with 25 or more logged dives. Maximum depth for divers of any certification is 80 feet.
- No Flash Photography Allowed – For further Filming and Photography Guidelines contact SEA

**Whale Shark Tourism Interaction Guidelines (SEA, 2010)**

**Licensing:**

1. Any person who wishes to conduct whale shark tours must have a valid tour guide license, dive master certification (for SCUBA), skin diver certification (for snorkelers) a certificate of graduation from a whale shark course. Boat captains must also attend the whale shark course.
2. Any boat used for whale shark tours must be at least 23 feet and no longer than 48
3. Any boat used for whale shark tours must carry oxygen, safety sausages, radio, and lights.
4. The annual fee for the boat license is \$100, payable to The Fisheries Department.

**Sanctions:**

1. Any person who contravenes any of the provisions of these regulations is guilty of an offense and liable on summary conviction to a fine not exceeding two thousand Belize dollars or to imprisonment for a period not exceeding six months, or to both such fine and period of imprisonment and/or revocation of whale shark license.
2. Notwithstanding the above, anyone touching a whale shark is liable for a \$10,000BZ fine.
3. Notwithstanding the above, any person who damages corals shall pay a fine not exceeding \$10,000BZ, or some higher penalty based on the assessed damage not exceeding \$1,000,000BZ.

**Filming Guidelines:**

FILMING/PHOTOGRAPHY/MEDIA VISITS at Marine Protected Areas co-managed by Southern Environmental Association (SEA).

In order to preserve the environmental integrity of marine resources and to ensure the enjoyment of those resources by current and future stakeholders, Southern Environmental Association has developed the following guidelines as they relate to filming, photo shoots and media visits within the marine protected area boundaries of Laughing Bird Caye National Park, Gladden Spit and Silk Cayes Marine Reserve and Sapodilla Cayes Marine Reserve.

These guidelines are in accordance with the policies of Southern Environmental Association and were developed to prevent potential deleterious impacts to the marine ecosystems within the protected areas and the disruption of visitor use.

**FILMING/PHOTOGRAPHY PERMITS**

Permits are required to access marine protected areas for professional /commercial photography and filming activities and media visits to ensure protection of resources and to prevent significant disruption of normal visitor uses, or when they involve props, models, set dressings, professional crews and casts.

In general, filmmakers and photographers seeking to produce film or photography within the marine protected areas for personal or non-commercial purposes are not required to apply for a permit. However, such filmmakers and photographers must supply to Southern Environmental Association with a detailed description of activities in a prescribed format developed by Southern Environmental Association.

News media wishing to access the marine protected areas for entertainment or to cover breaking news events will need to consult with Southern Environmental Association to determine if a filming permit will be required.

Prior to submitting an application to Southern Environmental Association for a FILMING PERMIT, filmmakers and photographers with definite plans to shoot commercial films, photographs, documentaries or media spots in Belize must submit a FILM LICENSE APPLICATION to the Belize Film Commission.

Applications must be submitted to Southern Environmental Association for processing of simple requests at least two weeks prior to the anticipated commencement date of any filming or photography activities. Requests that involve multiple locations, complex logistics and extensive coordination may require a processing period of four weeks. Applications are processed in the order in which they are received. Priority will not be given to urgent requests. Submission of an application does not automatically guarantee that a FILMING PERMIT will be granted.

A non-refundable processing fee of US \$50.00 must accompany each professional/commercial photography and filming activities application. Payment can be made in the form of a cashier's check or money order and must be payable to Southern Environmental Association. Approval of applications for a FILMING PERMIT is subject to a schedule of fees that will be payable upon the granting of the permit (Annex 2).



GOOD ENVIRONMENTAL PRACTICES

## DIVING



*Divers are some of the strongest and most effective advocates for coral reef conservation. Please follow these simple guidelines to become a “coral friendly” diver.*

### AS A RESPONSIBLE TOURIST

- For your vacation, choose an environmentally friendly resort or hotel; one that practices energy conservation, recycles, and treats sewage and solid waste in responsible ways.
- Choose coral friendly dive operations that practice reef conservation by:
  - Giving environmental briefings.
  - Holding buoyancy control workshops.
  - Using available moorings.
  - Using available wastewater pump-out facilities.
  - Actively supporting local coral parks.
  - Participating in local conservation projects.
- Pay user fees or make a donation when visiting coral parks and other marine conservation areas.
- Avoid purchasing souvenirs made from coral, turtles or other marine life—this is often illegal, and it’s never environmentally wise.
- Learn all you can about coral reefs—they are fascinating and fragile environments.

### IN THE WATER

- Never touch corals; even a slight contact can harm them and some corals can sting or cut you.
- Carefully select points of entry and exit to avoid areas of reef.
- Make sure all your equipment is well-secured.
- Make sure you are neutrally buoyant at all times.
- Maintain a comfortable distance from the reef.
- Practice good finning and body control to avoid accidental contact with the reef or stirring up the sediment.
- Stay off the bottom and never stand or rest on corals.
- Avoid using gloves and kneepads in coral environments.
- Take nothing living or dead out of the water, except recent garbage.



Good divers know that the best way to enjoy a reef is to slow down, relax and watch as reef creatures go about their daily lives undisturbed.

Be sure to find out about local laws and regulations as they may differ from these general guidelines.



GOOD ENVIRONMENTAL PRACTICES

## DIVING



### MINIMIZE CONTACT WITH MARINE LIFE

- Never chase, harass or try to ride marine life.
- Do not touch or handle marine life.



### PHOTOGRAPHY & VIDEOGRAPHY

Divers need advanced diving skills to take pictures and video underwater. Photographic and video equipment is cumbersome and affects a diver’s buoyancy and mobility in the water. It is all too easy to touch and damage marine life when concentrating on “the perfect shot.”

### ON DIVE BOATS

- Choose dive operations whose boats make use of available moorings—anchors and chains destroy fragile corals.
- Make sure garbage is well stowed, especially light plastic items and cigarette butts.
- Be sure to take away everything you brought on board, such as packaging, used batteries and bottles.



### SHORESIDE

- Support coral parks and other conservation projects:
  - Visit established coral parks and pay applicable user fees that support marine conservation.
  - Encourage and support the use of dive moorings.
  - Participate in local initiatives to monitor the marine environment.
  - Participate in cleanups.
  - Make a donation or volunteer your skills to support a coral park. For example, you can participate in a reef survey, conduct outreach, or help educate others about coral reef conservation.
  - Donate used equipment such as cameras, dive gear or reef identification books.
- Speak up. Make sure your dive buddies understand these simple but important conservation practices.



The Coral Reef Alliance (CORAL) is a member-supported, non-profit international organization dedicated to keeping coral reefs alive around the world. Visit our website <http://www.coral.org>



Visit the Project AWARE Foundation website at [www.projectaware.org](http://www.projectaware.org) to find out more about protecting the aquatic environment and its resources.

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GOOD ENVIRONMENTAL PRACTICES

## SNORKELING



*Coral reefs are among the world's most spectacular ecosystems and snorkeling is an excellent way to explore them. As coral reefs face an increasingly uncertain future, snorkelers and other coral reef visitors can play an important role in helping protect these fragile habitats. Follow these simple guidelines to become a "coral friendly" snorkeler.*

### BEFORE SETTING OUT TO EXPLORE THE REEFS

- For your vacation, choose an environmentally friendly resort or hotel; one that practices energy conservation, recycles, and treats sewage and solid waste in responsible ways.
- Pay user fees or make a donation when visiting coral parks and other marine conservation areas.
- Get the best possible snorkeling instruction you can.
- Practice snorkeling skills away from the reef.
- Make sure your equipment fits properly before you snorkel near corals—it can be very difficult to adjust in the water.
- If you feel uncertain, or are an inexperienced snorkeler, consider wearing a snorkel vest for added buoyancy.
- Learn all you can about coral reefs—they are fascinating and fragile environments.



### IN THE WATER

- Never touch corals; even slight contact can harm them. Some corals can sting or cut you.
- Select points of entry and exit to avoid walking on corals.
- Maintain a comfortable distance from the reef, so as to avoid contact.
- Know where your fins are at all times and don't kick up sand.
- Stay horizontal in the water while you're near or above the reef.
- Learn to swim without using your arms.
- Take nothing living or dead out of the water except recent garbage which does not have living organisms on it.
- Move slowly and deliberately in the water—relax as you swim and take your time.
- Avoid using gloves in coral environments.
- Remember, look but don't touch.



Good snorkelers know that the best way to enjoy a reef is to slow down, relax and watch as reef creatures go about their daily lives undisturbed.

Be sure to find out about local laws and regulations as they may differ from these general guidelines.



GOOD ENVIRONMENTAL PRACTICES

## SNORKELING



### MINIMIZE CONTACT WITH MARINE LIFE

- Never chase, harass or try to ride marine life.
- Never touch or handle marine life.



### ON BOATS

- Choose snorkel operations whose boats make use of available moorings—anchors and chains destroy fragile corals.
- Make sure garbage is well stowed, especially light plastic items.
- Be sure to take away everything you brought on board, such as packaging, used batteries and bottles.



### SHORESIDE

- Support coral parks and other conservation projects:
  - Visit established coral parks and pay applicable user fees that support marine conservation.
  - Encourage and support the use of boat moorings.
  - Participate in local initiatives to monitor the marine environment.
  - Participate in cleanups.
  - Make a donation or volunteer your skills to support a coral park. For example, you can participate in a reef survey, conduct outreach, or help educate others about reef conservation.
  - Donate used equipment such as cameras, dive gear or reef identification books.
- Avoid purchasing souvenirs made from coral, turtles or other marine life—this is often illegal, and it's never environmentally wise.
- Speak up. Make sure your snorkeling buddies understand these simple but important conservation practices.



The Coral Reef Alliance (CORAL) is a member-supported, non-profit international organization dedicated to keeping coral reefs alive around the world. Visit our website <http://www.coral.org>



Visit the Project AWARE Foundation website at [www.projectaware.org](http://www.projectaware.org) to find out more about protecting the aquatic environment and its resources.

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<b>Public Use Programme</b>	
<b>Visitor Management</b>	
<b>General Visitor Management</b>	<ul style="list-style-type: none"> <li>▪ Encourage greater visitation by local visitors and school groups through organized and guided day trips, school visits and other mechanisms</li> <li>▪ Maintain accurate visitor records (local and International), as well as records of visitor origin, tour operator, activities, and any enforcement action needed in respect to tourism visitation</li> <li>▪ Develop and implement strategies and actions to strengthen baseline data collection on resource use of the marine protected area, and data accessibility</li> <li>▪ Ensure sufficient mooring buoys are installed at key snorkel / dive sites</li> <li>▪ Work closely with Port Authority, Coast Guard and DoE towards mitigation of potential groundings including the installation of marker and mooring buoys where necessary for reducing boat impacts on reef</li> <li>▪ Enforce GSSCMR public use regulations:             <ul style="list-style-type: none"> <li>▪ Enforce ‘no take’ regulations for Conservation Zone</li> <li>▪ Ensure dive boats fly ‘divers down’ flag when divers are in the water</li> <li>▪ Ensure that dive boats follow the legislated diver:guide ratio of 8:1</li> <li>▪ Ensure that snorkel groups follow the recommended guide:snorkeler ratio</li> <li>▪ Ensure boat captains follow anchor-use / mooring regulations</li> <li>▪ Exclusion of jet ski and water-ski use</li> </ul> </li> <li>▪ Collaborate with Belize Tourism Board for effective enforcement of tourism legislation</li> <li>▪ Develop and implement best practices and guidelines for boats entering Gladden Spit and Silk Cayes Marine Reserve, with participation of live-aboard companies, boat captains, tour guides and rangers</li> <li>▪ Work with tour guides to develop a ‘code of conduct’ for reef based activities, based on Nest Practices</li> <li>▪ Develop certification of best practices system for tour operators (including live aboard operators)...and highlight these at promotional events, through SEA information flyers and other mechanisms</li> </ul>
<b>Visitor Management</b>	
<b>General Visitor Management</b>	<ul style="list-style-type: none"> <li>▪ Investigate feasibility of a including regulation of live-aboard charter and independent vessels – that all vessels entering the protected area have a Belize boat captain aboard, and that all snorkelers / divers are accompanied by a licensed, qualified Belize tour guide</li> <li>▪ Ensure all regulations are enforced within the Whale Shark Zone</li> </ul>

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<b>Public Use Programme</b>	
<b>Visitor Management</b>	
<b>General Visitor Management</b>	<ul style="list-style-type: none"> <li>▪ Develop and implement a ‘Limits of Acceptable Change’ programme for effective tourism management at the Gladden Spit and Silk Cayes Marine Reserve, especially for primary dive and snorkel sites within the protected area</li> <li>▪ Integrate tourism best practices into Best Practices planning for GSSCMR, including re-visiting tour guide-visitor ratios for snorkeling and diving</li> <li>▪ Develop conflict resolution mechanisms and in-house skills for dealing with public use conflicts</li> <li>▪ Ensure researchers and students follow Marine Reserve regulations and Fisheries Dept. and SEA research guidelines</li> <li>▪ Review camping regulations, and evaluate feasibility of shifting camping to Little Water Caye, in collaboration with tour operators and tour guide</li> <li>▪ Investigate feasibility of regulations stipulating that chartered boats must be accompanied by a local guide/captain when entering the reserve. Private boats/charter boats should have to check in and out of the marine reserve by radio contact to the Ranger Station.</li> </ul>
<b>Whale Shark Visitation</b>	<ul style="list-style-type: none"> <li>▪ Review of past whale shark research and filming activities, with development a targeted strategic plan to guide future activities at the spawning aggregation site</li> <li>▪ Support and strengthen the Whale Shark Committee for continued effective management decision-making relevant to whale shark tourism</li> <li>▪ Effective surveillance and enforcement of visitor behaviour and clear mechanisms for enforcement, to reduce impacts on whale shark / spawning aggregation site</li> <li>▪ Develop specific tourism best practices and guidelines for Gladden Spit and Silk Cayes Marine Reserve, with participation of tour guides and rangers</li> </ul>
<b>Awareness</b>	<ul style="list-style-type: none"> <li>▪ Ensure visitors, tour guides and tour operators using Gladden Spit and Silk Cayes Marine Reserve are aware of rules and regulations – clear, on-site signs at South Silk Caye and Little Water Caye indicating rules and regulations, and through brochures, handouts and other educational material related to regulations</li> <li>▪ Increase good practices awareness among dive/snorkel groups through skills training, annual refresher courses on rules, regulations and tourism policies, and development and dissemination of best practices information (eg. from Coral Reef Alliance (<a href="http://www.coral.org">www.coral.org</a>))</li> </ul>

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<b>Public Use Programme</b>	
<b>Visitor Management</b>	
<b>Awareness</b>	<ul style="list-style-type: none"> <li>▪ Develop outreach program specifically for the live-aboard companies, employees and clients with literature on rules, guidelines and maps relevant to all SEA protected areas</li> <li>▪ Ensure visitors in independent sailboats visiting Gladden Spit and Silk Cayes Marine Reserve are aware of rules and regulations, mooring buoy locations and mooring regulations</li> <li>▪ Ensure all researchers and students are aware of the rules and regulations of the Marine Reserve, and under the Fisheries legislation</li> <li>▪ Increase awareness of tour operators and guides of the impacts of camping on the silk cayes on the biodiversity, working towards shifting camping to Little Water Caye</li> </ul>
<b>Visitor Education and Interpretation</b>	
<b>Interpretation</b>	<ul style="list-style-type: none"> <li>▪ Provide information and training to tour guides on:               <ul style="list-style-type: none"> <li>▪ conservation targets,</li> <li>▪ climate change,</li> <li>▪ coral bleaching,</li> <li>▪ sea turtles, turtle nesting and turtle conservation,</li> <li>▪ bird use of the cayes,</li> <li>▪ sharks</li> </ul> <p>and other topical subjects to assist them in providing accurate information for their visitors</p> </li> <li>▪ Provide laminated information sheets for use by visitors whilst on the Silk Cayes</li> <li>▪ Provide quarterly information to tour guides on interesting activities, research outputs, educational activities etc. that can be incorporated into their interpretation during tours</li> </ul>
<b>Visitor Safety</b>	
<b>Visitor Safety</b>	<ul style="list-style-type: none"> <li>▪ Ensure staff boat is equipped with good radio communications / satphone</li> <li>▪ Ensure staff boat is equipped with an adequate first aid kit</li> <li>▪ Ensure all rangers based on Little Water Caye / GSSCMR are trained in first aid and CPR, and dealing with marine-based first aid (including lionfish stings)</li> <li>▪ Ensure a ranger is on-site at all times when visitors are present</li> <li>▪ Ensure all snorkeling / diving groups have the legislated guide / visitor ratio</li> <li>▪ Ensure all tour guides and boat captains are trained and licensed</li> <li>▪ Ensure enforcement of visitor regulations designed to provide visitor safety</li> </ul>

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<b>Public Use Programme</b>	
<b>Visitor Facilities</b>	
<b>Facilities</b>	<ul style="list-style-type: none"><li>▪ Ensure visitor facilities (barbecue stands, picnic tables, and bathrooms) are maintained in good condition</li><li>▪ Ensure bathrooms are adequate for the number of visitors on the cayes at any one time</li><li>▪ Ensure sufficient mooring buoys are installed for visitation requirements</li></ul>

### **3.5.5 Infrastructure Management Programme**

The Site and Infrastructure Management Programme covers activities such as the maintenance of present infrastructure and equipment, and planning for future infrastructure and equipment needs. Site and infrastructure management is addressed under three sub-programmes:

- **Infrastructure**
- **Equipment**
- **Maintenance**

The Fisheries Department office is located in Belize City. The SEA office is located in Placencia. Both are well equipped as administrative headquarters, though the SEA office would benefit from being relocated to a SEA-owned property, to reduce overheads. A second satellite office is located in Punta Gorda.

A Ranger Station is located on Little Water Caye, and is in good condition, with good sewage and water storage capacity. SEA is seeking to ensure increased environmental sustainability at all the Ranger Stations, including Little Water Caye, through the installation of solar power systems.

Camping and overnight mooring has been allowed to date on South Silk Caye, though there are concerns about fishing within the Conservation Zone, and impacts from poorly moored boats on the reef. It is hoped to relocate camping to Little Water Caye.

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Site and Infrastructure Management Programme	
Infrastructure	
<b>SEA Office Facilities</b>	<ul style="list-style-type: none"> <li>▪ Ensure all Programme Directors / Managers are fully equipped for effective implementation of their programme areas</li> <li>▪ Investigate the feasibility of purchase of land and design and construction of SEA office, and locate funds for implementation</li> <li>▪ Incorporate solar power and other green initiatives into the design and operation of the SEA Offices, rangers stations, and all SEA activities</li> </ul>
<b>Fisheries Department Office Facilities</b>	<ul style="list-style-type: none"> <li>▪ Ensure the Fisheries Department enforcement and Ecosystem Management Unit offices are adequately equipped for effective implementation of their programme areas</li> </ul>
<b>On-site Staff Facilities</b>	<ul style="list-style-type: none"> <li>▪ Ensure current on-site staff facilities are maintained / improved for high staff satisfaction</li> <li>▪ Maintain and improve solar power to supply the staff and visitor facilities on Little Water Caye</li> <li>▪ Ensure Little Water Caye facilities sewage and grey water system is effective and not contaminating groundwater or waters adjacent to cayes</li> <li>▪ Ensure bathroom facility sewage and grey water system on South Silk Caye is effective and not contaminating groundwater or waters adjacent to cayes</li> </ul>
<b>On-site Visitor Facilities</b>	<ul style="list-style-type: none"> <li>▪ Ensure visitor facilities are adequate for visitation levels and for maintaining high visitor satisfaction (picnic tables, barbecue grills (renovated), bathrooms)</li> <li>▪ Ensure sufficient and adequate mooring buoys are installed for visitation requirements</li> <li>▪ Ensure sufficient signage, including:               <ul style="list-style-type: none"> <li>▪ Large “Welcome’ / rules and regulations sign</li> <li>▪ Temporary turtle nesting signs (for nesting sites) – no-entry and info</li> </ul> </li> </ul>
Equipment	
<b>SEA Equipment</b>	<ul style="list-style-type: none"> <li>▪ Maintain and replace office equipment as necessary for ensuring effective operations</li> <li>▪ Identify equipment gaps and locate funds for equipment</li> <li>▪ Ensure SEA has sufficient vehicles, boats and motors for effective operations</li> </ul>
<b>Fisheries Department Equipment</b>	<ul style="list-style-type: none"> <li>▪ Maintain and replace office equipment as necessary for ensuring effective operations</li> <li>▪ Identify equipment gaps and locate funds for equipment purchase</li> <li>▪ Ensure Fisheries Department has sufficient vehicles and boats for effective operations</li> </ul>

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Site and Infrastructure Management Programme	
<b>Equipment</b>	
<b>SEA Equipment</b>	<ul style="list-style-type: none"> <li>▪ Maintain and replace office equipment as necessary for ensuring effective operations</li> <li>▪ Identify equipment gaps and locate funds for equipment</li> <li>▪ Ensure SEA has sufficient vehicles, boats and motors for effective operations</li> </ul>
<b>On-site Equipment-General</b>	<ul style="list-style-type: none"> <li>▪ Ensure Little Water Caye Ranger Station is adequately equipped for surveillance and enforcement activities and good radio communications</li> <li>▪ Ensure GSSCMR has two operational and fully equipped boat and engine for visitor management, surveillance and enforcement activities</li> <li>▪ Ensure surveillance and enforcement team are fully equipped for day and night patrols – spotlights, raincoats</li> <li>▪ Ensure staff are equipped for health and safety - with extensive first aid kit, life-jackets, fire extinguishers (boat and Ranger Station), flares and satphone at minimum</li> <li>▪ Identify, source and install essential protected area signs</li> </ul>
<b>Maintenance</b>	
<b>Facilities</b>	<ul style="list-style-type: none"> <li>▪ Ensure staff facilities are maintained in good condition</li> <li>▪ Ensure visitor facilities (barbecue stands, picnic tables, bathrooms) are maintained in good condition</li> <li>▪ Ensure bathrooms are adequately maintained on a daily basis</li> <li>▪ Ensure mooring buoys are adequately maintained on a monthly basis</li> </ul>

### **3.5.6 Administrative Programme**

SEA's Administration Programme is centralized in Placencia, with a sub-office in Punta Gorda. It focuses on management of three marine protected areas, including Gladden Spit and Silk Cayes Marine Reserve. As a larger NGO, SEA has developed an Administration and Policies Manual to ensure that all staff and members of the Board of Directors are aware of the administrative procedures and policies of the organization. The Fisheries Department Administrative Headquarters is in Belize City, and is responsible for all Fisheries Department operations.

SEA developed a Financial Plan in 2010, which guides implementation of mechanisms towards greater financial sustainability for the organization and the protected areas it co-manages.

Activities fall under five sub-programmes:

- **Administration Procedures**
- **Staff**
- **Health and Safety**
- **Communication and Collaboration**
- **Financial Sustainability**



Administration Programme	
<b>Administration Procedures</b>	<ul style="list-style-type: none"> <li>▪ Finalize five-year co-management agreement between Fisheries Department and SEA</li> <li>▪ Ensure continued, ongoing communication between Fisheries Department and SEA programme areas to support overall adaptive management of GSSCMR and the SBRC</li> <li>▪ Ensure staff capacity in using operational and workplans effectively, for effective project and operational management</li> <li>▪ Preparation of annual workplan and budget by each programme manager in November each year</li> <li>▪ Ensure operational plans / workplans are based on the management plan</li> <li>▪ Ensure monitoring and evaluation of operational plans / workplans on a quarterly basis</li> <li>▪ Ensure monitoring and evaluation of management plan on a biennial basis</li> <li>▪ Prepare annual State of the Park / SBRC reports including monitoring / research output for SBRC area</li> <li>▪ Produce quarterly reports for SEA and Fisheries Department reporting, and submit to Fisheries Department and the SEA Board of Directors</li> <li>▪ Develop conflict resolution mechanisms and in-house skills for dealing with public use conflicts</li> </ul>
<b>Staff</b>	<ul style="list-style-type: none"> <li>▪ Ensure there are sufficient on-site staff for effective management of GSSCMR</li> <li>▪ Identify and recruit qualified staff for all vacant positions</li> <li>▪ Ensure all SEA employees are familiar with organizational policies and procedures</li> <li>▪ Ensure all SEA staff are aware of Administrative and Operations Manual covering topics such as job duties, employee policies, transport policy, gender issues and a staff appraisal process</li> <li>▪ Ensure on-site staff have adequate support from SEA</li> <li>▪ Ensure GSSCMR staff are equipped with uniforms</li> <li>▪ Conduct an annual evaluation of staff performance and ensure that recommendations are implemented</li> <li>▪ Identify human resource skills gaps and implement training programme to build capacity where required</li> <li>▪ Conduct an annual review of staff capacity and training requirements</li> <li>▪ Continue encouraging participation of local stakeholders through volunteer rangers programme – local fishermen and tour guides</li> <li>▪ Engage local students and community groups in assisting staff in beach clean ups during times of peak garbage</li> </ul>

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<b>Administration Programme</b>	
<b>Training</b>	<ul style="list-style-type: none"> <li>▪ Ensure operational staff are trained in CPR, First Aid and use of the oxygen kit</li> <li>▪ Ensure staff have sufficient administrative training for effective general management, fundamental accounting, budget and proposal / workplan preparation and implementation</li> <li>▪ Ensure surveillance and enforcement staff have sufficient surveillance and enforcement training to be effective</li> <li>▪ Ensure all on-site and operational staff members are trained in operation and maintenance of reserve equipment (boat handling, outboard engine repair etc.)</li> <li>▪ Ensure staff have sufficient training in relevant biodiversity monitoring protocols for effective monitoring</li> <li>▪ Ensure staff are trained in conflict resolution, consensus building, public relations and communications skills</li> <li>▪ Ensure the Board members have the skills and capacity to perform effectively</li> </ul>
<b>Health and Safety</b>	<ul style="list-style-type: none"> <li>▪ Ensure an effective Emergency Plan is in place (to include natural and anthropogenic disasters), and staff are trained in implementation</li> <li>▪ Ensure all staff working in GSSCMR have adequate insurance for their roles</li> </ul>
<b>Communication and Collaboration</b>	<ul style="list-style-type: none"> <li>▪ Strengthen communication and collaboration between SEA and Fisheries Department</li> <li>▪ Strengthen communication and collaboration between SEA Programme managers</li> <li>▪ Identify and implement mechanisms to increase stakeholder involvement in management and participation in decision making</li> <li>▪ Maintain and update SEA website on an ongoing basis</li> <li>▪ Strengthen links with other organizations and Government agencies involved in marine protected areas management</li> <li>▪ Ensure tour guides operating in the Gladden Spit and Silk Cayes Marine Reserve are kept informed of reserve activities and management decisions affecting them</li> </ul>
<b>Communication and Collaboration</b>	<ul style="list-style-type: none"> <li>▪ Ensure a flow of information to on-site staff re. science and monitoring outputs</li> </ul>

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<b>Administration Programme</b>	
<b>Communication and Collaboration</b>	<ul style="list-style-type: none"> <li>▪ Ongoing communication and dissemination of information to all stakeholder sectors               <ul style="list-style-type: none"> <li>▪ Belize Fisheries Department</li> <li>▪ Board of Directors</li> <li>▪ Staff</li> <li>▪ Surveillance and enforcement and research partners,</li> <li>▪ Funding partners</li> <li>▪ Stakeholder partners – tour guides, fishermen, schools</li> <li>▪ Government agencies (especially Coast Guard, Port Authority, Dept. of the Environment, and Dept. of Geology and Petroleum)</li> <li>▪ Local decision makers</li> </ul> </li> </ul>
<b>Financial Sustainability</b>	<ul style="list-style-type: none"> <li>▪ Improve the internal financial system, and link expenditures to programme areas</li> <li>▪ Update the assessment of the socio-economic value of the Marine Reserve to the stakeholders and to the economy of the country in terms of tourism, and also in terms of the less easily measurable factors such as recreation and storm protection, on a regular basis</li> <li>▪ Seek funding to fully implement SEA’s Financial Plan</li> <li>▪ Increased promotion and marketing of Gladden Spit and Silk Cayes Marine Reserve through media such as video, posters etc.</li> <li>▪ Establish an ‘honorary Board’ to assist with fundraising</li> <li>▪ Investigate mechanisms for diversifying the funding base</li> <li>▪ Seek funding for establishing an endowment fund for long term sustainability</li> <li>▪ Market SEA, with increased brand name recognition locally, nationally and internationally</li> <li>▪ Seek to reduce variable costs through strategic partnerships in all programme areas</li> <li>▪ Investigate the potential for using international volunteers to fill identified technical skills gaps</li> <li>▪ Identify non-monetary mechanisms for increasing staff satisfaction</li> <li>▪ Assess and plan for potential liability issues</li> </ul>

### **3.5.7 Management Policies**

On-site staff at GSSCMR are trained as Fisheries Officers, and as such follow the policies of the Belize Fisheries Department. These include the Fisheries Department Weapons Policy, and the Enforcement Plan - an official Fisheries Department policy to guide Fisheries Officers through standardized procedures for approaching and apprehending people in contravention of the protected area regulations.

SEA has also developed an Administration and Policies Manual to ensure that all SEA staff and members of the Board of Directors are aware of the administrative procedures and policies of the organization. This is being reviewed by the Ministry of Labour for approval (2010).

### **3.6 Timeline, Evaluation and Review**

It is suggested that the activities of each programme area are expanded to form an implementation matrix, including present and desired status, responsible parties, a timeline based on the 5-year implementation period, and highlighting any limitations or context conditions that would need to be taken into consideration for successful implementation. This has been completed for the first section of the Natural Resource Management Programme (Table 26).

Monitoring and evaluation are integral components of any management system and annual evaluations of protected area management are recommended. In the development of this management plan, the action areas are relatively specific, simplifying the process of monitoring success of implementation, and providing a mechanism for continual tracking of management activities, through annual review by the Fisheries Department, and by the SEA Board members and management staff of the Southern Environmental Association.

The management plan should not be considered static, and the annual review should ensure that strategies and activities are still relevant for the changing socio-economic and climatic contexts. Some management strategies may become obsolete, whilst new management activities may need to be included.

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**Table 26: Implementation Table**

A. Natural Resource Management Programme									
Management Actions	Present Status	Desired Status	Year					Responsible Party	Limitations/Requirements
Effective Surveillance and Enforcement			1	2	3	4	5		
Ensure GSSCMR has the human resources, equipment and training for effective surveillance and enforcement	GSSCMR is fully staffed	GSSCMR continues to be fully staffed						SEA Executive Director PA Program Director	
Ensure ongoing demarcation of MPA boundaries to ensure visual recognition of boundaries at all points by fishermen,	Boundary marker buoys are far apart, and can be hard for fishermen to see from dories	Boundaries clearly defined by sufficient, highly visible marker buoys						SEA PA Program Director PA Manager	With replacement of buoys when necessary
Ensure infrastructure is in place to minimize tourism infractions	Some mooring buoys in place	Information on rules and regulations posted on caye, sufficient mooring buoys in place, dissemination of information on tourism rules and regulations						PA Program Director PA Manager	Signs, mooring buoys, designated dive sites, information on rules and regulations to tour guides, tour operators (Bze and transboundary) and live aboard companies
Ensure all GSSCMR staff are aware of the rules and regulations of the protected area, and trained for effective surveillance and enforcement	Staff are all Fisheries Officers, trained in handling evidence and court procedures.	On-site staff trained in standard procedures and guidelines for enforcement of fisheries and tourism infractions						PA Program Director PA Manager	
Ensure continued implementation / enforcement of non-extractive regulations within no-take zones of GSSCMR	Effective implementation / enforcement of regulations within non-extractive zones of GSSCMR	Continued effective implementation / enforcement of regulations within non-extractive zones of GSSCMR						PA Program Director PA Manager	Ensure that patrols scheduled and implemented on a regular basis (daily if possible, and at night, at peak activity times)
Implement policies and regulations for all tour boats – requirement for local guides, boat captains, use of mooring points, removal of garbage	Liveaboard charters do not always have local guides or boat captains, and do not always follow regulations	Policies and regulations are implemented for all visiting tour boats						PA Program Director PA Manager	In collaboration with Fisheries Department and the Belize Tourism Board

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A. Natural Resource Management Programme									
Management Actions	Present Status	Desired Status	Year					Responsible Party	Limitations/Requirements
Effective Surveillance and Enforcement			1	2	3	4	5		
Ensure continued implementation / enforcement of non-extractive regulations within no-take zones of GSSCMR, with particular focus on: <ul style="list-style-type: none"> <li>▪ Illegal fishing in Conservation Zones and spawning aggregation site</li> <li>▪ Illegal fishing of conch in Conservation Zone by tour guides</li> </ul>	Some illegal extraction taking place	Reduced level of illegal extraction (ideally none)						PA Program Director PA Manager	
Strengthen visitor management, and enforcement of visitor rules and regulations	Some implementation of tourism regulations and policies	Effective implementation of BTB tourism regulations and policies in collaboration with						PA Program Director PA Manager	Divers / snorkelers : licensed guide ratio (in collaboration with BTB); Exclusion of jet ski and water-ski use within Marine Reserve; Mooring buoy-use regulations at dive sites and caye
Implement policies and regulations for all tour boats: <ul style="list-style-type: none"> <li>▪ Requirement for local guides and boat captains,</li> <li>▪ Use of mooring points,</li> <li>▪ Removal of garbage</li> </ul>	Some implementation ongoing	Ongoing implementation reducing visitor impacts to reef						PA Program Director PA Manager	
Identify hotspot areas, times and visiting boats / tour operators requiring increased enforcement effort, using SEA enforcement data, and enforce visitor regulations accordingly	There is little surveillance and enforcement of tourism activities within the GSSCMR	Increased surveillance and enforcement of tourism activities within the GSSCMR guided by past hotspots / times for tourism infractions						PA Program Director PA Manager	

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It is suggested that a monitoring and evaluation tracking matrix be developed for the activities under the management programme, and using the following criteria (Table 27), and following the outline example (Table 28).

Criteria	Score	Criteria Description
Not Started	1	Activities for achieving this result have not been started
Ongoing (-)	2	Whilst project activities are ongoing, implementation is slower than planned, with delays and limitations, and the result has not yet been achieved
Ongoing (+)	3	Activity implementation towards these results is ongoing as planned, but with some limitations, with partial result achievement
Completed / On schedule	4	Activity implementation is on schedule and/or activities have been completed successfully and achieved the relevant result

**Table 27: Criteria for tracking implementation**

Management evaluation is also achieved by an assessment of management effectiveness. An initial management effectiveness evaluation was conducted in 2006 (Walker and Walker, 2006), to provide a baseline for assessment, and again in 2009 (Walker and Walker, 2010).



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**Table 28: Criteria for tracking implementation**

Tracking of Management Action Implementation							
Management Actions	Present Status	1 <sup>st</sup> Year	2 <sup>nd</sup> Year	3 <sup>rd</sup> Year	4 <sup>th</sup> Year	5 <sup>th</sup> Year	Desired Status
Ensure GSSCMR has the human resources, equipment and training for effective surveillance and enforcement	GSSCMR is fully staffed						GSSCMR continues to be fully staffed
Ensure ongoing demarcation of MPA boundaries to ensure visual recognition of boundaries at all points by fishermen,	Boundary marker buoys are far apart, and can be hard for fishermen to see from dories						Boundaries clearly defined by sufficient, highly visible marker buoys
Ensure infrastructure is in place to minimize tourism infractions	Some mooring buoys in place						Information on rules and regulations posted on caye, sufficient mooring buoys in place, dissemination of information on tourism rules and regulations
Ensure all GSSCMR staff are aware of the rules and regulations of the protected area, and trained for effective surveillance and enforcement	Staff are all Fisheries Officers, trained in handling evidence and court procedures.						On-site staff trained in standard procedures and guidelines for enforcement of fisheries and tourism infractions
Ratings: 1: Not started 2: Started, but some limitations to implementation				3. Ongoing but behind schedule 4. On schedule			

### 3.7 Financing

Financing for management of Gladden Spit and Silk Cayes Marine Reserve is located through SEA, with the organization taking on the financial responsibility for the protected area.

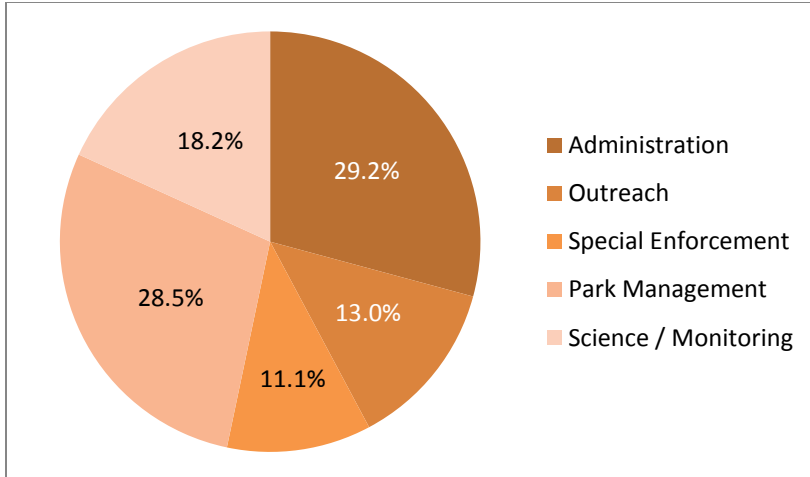
A recent financial analysis (part of the development of SEA’s Financial Plan (Table 29; Bravo, 2010)), estimated that the organization presently requires approximately Bz\$1,530,000 to cover core operational costs for the four important programs:

- Education and Outreach Program
- Protected Areas Program
- Science and Monitoring Program
- Administration Program

Current Expenses Per Programme	Outreach	Protected Areas		Science and Monitoring	Administration	Total Organization
		Special Enforcement	Site Management			
<b>Variable Expenses</b>	102,176	119,060	173,890	138,834	167,518	701,477
<b>Fixed Expenses</b>						
Personnel	74,662	47,062	241,218	128,125	146,295	637,363
General Overhead	6,575	3,716	21,522	11,571	131,407	174,791
Marketing	15,000	0	0	0	1,471	16,471
<b>Total Fixed Expenses</b>	96,237	50,779	262,740	139,696	279,173	828,625
<b>TOTAL EXPENSES</b>	198,413	169,838	436,630	278,530	446,691	1,530,102

**Table 29:** Current Expenses per Programme (SEA Financial Plan (Draft) / P. Bravo, 2010)

A breakdown of the expenditures shows that 29% goes towards the administration of the organization and the three protected areas, closely followed by Park Management (Figure 46), with the majority of fixed expenses being administrative overheads and personnel (principally park staff). Currently only the Administration Programme is considered to be fully funded for basic core operations, with the largest funding gaps identified in the Science and Monitoring Programme.



**Figure 46: Breakdown of Total Current Expenses per Programme (SEA Financial Plan (Draft) / P. Bravo, 2010)**

Income is primarily from grant funding – foundations, private contributions, US Federal funds and United Nations funding (through COMPACT). In both 2009 and 2010, grant funding was responsible for between 80% and 82.5% of income, with internal revenues (ticket sales/entrance fees, souvenir sales etc.) providing the balance of available funding. Revenue generated from visitation to Gladden Spit and Silk Cayes Marine Reserve through ticket, totalled Bz\$68,740 in 2009 (Bravo, 2010), approximately 25% of internally generated revenue, and only 5% of the total budget required to manage the organization.

SEA has already shown that management at system level is more efficient than management at site level, reducing core costs and overlap in areas such as biodiversity monitoring and education and outreach. However, the organization still has a significant gap between financial requirements for core operational costs, and income. The recently completed financial planning process identifies potential financial mechanisms to allow the organization to work towards future financial sustainability in its programme areas. Six strategic recommendations have been highlighted for increased revenue generation in order to close funding gaps and bring the organization to a sustainable financial level.

Whilst the promotion of endowments is considered to be the most effective mechanism for financial sustainability, with the greatest financial impact, it is also one

of the more complex mechanisms, requiring intensive efforts in terms of lobbying. It is recognized that a mature relationship with donors, and open, ongoing and transparent

**Recommended Strategies for Financial Sustainability**

- Promote endowments
- Improve Internal Financial System
- Reduce variable cost through strategic partnerships
- Increase ticket revenue generation
- Brand name recognition to attract individual donations
- Diversify funding base

***Southern Environmental Association Financial Plan (Draft), P. Bravo, 2010***

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communication with potential endowment sponsors are essential for success in establishing an endowment fund (SEA Financial Plan (Draft), Bravo, 2010).

The easiest mechanism identified for achieving better financial sustainability is the improvement of the organizational capacity to adequately record, analyze and manage financial resources by improving the internal financial system. Re-organization of the financial system to link expenditures to programme areas will facilitate identification of income and expenditure per programme, increasing SEA's capacity to analyse programme expenditures, and strengthen financial resource management.

Diversifying the funding base is also considered an important strategy for the future, providing greater stability to the funding of the organization. The Financial Plan recommends that SEA should focus on a small number of large donors – currently, 73% of total revenue is from one donor, supported by a number of small proposals. It is recommended that there be a shift away from small proposals, and a greater concentration on increasing engagement of larger grant-giving organizations, with the development of medium to long term funding partnerships (SEA Financial Plan (Draft), Bravo, 2010).

Reducing core costs per programme area through strategic partnerships with national and international organizations is also recommended as a mechanism for increasing financial sustainability, through sharing of costs.

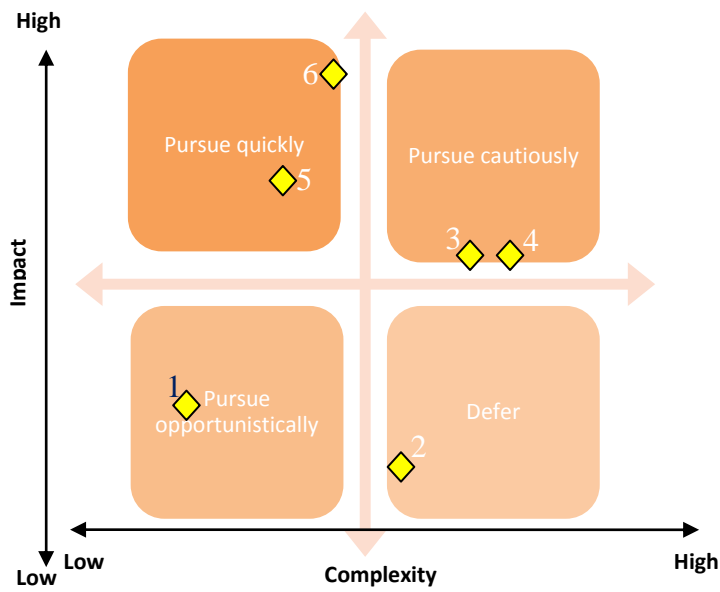
Developing partnerships with UB, or international research / environmental organizations is highlighted in the Financial Plan as a viable mechanism for achieving programme goals whilst minimizing costs. This is particularly targeted at the Science and Monitoring Programme, to increase the level of monitoring and research outputs available on which to base management decisions. The success of this as a mechanism for achieving conservation strategies can be seen with the Conservation International MMAS initiative, and Fragments of Hope.

Past experience, however, has shown that engaging partners is most successful if they are able to be logistically independent to a certain degree - use of volunteer groups such as Earthwatch, for example, may require more staff-time than is economically viable. It is also very important that these initiatives and the results are integrated into the organization, with constant communication, collaboration, skill-transfer and access to results.

This strategy is also viable when reaching out to stakeholders under the Education and Outreach Programme. Partnering with TIDE, for example, for education and outreach activities in Punta Gorda would be of benefit to both organizations, reducing costs per organization when both require a similar output.

A cost-benefit analysis has been conducted for each of the primary strategies highlighted by the Financial Plan, based on fundraising impact and level of complexity to provide strategy prioritisation (Figure 47).

**Gladden Spit and Silk Cayes Marine Reserve – Management Plan  
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**Pursue Quickly**

1. Diversify Funding Base
2. Promote endowments

**Pursue Opportunistically**

3. Improve internal financial system

**Pursue Cautiously**

4. Increase ticket revenue generation
5. Brand name recognition to attract individual donations

**Defer**

6. Reduce variable costs through strategic partnerships

**Figure 47: Results of Cost / Benefit analysis based on complexity and impacts**

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Citation for 1<sup>st</sup> GSSCMR Management Plan

Annex One

CHAPTER 210

FISHERIES (GLADDEN SPIT AND SILK CAYES MARINE  
RESERVE) ORDER

*(Section 14)*  
*[29th July, 2000.]*

**WHEREAS**, it is expedient to establish the Gladden Spit and Silk Caye Area, with wide community-initiated management and participation, as a Marine Reserve for the immediate management of whale shark tourism, diving and snorkeling;

**NOW, THEREFORE**, it is hereby provided as follows:-

1. This Order may be cited as the

**FISHERIES (GLADDEN SPIT AND SILK CAYES MARINE  
RESERVE) ORDER.**

2. The area specified in the Schedule to this Order shall be and is hereby declared to be a Marine Reserve for the purposes of the Fisheries Act.

3. A map of the Marine Reserve established pursuant to paragraph 2 above is attached in the Schedule to this Order and may be seen at the office of the Fisheries Administrator, Fisheries Department, Belize City.

**MADE** by the Minister of Agriculture, Fisheries and Cooperatives this 18th day of May, 2000.

**(DANIEL SILVA)**  
*Minister of Agriculture,  
Fisheries and Cooperatives*

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**GLADDEN SPIT AND SILK CAYES MARINE RESERVE**

**ALL THAT PORTION** of the Caribbean Sea comprising the General Use Zone and the Conservation Zone and more fully described as follows:-

**A. GENERAL USE ZONE**

Commencing at a point BND-NW, lying more than 0.5 miles southeast of Gladden Caye, and having scaled UTM coordinates 389 229 East 1 830 932 North; thence in a general southeasterly direction to a point BNDM, having scaled UTM coordinates 390 330 East 1824 363 North; thence in a general southwesterly direction to a point, BND-SW, having scaled UTM coordinates 387 507 East 1 817 964 North; thence on a bearing of 135° (true bearing) for 2.50 miles to a point one-half mile outside of the step reef drop-off at a point BND-SE, having scaled UTM coordinates 390 332 East 1815 123 North; thence bearing 41° (true bearing) parallel to the reef to a point BND-ES, having scaled UTM coordinates 398 167 East 1824 130 North; thence bearing 0° (true bearing) to a point BND-EN, having scaled UTM coordinates 398 197 East 1 826 714 North; thence bearing 319° (true bearing) parallel to the reef to a point, BND-NE, one-half mile from the steep reef drop-off, and having scaled UTM coordinates 392 095 East 1833 735 North; thence bearing 225° (true bearing) for a distance of 2.50 miles, back to the point of origin.

Note that all points have been taken using NAD27 Central America Datum.

**B. CONSERVATION ZONE 1**

**The Silk Cayes Conservation Zone includes:** an approximately 0.25 mile area surrounding the Northern, Middle and South Silk Cayes and also including two shallow reefs to the south east of Middle Silk Caye and bounded by scaled

UTM coordinates:

NTSE 388 652 East 1 818 393 North  
NTSW 388 153 East 1 818 798 North  
NTNW 389 300 East 1 820 230 North  
NTNE 389 793 East 1 819 833 North  
NTESE 389 518 East 1 818 855 North

**Annex Two**

**CHAPTER 210**

**(GLADDEN SPIT AND SILK CAYES MARINE RESERVE)**

**REGULATIONS**

*(Section 13)  
[5th July, 2003.]*

95 of 2003.  
CAP. 210.

**PART I  
PRELIMINARY**

1. These Regulations maybe cited as the

**FISHERIES (GLADDEN SPIT AND SILK CAYES MARINE  
RESERVE) REGULATIONS**

Short title.

2. In these Regulations, unless the context otherwise requires:  
“Advisory Committee” means the committee established under  
regulation 3;

Interpretation

“committee member” means any person appointed under  
regulation 3 to assist  
in the management of the Reserve;

“fish” includes all the varieties of marine or fresh water animals or  
plant life;

“fishing” means fishing for, capturing, taking or killing fish, or  
attempting to do any of the above by any method;

“Fisheries Administrator” means the Fisheries Administrator  
appointed under section 107 of the Belize Constitution for the  
purpose of the Fisheries Act and the regulations made thereunder;

“Fisheries Officer” means any technician, conservation officer,  
assistant fisheries

officer or fisheries officer employed by the Reserve;

“recreational fishing” means fishing for the fun with the intention to  
eat the fish caught but not for the purpose of selling;

“Reserve” means the Gladden Spit Marine Reserve declared under  
the Fisheries (Gladden Spit and Silk Cayes Marine Reserve) Order;

“Reserve Manager” means an officer appointed for the purpose of  
managing the Reserve;

“Schedule” means the schedule to these Regulations;

“sport fishing” means catch and release.

**PART II**

**ESTABLISHMENT OF AN ADVISORY COMMITTEE**

3. (1) The Fisheries Administrator shall establish an Advisory Committee for the purpose of assisting in the management of the Reserve.

Establishment of an Advisory Committee.

(2) The committee members shall be appointed by the post they hold in their organization.

(3) The committee members shall consist of representatives from the following organizations:

- (a) Fisheries Department;
- (b) Forest Department;
- (c) Coastal Zone Management Authority and Institute;
- (d) Placencia BTIA;
- (e) Placencia Village Council;
- (f) Friends of Nature;
- (g) Belize Fishermen Cooperative Association;
- (h) Northern Fishermen Cooperative;
- (i) Monkey River Fishermen; and
- (j) Placencia Tour Guide Association.

**PART III**

**ESTABLISHMENT OF ZONES AND RULES FOR ZONES**

4. (1) For the purposes of the regulation and control of the Reserve, there shall be established three zones within the Reserve as follows:

- (a) the General Use Zone;
- (b) the Conservation Zone 1; and
- (c) the Conservation Zone 11 (Restoration Area and Spawning Area).

(2) The description of the above Zones shall be as set out in the Schedule hereto.

Establishment of Zones.

5. (1) The General Use Zone shall be restricted to those with the appropriate fishing licence for commercial, sport or recreational fishing. Fishermen shall apply for a licence to fish in accordance with these regulations.

(2) No person shall be permitted to use long lines, trawlers or gill nets in the Reserve unless authorized by the Fisheries Administrator.

Rules for General Use Zone.

**Gladden Spit and Silk Cayes Marine Reserve – Management Plan  
2011-2016**

(3) No person shall, within the General Use Zone, cast or drag any anchor in any manner that may damage coral reef formation.

(4) Fishermen catching lobster shall possess lobster with its carapace, tailed but not as fillet while in the Reserve.

(5) Fishermen catching conch shall possess conch whole or market clean but not as fillet or diced while in the Reserve.

Rules for  
Conservation  
Zone I.

6. (1) No person shall engage in commercial fishing, sport fishing or recreational fishing within the **Conservation Zone I**.

(2) No person shall engage in water-skiing and jet- skiing.

(3) No person shall secure a boat to the seabed of the Conservation Zones except by means of a mooring that is officially designated for this purpose, (save in the case of an emergency where life and property are endangered), or with the prior written permission of the Reserve Manager.

Rules for  
Conservation  
Zone II.

7. (1) **Restoration Area and Spawning Area-**

(a) No person shall engage in commercial, sports and recreational fishing;

(b) No person shall engage in trawling, setting nets, long-lines and traps; and

(c) No person shall engage in water-skiing and jet skiing.

(2) No person shall secure a boat to the seabed of the Conservation Zones except by means of a mooring that is officially designated for this purpose, (save in the case of an emergency where life and property are endangered), or with the prior written permission of the Reserve Manager.



- (3) Spawning area-
- (a) no touching, chasing or molesting of whale sharks will be permitted;
  - (b) divers and snorkelers should remain at least 15 feet away in any direction from any whale shark;
  - (c) maximum depth for divers of any certification is 80 feet to avoid disturbing fish aggregations;
  - (d) boats shall remain at least 50 feet away from any whale shark;
  - (e) dive and snorkel boats should maintain a distance of at least 200 feet away from each other;
  - (f) all divers and snorkelers should be out of the water by 5:30p.m;
  - (g) six (6) dive and snorkel tours will be limited to two hours from March 1 to July 31 of any year inclusive;
  - (h) a maximum of two boats per day per tour operator will be allowed;
  - (i) all boats will be allowed to carry a maximum of 12 visitors at any one time;
  - (j) no vessel larger than 48 feet will be allowed within this area; and
  - (k) the Fisheries Department reserves the right to close the Spawning Area because of inclement weather conditions or for any other reason it deems necessary.

8. (1) Divers shall register with the Reserve Manager prior to entering the Conservation Zones.
- (2) Charter dives shall first obtain a licence in the prescribed form set out as Form VI of the Schedule hereto before operating in the Conservation Zones and all dive boats shall fly the “divers down flag” when they have divers in the water.
- (3) Only certified scuba divers, or divers undergoing a training course conducted by a recognized instructor shall be allowed to use scuba equipment in areas of the Reserve where diving is permitted.
- (4) Dive guides shall be required to explain the rules of the Reserve to all divers within the Reserve.
- (5) All boats which need to operate in this zone shall first obtain registration from the Fisheries Administrator in accordance with these Regulations.
- (6) For the purpose of this Regulation “divers down flag” means a flag with a white diagonal stripe upon a red background.
- (7) All motorboats are to observe the low wake boat way when approaching snorkelers or divers.
- (8) For SCUBA tours a maximum of eight divers per licensed dive master will be permitted.
- (9) For snorkel tours a maximum of eight snorkelers per licensed tour guide will be permitted.

General Reserve  
Rules.

Form VI.  
Schedule.

**PART IV  
COMMERCIAL FISHING, RESEARCH, SPORT FISHING  
LICENCES AND REGISTRATION OF DIVE BOATS**

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|---|--|
| <p>9. (1) Any person who is desirous of fishing within the Reserve shall apply to the Fisheries Administrator for a commercial fishing licence in the prescribed form set out as Form I of the Schedule</p> <p>(2) The Fisheries Administrator may within fourteen (14) days of the receipt of an application under this regulation grant a fishing licence in the prescribed form set out as Form II of the Schedule after consultation with the advisory committee.</p> <p>(3) Upon the expiry of a fishing licence granted under these Regulations, the license holder may apply to the Fisheries Administrator for a renewal of the same in prescribed form set out as Form I of the Schedule.</p> <p>(4) A fee of (\$25.00) shall be payable upon the receipt of a fishing licence or for the renewal of the same.</p> | <p>Commercial fishing licences.<br/>Form I.</p>  |
| <p>10. (1) Any person who is desirous of conducting research shall apply to the Fisheries Administrator for a licence to do so in the prescribed form set out as Form III of the Schedule.</p> <p>(2) The Fisheries Administrator may within fourteen (14) days of the receipt of an application under this regulation issue or grant a licence in writing to conduct research.</p> <p>(3) The Fisheries Administrator shall set conditions for research licences issued under these regulations.</p> <p>(4) (a) A fee of \$500.00BZ shall be payable upon the receipt of a research licence or for the renewal of same.</p> <p>(b) The Fisheries Administrator may in his discretion, waive or vary the fee payable for a research licence.</p>  | <p>Research licences.<br/>Form III.</p>  |
| <p>11. (1) Any person who is desirous of conducting sport/recreational fishing within the Reserve shall apply to the Fisheries Administrator or the Reserve Manager for a fishing licence in the prescribed form set up as Form IV of the Schedule.</p> <p>(2) The Fisheries Administrator or the Reserve Manager, as the case may be, may grant a fishing license in the prescribed form set up as Form V of the Schedule.</p> <p>(3) A fee of \$100.00BZ shall be payable upon receipt of a sports fishing licence.</p> <p>(4) The licensee shall not kill any fish caught under a sport fishing license.</p>   | <p>Sport/<br/>recreational fishing licence.<br/>Form IV.<br/>Schedule.<br/>Form V.<br/>Schedule.</p> |

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| 12. (1) Any boat operator who is desirous of conducting SCUBA diving/snorkeling within the Reserve shall apply to the Fisheries Administrator for registration in the prescribed form set up as Form VI of the Schedule.<br>(2) A fee of \$100.00BZ shall be payable upon registration of the boat.<br>(3) Boat registration under this section shall expire on the 31 <sup>st</sup> December of any year inclusive. | Registration of Dive Boats. Form VI. Schedule. |
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**PART IV  
LICENCES**

- |   |                                   |
|---|-----------------------------------|
| 13. Licences issued under these regulations shall not be transferable.  | Licences not transferable.        |
| 14. Licences issued under these regulations, unless otherwise stated, shall be valid until December 31 of any year and maybe renewed for like period upon payment of the fees specified in these regulations.   | Duration and renewal of licences. |
| 15. The Fisheries Administrator may cancel any licence granted under these regulations if the license holder breaches any conditions of the licence or contravenes any provision of these regulations or the Fisheries Regulations.                     | Cancellation of licences.         |
| 16. In issuing a licence under these regulations, the Fisheries Administrator may attach conditions to such licences, as the case may be, having due regard to the nature of the licence and the need to protect the environment and natural resources. | Condition of licences.            |

**PART V  
GENERAL**

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| 17. Any person in an accident which involves personal injury or damage to property or the environment within the Reserve shall report such accident to the person in charge of the Reserve or to any officer of the Reserve or the Fisheries Administrator as soon as possible or at least within twelve (12) hours of the occurrence of the accident. | Duty to report accident.                   |
| 18. The Government shall not be liable for any personal injury or damage to property occurring within the Reserve.   | Non-liability of Government.               |
| 19. Notwithstanding the provisions of these regulations, the Fisheries Regulations shall apply within the Reserve.   | Application of Fisheries Regulations       |
| 20. The Reserve Office shall be open daily to the public between the hours of 6:00 a.m. to 6:00 p.m.   | Opening days of Reserve.<br>Prohibition of |

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21. (1) For all water recreational activities, excluding sports and recreational fishing, fees shall be as follows: Admission fees.
- (a) Swimmers/Snorkelers \$ 10.00 per person per day in the General Use Area.
  - (b) Scuba \$30.00 per person per week in the General Use Area.
  - (c) Scuba \$ 100.00 per person in the Spawning Area.
  - (d) Snorkel \$50.00 per person in the Spawning Area.
  - (e) Belizeans will pay \$15.00 per person in the Spawning Area.
- (2) No fees shall be payable by Belizeans and foreign children below twelve years of age.
22. Without prejudice to the activities prohibited by the Fisheries Act and the Penalties prescribed therein, no person shall-
- (a) Remove, damage or have in his possession any flora, fauna or part thereof except under a license issued by the Fisheries Administrator;
  - (b) Deposit any material in or on the waters of the Reserve, except in the case where a license to do so has been issued by the Fisheries Administrator;
  - (c) Deface or tamper with any sign, buoy or notice which is installed in the Reserve.
23. (1) The Fisheries Administrator may designate certain areas as special development areas.
- (2) No person shall within the Reserve engage in water activities outside of the designated areas.
24. All commercial, recreational and sport fishermen shall render the weight of fish caught within the Reserve to the Reserve Rangers upon request.
25. Any person employed (technician, conservation officer, Assistant Fisheries Officer or Fisheries Officer) by the Reserve for the purpose of management of the Reserve, shall be a Fisheries Officer to uphold the Reserve Regulations as well as the Fisheries Regulations.
26. (1) Any person who contravenes any of the provisions of and these regulations is guilty of an offence and liable on summary conviction to a fine not exceeding five hundred dollars or to imprisonment for a period not exceeding six months, or to both such fine and imprisonment.
- (2) Notwithstanding sub-regulation (1) any person who damages corals shall pay a penalty of five hundred dollars and an additional penalty may be imposed based on the assessed damage but such penalty shall not exceed five hundred dollars.

**MADE** by the Minister of Agriculture and Fisheries this 30th day of June, 2003.

**(SERVULO BAEZA)**

*Minister of Agriculture and Fisheries*

## Annex Three

### SCHEDULE OF FEES

**Protected Area Entrance Fee:** A park entrance fee is required for all visitors to enter any of the three marine protected areas co-managed by Southern Environmental Association. These fees are to be paid for each entry into the protected area and will allow access to the protected area only for the duration of the filming/photography schedule agreed to by Southern Environmental Association and the applicant in the FILMING PERMIT. The entrance fee does not automatically grant exclusive rights to film crews, photographers or media personnel to access any location within any of the respective marine protected areas. Grantees of a permit must remain within the specific designated locations to conduct all activities as agreed to by Southern Environmental Association and the grantee in the permit agreement.

Laughing Bird Caye National Park US \$10  
Gladden Spit & Silk Cayes Marine Reserve US \$10  
Sapodilla Cayes Marine Reserve US \$10

**Whale Shark Zone Entrance Fee:** All visitors to the Whale Shark Zone at Gladden Spit & Silk Cayes Marine Reserve are subject to an entrance fee. This fee is to be paid for each entry into the Whale Shark Zone and will allow access to the protected area only for the duration of the filming/photography schedule agreed to by Southern Environmental Association and the applicant in the FILMING PERMIT.

Whale Shark Zone Entrance Fee US \$15

**Administrative Fee:** An administrative fee will be levied to cover the cost associated with the actual site usage. These fees are as follows for Laughing Bird Caye National Park, Gladden Spit and Silk Cayes Marine Reserve and Sapodilla Cayes Marine Reserve:

- Photographers shooting 1-4 days are subject to an administrative fee of US \$500 with US\$ 100 for each additional day.
- Film crews shooting 1-4 days are subject to an administrative fee of US \$2000 with US \$300 for each additional day.

### PROHIBITED ACTIVITIES

All activities within the marine protected areas must be conducted in accordance with the respective rules and regulations that govern each marine protected area. Upon approval, permit grantees shall be supplied with a list of prohibited activities, as laid out in the regulations for each marine protected area, which has the potential to damage or significantly alter marine resources.

## **RESTRICTIONS AND CONDITIONS**

**Diving Activities:** Southern Environmental Association will determine the extent of allowable dives, including dive depths and schedule for dives. If filming / photographing activities are taking place within the Whale Shark Zone, film crews are required to adhere to the Whale Shark Zone Guidelines, inclusive of time allotted per dive, maximum depth and hours permitted to dive.

**Vessel Requirements:** Film crews, photographers and media personnel must rent a dedicated boat and shall use the services of a captain and assistant approved by Southern Environmental Association. A list of approved boat captains and assistants shall be supplied upon request.

Film crews are allowed a maximum of four (4) crew members in the water at any given time, of which, one is to be an approved guide. Crews are to have at least two (2) people on the boat, which shall include the boat captain and boat captain's assistant. Film Crews are allowed a maximum of two (2) cameras or videos in water per dive. In an effort to mitigate any potential disruptions to the ongoing ecological processes at this site, requests for crew sizes exceeding six (6) individuals must be reviewed and approved on a case by case basis by Southern Environmental Association.

It shall be the responsibility of film crews, photographers and media personnel to carry satellite phones and radios in their emergency kit as a safety precaution.

**Supervisory Staff Requirements:** Filming within the Whale Shark Zone at Gladden Spit and Silk Cayes Marine Reserve must be accompanied by at least one whale shark accredited Dive Master or researcher approved by Southern Environmental Association. It will be the responsibility of film crews to cover this individual's fee for the duration of the filming activity.

Should Southern Environmental Association allow overnight stays at the Protected Areas, the film crew must be accompanied by an approved guide/dive master to supervise all night activities. The film crew would have to cover this individual's fee.

The Southern Environmental Association reserves the right to monitor activities as specified and agreed to in the permit.

**Filming/Photography Permit Conditions:** Upon approval, permits shall be developed by Southern Environmental Association which shall contain detailed terms and conditions of the permit and will be developed on a case by case basis. The permit shall also include Southern Environmental Association's policy for the payment of fees. The permit will only be considered a valid agreement upon signing by Southern Environmental Association and the permit grantee.

Southern Environmental Association reserves the right to request copies of the final production of video or photographic development to use for non-commercial purposes (i.e. educational, scientific, etc) that will enhance and promote the management of the marine

protected areas that it co-manages.

#### **DENIAL OF REQUEST FOR PERMIT**

Requests for a FILMING PERMIT may be denied if it is the opinion of the Southern Environmental Association's Executive Director, Protected Area Manager or other qualified technical consultants that the proposed activities:

- Represents a potential harm or impact on the protected areas' natural, cultural or recreational resources or may create health or safety risks, or disrupt visitor use and enjoyment;
- It is determined that supervisory requirements for the proposed activities will place unreasonable burdens on protected area staff, regardless of the applicant's willingness to pay for supervisory costs;
- The proposed filming or photography would conflict with visitors' normal use of the marine protected area.

#### **TERMINATION OF PERMIT**

All filming or photography permits issued by Southern Environmental Association are "revocable" on 24 hours notice or WITHOUT NOTICE if the terms of the permit are violated. Deliberate infractions of the terms of the filming permit or the deliberate making of false or misleading statements concerning intended actions in order to obtain a permit are causes for immediate termination of the permit and cause for possible prosecution. Permits will be revoked if damage to resources or facilities is threatened, or if there is a clear danger to public health or safety.

Completed application forms for FILMING PERMITS within Marine Protected Areas co-managed by Southern Environmental Association can be sent with cashier's check or money order for US \$50 made out to Southern Environmental Association.

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**Annex Four**

Fish Species of Gladden Spit and Silk Cayes Marine Reserve			
Family	Species	Common name	IUCN
Acanthuridae	<i>Acanthurus bahianus</i>	Ocean surgeonfish	
	<i>Acanthurus chirurgicus</i>	Doctorfish	
	<i>Acanthurus coeruleus</i>	Blue tang	
Albulidae	<i>Albula vlupes</i>	Bonefish	
Apogonidae	<i>Apogon bintatus</i>	Barred Cardinalfish	
	<i>Apogon lachneri</i>	Whitestar cardinalfish	
	<i>Apogon maculatus</i>	Flamefish	
	<i>Apogon townsendi</i>	Twospot cardinalfish	
	<i>Apogon robinsi</i>	Roughlip Cardinalfish	
	<i>Apogon stellatus</i>	Conchfish	
Aulostomidae	<i>Aulostomus maculatus</i>	Trumpetfish	
Balistidae	<i>Aluterus schoepfi</i>	Orange filefish	
	<i>Balistes capriscus</i>	Gray triggerfish	
	<i>Balistes vetula</i>	Queen triggerfish	VU
	<i>Cantherdermis sufflamen</i>	Ocean triggerfish	
	<i>Cantherhines macrocerus</i>	Whitespotted filefish	
	<i>Cantherhines pullus</i>	Orangespotted filefish	
	<i>Melichthys niger</i>	Black durgon	
	<i>Monocanthus tuckeri</i>	Slender filefish	
	<i>Xanthichthys ringens</i>	Sargassum triggerfish	
	Batrachoides	<i>Batrachoides gilberti</i>	Large eye toadfish
<i>Sanopus barbatus</i>		Bearded toadfish	
<i>Sanopus greenfieldorum</i>		Whitelined toadfish	VU
<i>Sanopus splendidus</i>		Splendid toadfish	VU
Belonidae	<i>Ablennes hiannes</i>	Flat needlefish	
	<i>Strongylura notata</i>	Redfin needlefish	
	<i>Tylosurus crocodilus</i>	Houndfish	
Bothidae	<i>Bothus lunatus</i>	Peacock flounder	
Carangidae	<i>Caranx batholomaei</i>	Yellow jack	
	<i>Caranx crysos</i>	Blue runner	
	<i>Caranx hippos</i>	Crevalle jack	
	<i>Caranx latus</i>	Horse-eye jack	
	<i>Caranx lugubris</i>	Black jack	
	<i>Caranx ruber</i>	Bar jack	
	<i>Decapterus macarellus</i>	Mackerel scad	
	<i>Elagatis bipinnulata</i>	Rainbow runner	
	<i>Trachinotus falcatus</i>	Permit	
<i>Trachinotus goodei</i>	Palometa		



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Carcharhinidae	<i>Carcharhinus leucas</i>	Bull shark	
	<i>Carcharhinus limbatus</i>	Blacktip shark	
	<i>Carcharhinus perezi</i>	Caribbean Reef Shark	
	<i>Carcharhinus falciformis</i>	Silky shark	
	<i>Carcharhinus acronotus</i>	Blacknose shark	
	<i>Galeocerdo cuvier</i>	Tiger Shark	
	<i>Negaprion brevirostris</i>	Lemon shark	
	<i>Rhizoprionodon porosus</i>	Caribbean Sharpnosed shark	
	<i>Carcharhinus brevipinna</i>	Spinner Shark	
	<i>Carcharhinus galapagensis</i>	Galapagos shark	
Centropomidae	<i>Centropomus undecimalis</i>	Common snook	
Chaenopsidae	<i>Emblemariopsis diana</i>	Orangeflag blenny	
Chaetodontidae	<i>Chaetodon aculeatus</i>	Longsnout butterflyfish	
	<i>Chaetodon capistratus</i>	Foureye butterflyfish	
	<i>Chaetodon ocellatus</i>	Spotfin butterflyfish	
	<i>Chaetodon sedentarius</i>	Reef butterflyfish	
	<i>Chaetodon striatus</i>	Banded butterflyfish	
Cirrhitidae	<i>Amblycirrhitus pinos</i>	Red-spotted hawkfish	
Clinidae	<i>Acanthemblemaria spinosa</i>	Spinyhead blenny	
	<i>Chaenopsis ocellata</i>	Bluethroat pike blenny	
	<i>Emblemaria pandionis</i>	Sailfin blenny	
	<i>Lucayablennius zingaro</i>	Arrow blenny	
	<i>Malacoctenus boehlkei</i>	Diamond blenny	
	<i>Malacoctenus macropus</i>	Rosy blenny	
	<i>Malacoctenus triangulatus</i>	Saddled blenny	
	<i>Ophioblennius atlanticus</i>	Redlip blenny	
Congridae	<i>Heteroconger halis</i>	Garden eel	
Dasyatidae	<i>Dasyatis americana</i>	Southern stingray	
	<i>Dasyatis gutatta</i>	Longnose stingray	
	<i>Himantura schmardae</i>	Chupare stingray	
Diodontidae	<i>Diodon holocanthus</i>	Balloonfish	
	<i>Diodon hystrix</i>	Porcupinefish	
Echeneidae	<i>Echeneis neucratoides*</i>	Whitefin sharksucker	
Elopidae	<i>Megalops atlanticus</i>	Tarpon	
Ephippidae	<i>Chaetodipterus faber</i>	Atlantic spadefish	
Exocoetidae	<i>Hirundichthys speculiger</i>	Mirrorwing flyingfish	
Gerreidae	<i>Eucinostomus lefroyi</i>	Mottled mojarra	
	<i>Gerres cinereus</i>	Yellowfin mojarra	
Ginglymostomidae	<i>Ginglymostoma cirratum</i>	Nurse shark	
Gobiesocidae	<i>Tomicodon briggsi</i>		
	<i>Tomicodon clarkei</i>		
	<i>Tomicodon lavettsmithi</i>		

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Gobiidae	<i>Ctenogobius saepapellans</i>	Dash goby	
	<i>Coryphopterus dicrus</i>	Colon goby	
	<i>Coryphopterus eidolon</i>	Pallid goby	
	<i>Coryphopterus galucofraenum</i>	Bridled goby	
	<i>Coryphopterus lipernes</i>	Peppermint goby	
	<i>Coryphopterus personatus</i>	Masked goby	
	<i>Gnatholepsis thompsoni</i>	Goldspot goby	
	<i>Gobionellus saepepallens</i>	Dash goby	
	<i>Gobiosoma dilepsis</i>	Orangesided goby	
	<i>Gobiosoma evelynae</i>	Sharknose goby	
	<i>Gobiosoma genie</i>	Cleaning goby	
	<i>Gobiosoma horsti</i>	Yellowline goby	
	<i>Gobiosoma illecebrosus</i>	Barsnout goby	
	<i>Gobiosoma prochilos</i>	Broadstripe goby	
	<i>Elacatinus colini</i>		
	<i>Elacatinus lobeli</i>		
	<i>Elacatinus lori</i>		
	<i>Lophogobius cyprinoides</i>	Crested goby	
Grammistinidae	<i>Gramma loreto</i>	Fairy basslet	
	<i>Gramma melacara</i>	Blackcap basslet	
	<i>Liopropoma rubre</i>	Peppermint basslet	
Haemulidae	<i>Anisotremus surinamensis</i>	Black margate	
	<i>Anisotremus virginicus</i>	Porkfish	
	<i>Haemulon album</i>	White margate	
	<i>Haemulon aurolineatum</i>	Tomtate	
	<i>Haemulon carbonarium</i>	Caesar grunt	
	<i>Haemulon chrysargyreum</i>	Smallmouth grunt	
	<i>Haemulon flavolineatum</i>	French grunt	
	<i>Haemulon macrostomum</i>	Spanish grunt	
	<i>Haemulon melanurum</i>	Cottonwick	
	<i>Haemulon parra</i>	Sailor's choice	
	<i>Haemulon plumieri</i>	White grunt	
	<i>Haemulon sciurus</i>	Bluestriped grunt	
	<i>Haemulon striatum</i>	Striped grunt	
Hemiramphidae	<i>Hemiramphus brasiliensis</i>	Ballyhoo	
Holocentridae	<i>Holocentrus adscensionis</i>	Squirrelfish	
	<i>Holocentrus rufus</i>	Longspine squirrelfish	
	<i>Sargocentron coruscum</i>	Reef squirrelfish	
	<i>Sargocentron vexillarium</i>	Dusky squirrelfish	
	<i>Myripristis jacobus</i>	Blackbar soldierfish	
	<i>Neoniphon marianus</i>	Longjaw squirrelfish	
	<i>Priacanthus arenatus</i>	Bigeye	

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Inermiidae	<i>Emmelichthys atlanticus</i>	Bonnetmouth	
	<i>Inermia vittata</i>	Boga	
Kyphosidae	<i>Kyphosus sectatrix</i>	Bermuda chub	
Labridae	<i>Bodianus pulchellus</i>	Spotfin hogfish	
	<i>Bodianus rufus</i>	Spanish hogfish	
	<i>Clepticus parrae</i>	Creole wrasse	
	<i>Doratonatus megalepis</i>	Dwarf wrasse	
	<i>Halichoeres bivittatus</i>	Slippery dick	
	<i>Halichoeres cyanocephalus</i>	Yellowcheek wrasse	
	<i>Halichoeres garnoti</i>	Yellowhead wrasse	
	<i>Halichoeres maculipinna</i>	Clown wrasse	
	<i>Halichoeres radiatus</i>	Puddingwife	
	<i>Hemipteronotus novacula</i>	Pearly razorfish	
	<i>Lachnolaimus maximus</i>	Hogfish	VU
	<i>Thalassoma bifasciatum</i>	Bluehead wrasse	
	<i>Xyrichtys martinicensis</i>	Rosy razorfish	
	<i>Xyrichtys spendens</i>	Green razorfish	
Labridomidae	<i>Malacoctenus triangulatus</i>	Saddled blenny	
Lutjanidae	<i>Lutjanus analis</i>	Mutton snapper	VU
	<i>Lutjanus apodus</i>	Schoolmaster	
	<i>Lutjanus cyanopterus</i>	Cubera snapper	VU
	<i>Lutjanus griseus</i>	Grey Snapper	
	<i>Lutjanus jocu</i>	Dog snapper	
	<i>Lutjanus mahogani</i>	Mahogany snapper	
	<i>Lutjanus synagris</i>	Lane Snapper	
	<i>Ocyurus chrysurus</i>	Yellowtail snapper	
Malacanthidae	<i>Malacanthus plumieri</i>	Sand tilefish	
Mobulidae	<i>Manta birostris</i>	Atlantic manta	
	<i>Mobula hypostoma</i>	Devil ray	
Monacanthidae	<i>Cantherhines pullus</i>		
	<i>Cantherhines macrocerus</i>	Whitespotted filefish	
	<i>Aluterus scriptus</i>	Scrawled Filefish	
Mugilidae	<i>Mugil curema</i>	White mullet	
Mullidae	<i>Mulloidichthys martinicus</i>	Yellow goatfish	
	<i>Pseudopeneus maculatus</i>	Spotted goatfish	
Muraenidae	<i>Enchelycore carychroa</i>	Chestnut moray	
	<i>Gymnothorax funebris</i>	Green moray	
	<i>Gymnothorax miliaris</i>	Goldentail moray	
	<i>Gymnothorax moringa</i>	Spotted moray	
	<i>Gymnothorax vicinus</i>	Purplemouth moray	
Myliobatidae	<i>Aetobatus narinari</i>	Spotted eagle ray	
Ogcocephalidae	<i>Ogcocephalus nasutus</i>	Shortnose batfish	

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Ophichthidae	<i>Myrichthys breviceps</i>	Sharptail eel	
Opisthognathidae	<i>Opistognathus aurifrons</i>	Yellowhead jawfish	
	<i>Opistognathus macrognathus</i>	Banded jawfish	
	<i>Opistognathus whitehurstii</i>	Dusky jawfish	
Ostraciidae	<i>Acanthostracion polygonia</i>	Honeycomb cowfish	
	<i>Acanthostracion quadricornis</i>	Scrawled cowfish	
	<i>Lactophrys bicaudalis</i>	Spotted trunkfish	
	<i>Lactophrys trigonus</i>	Buffalo trunkfish	
	<i>Lactophrys triqueter</i>	Smooth trunkfish	
Pempheridae	<i>Pempheris schomburgki</i>	Glassy sweeper	
Pomacanthidae	<i>Holacanthus ciliaris</i>	Queen angelfish	
	<i>Holacanthus tricolor</i>	Rock beauty	
	<i>Pomacanthus arcuatus</i>	Grey angelfish	
	<i>Pomacanthus paru</i>	French angelfish	
	<i>Holacanthus ciliaris</i>	Queen angelfish	
Pomacentridae	<i>Abudefduf saxatilis</i>	Sergeant major	
	<i>Abudefduf taurus</i>	Night sergeant	
	<i>Chromis cyanea</i>	Blue chromis	
	<i>Chromis insolata</i>	Sunshinefish	
	<i>Chromis multilineata</i>	Brown chromis	
	<i>Microspathodon chrysurus</i>	Yellowtail damselfish	
	<i>Stegastes diencaeus</i>	Longfin damselfish	
	<i>Stegastes adustus</i> <sup>6</sup>	Dusky damselfish	
	<i>Stegastes leucostictus</i>	Beaugregory	
	<i>Stegastes partitus</i>	Bicolor damselfish	
	<i>Stegastes planifrons</i>	Threespot damselfish	
	<i>Stegastes variabilis</i>	Cocoa damselfish	
Priacanthidae	<i>Priacanthus arenatus</i>	Bigeye	
	<i>Priacanthus cruentatus</i>	Glasseye snapper	
Rhincodontidae	<i>Rhincodon typus</i>	Whale shark	
Scaridae	<i>Scarus coelestinus</i>	Midnight parrotfish	
	<i>Scarus coeruleus</i>	Blue parrotfish	
	<i>Scarus guacamaia</i>	Rainbow parrotfish	VU
	<i>Scarus iserti</i>	Striped parrotfish	
	<i>Scarus taeniopterus</i>	Princess parrotfish	
	<i>Scarus vetula</i>	Queen parrotfish	
	<i>Sparisoma atomarium</i>	Greenblotch parrotfish	
	<i>Sparisoma aurofrenatum</i>	Redband parrotfish	
	<i>Sparisoma chrysopterus</i>	Redtail parrotfish	
	<i>Sparisoma radians</i>	Bucktooth parrotfish	
	<i>Sparisoma rubripinne</i>	Yellowtail parrotfish	

<sup>6</sup> Formerly classified as *S. fuscus*, but now considered to be a separate species

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	<i>Sparisoma viride</i>	Stoplight parrotfish	
	<i>Cryptotomus roseus</i>	Bluelip parrotfish	
Sciaenidae	<i>Equetus acuminatus</i>	Highhat	
	<i>Equetus punctatus</i>	Spotted drum	
	<i>Equetus umbrosus</i>	Cubbyu	
	<i>Odontoscion dentex</i>	Reef croaker	
Scombridae	<i>Scomberomorus regala</i>	Cero	
Scorpaenidae	<i>Scorpaena plumieri</i>	Spotted scorpionfish	
Serranidae	<i>Alphesthes afer</i>	Mutton hamlet	
	<i>Cephalopholis fulvus</i>	Coney	
	<i>Cephalopholis s cruentatus</i>	Graysby	
	<i>Epinephelus adscensionis</i>	Rock hind	
	<i>Epinephelus guttatus</i>	Red hind	
	<i>Epinephelus inermis</i>	Marbled grouper	
	<i>Epinephelus itajara</i>	Goliath grouper	CR
	<i>Epinephelus morio</i>	Red grouper	
	<i>Epinephelus striatus</i>	Nassau grouper	EN
	<i>Hypoplectrus aberrans</i>	Yellowbelly hamlet	
	<i>Hypoplectrus chlorurus</i>	Yellowtail hamlet	
	<i>Hypoplectrus gemma</i>	Blue hamlet	
	<i>Hypoplectrus gummingatta</i>	Golden hamlet	
	<i>Hypoplectrus guttavarius</i>	Shy hamlet	
	<i>Hypoplectrus indigo</i>	Indigo hamlet	
	<i>Hypoplectrus nigricans</i>	Black hamlet	
	<i>Hypoplectrus puella</i>	Barred hamlet	
	<i>Hypoplectrus unicolor</i>	Butter hamlet	
	<i>Mycteroperca bonaci</i>	Black grouper	
	<i>Mycteroperca interstitialis</i>	Yellowmouth grouper	
	<i>Mycteroperca rubra</i>	Comb grouper	
	<i>Mycteroperca tigris</i>	Tiger grouper	
	<i>Mycteroperca venenosa</i>	Yellowfin grouper	
	<i>Paranthias furcifer</i>	Creole-fish	
	<i>Rypticus saponaceus</i>	Greater soapfish	
	<i>Serranus baldwini</i>	Lantern bass	
	<i>Serranus flaviventris</i>	Twinspot bass	
	<i>Serranus tabacarius</i>	Tobaccofish	
	<i>Serranus tigrinus</i>	Harlequin bass	
	<i>Serranus tortugarium</i>	Chalk bass	
Sparidae	<i>Calamus bajonado</i>	Jolthead progy	
	<i>Calamus calamus</i>	Saucereye porgy	
Sphyraenidae	<i>Sphyraena barracuda</i>	Barracuda	
	<i>Sphyraena picudilla</i>	Southern sennet	

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Sphyrnidae	<i>Sphyrna mokarran</i>	Great Hammerhead	
	<i>Sphyrna lewini</i>	Scalloped hammerhead	
	<i>Sphyrna tiburo</i>	Bonnethead	
Sygnathidae	<i>Cosmocampus elucens</i>	Shorthorn pipefish	
	<i>Hippocampus erectus</i>	Northern seahorse	VU
Synbranchidae	<i>Ophisternon aenigmaticum</i>	Obscure swamp eel	
Synodontidae	<i>Synodus intermedius</i>	Sand diver	
	<i>Synodus saurus</i>	Bluestriped lizardfish	
Tetraodontidae	<i>Canthigaster rostrata</i>	Sharpnose puffer	
	<i>Chilomycterus antennatus</i>	Bridled burrfish	
	<i>Chilomycterus antillarum</i>	Web burrfish	
	<i>Diodon holocanthus</i>	Balloonfish	
	<i>Diodon hystrix</i>	Porcupinefish	
	<i>Sphoeroides spengleri</i>	Bandtail puffer	
	<i>Sphoeroides testudineus</i>	Checkered pufferfish	
Triakidae	<i>Mustelus canis</i>	Dusky smooth hound	
Triglidae	<i>Prionotus ophryas</i>	Bandtail searobin	
Tripterygiidae	<i>Enneanectes altivelis</i>	Lofty tripletail	
	<i>Enneanectes atorus</i>	Blackedge triplefin	
Urolophidae	<i>Urolophus jamaicensis</i>	Yellow stingray	