Sapodilla Cayes Marine Reserve

Management Plan

2011 – 2016

A component of Belize's

World Heritage Site

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Sapodilla Cayes Marine Reserve

We would like to thank the Board members, programme managers and staff of the Southern Environmental Association, and more specifically of the Sapodilla Cayes Marine Reserve, for their participation and input into this management plan. Special thanks also go Isaias Majil (Fisheries Department), and to all stakeholders who participated in the workshops and meetings of the management planning process – particularly the tour guides and fishermen of Punta Gorda, who provided important input into the planning. A number of other people also provided technical input outside of the planning meetings and forums – particular thanks go to Melanie McField, Rachel Graham, Burton Shank, Adele Catzim and Guiseppe di Carlo, Lee Jones, Bert Frenz, John Tschirky, Russel, Vincente, Mrs. Garbutt, Armando, ReefCI, Adele Catzim and Guiseppe di Carlo.

We would also like to thank Jocelyn Rae Finch and Timothy Smith for all their assistance in the preparation of the management plan, to Adam Lloyd (GIS Officer, Wildtracks) for the mapping input, and to Hilary Lohmann (Wildtracks) for editing assistance. We also appreciate the input into the previous draft management plan by Jack Nightingale in 2004, which provided much of the historical perspective for this plan.

Financial support towards this management planning process was provided by NOAA (National Oceanic and Atmospheric Administration)

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Introduction

Background and Context

Sapodilla Cayes Marine Reserve is the most southern of the marine protected areas in Belize, and encompasses the southern-most tip of the Belize Barrier Reef. Covering an area of 38,595 acres (approximate 15,619 ha), the Marine Reserve surrounds fourteen palm-fringed sand or mangrove cayes, some considered to be among the most scenic within Belize.

The distinctive hook-shaped reef structure forms the end of the Belize Barrier Reef, and is unique within the Caribbean region (Kramer and Kramer, 2002). Sapodilla Caye Marine Reserve is located approximately 50km east of Punta Gorda, Toledo District, and encompasses the southern-most tip of the Belize Barrier Reef. The Marine Reserve includes twelve palm-fringed sand or mangrove cayes, considered to be among the most scenic within Belize. The marine component consists mainly of submerged sand in shallow water of 3-10 meters; a carbonate pavement on the leeside of the reef crest; the reef crest; and shallow reef with shallow patches of reefs and sea grass beds. The reef drop-off occurs on three sides, with conditions that have resulted in the establishment of three nationally and regionally important spawning aggregation sites

SITE INFORMATION

Size: 38,594 acres (15,618 ha)
Preservation Zone 548 acres (222 ha)
Conservation Zone I 651 acres (264 ha)
Conservation Zone II 4,913 acres (1,988 ha)
General Use Zone 32,482 acres (13,145 ha)
Spawning Aggregations (3)*
Statutory Instrument: SI 50 of 2009
Original SI: SI 117 of 1996
Spawning Aggregation Site SI 161 of 2003
IUCN Category: IV
Management Authority: Fisheries Department
Co-management Partner:
Southern Environmental Association (SEA)
Contact E-mail: info@seabelize.org
Web site: www.seabelize.org

Location: Sapodilla Caye Marine Reserve is located approximately 75 km east of Punta Gorda, Toledo District, and encompasses the southern-most tip of the Belize Barrier Reef.
Uses: Extractive and Non-extractive – fishing, tourism, education and research.

Management Plan: In prep. (2010)
Biodiversity information: SEA, Fisheries Dept., Healthy Reefs, Conservation International (MMAS) and various independent researchers. UB research station on Hunting Caye.
Facilities (2009): Rangers station, tourism beach infrastructure.
Tourism Visitation (2009):
On-site Staff (2009): 1 head ranger, 2 rangers, supported by the SEA central office staff in Placencia

* Spawning aggregation sites partially overlap the marine protected area

The Sapodilla Cayes have long been used by Guatemalans, Hondurans, and to a lesser extent by Belizeans for swimming, snorkeling, diving and fishing. Despite their remoteness, these cayes are easily accessible by sea, and there is increasing tourism visitation from Punta Gorda. There is also ongoing annual visitation by small cruise ships, with facilities in place to provide visitors with amenities.

Hunting Caye provides a base for the reserve staff, and a research facility for the University of Belize and visiting students and researchers. Also based here are staff of Fisheries Department, and an outpost of the Belize Defense Force/Coast Guard.

Coral biodiversity is at its highest in Belize in the Sapodilla Cayes Marine Reserve, although impacts from increasing visitation and from agricultural runoff from the coastline to the south are thought to be reducing the viability of the coral and its ability to recover following bleaching.

The littoral forest provides an important connectivity point for migrating birds, as they travel south to their wintering areas, whilst the sandy beaches attract both nesting turtles and human visitors, the latter accessing the area from Punta Gorda as well as from communities on the Guatemalan and Honduran coastline.

Sapodilla Cayes Marine Reserve (SCMR) itself has been designated as one of seven components of the Belize Barrier Reef System - World Heritage Site, in recognition of the uniqueness of its contribution to Belize's reef system. It was designated to "*afford special protection to the aquatic flora and fauna …and to protect and preserve the natural breeding grounds and habitats of aquatic life*" (Fisheries Act, 1945, amended 1987).

In keeping with its designation as a Marine Reserve, SCMR is a multiple use area, supporting both commercial fishing and tourism activities. The reserve provides nursery and feeding habitats for at least twenty eight species of international concern, recognized under the IUCN Redlist as Critically Endangered, Endangered or Vulnerable (IUCN, 2010), including five species of coral, three species of turtle, thirteen species of fish and the vulnerable West Indian manatee. The Sapodilla Cayes have also historically provided nesting sites for hawksbill, green and loggerhead turtles, critical to the survival of these species within the region.

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

Sapodilla Cayes Marine Reserve is one of three protected areas managed by Southern Environmental Association (SEA), and a component of the Southern Belize Reef Complex. This five year management plan has been developed to provide guidance to SEA and the Fisheries Department, co-management partners, towards effective management of the Marine Reserve.

Its designation as part of Belize's World Heritage Site (1996) also brings certain criteria to be taken into consideration during the development of the management plan, as does its contribution to the Southern Belize Reef Complex system level planning initiative.

This is the third management plan developed for the Sapodilla Cayes Marine Reserve, the first being completed in 1996, with a more recent revision in 2004. Over this time period the uses of the protected area and status of the resources have changed, and the knowledge base has improved substantially from the many years of research and data collection carried out since its establishment. Management has changed from the Fisheries Department, to collaborative co-management with the Toledo Association for Sustainable Tourism and Empowerment (TASTE) and most recently, through a merger of TASTE and Friends of Nature (FoN) to form the Southern Environmental Association (SEA). The programmes in this Plan therefore address the current status of the Marine Reserve, as well as reflect the more participatory approach to management being adopted in Belize today.

The Management Plan includes general information on the physical and biological attributes of the Marine Reserve, documents the current uses and management problems, defines the goals and objectives of the Marine Reserve, summarizes conservation planning 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, the 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 and operational staff, and researchers, and 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.

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 on an annual basis by the Southern Environmental Association, based on the framework provided by this plan, with an annual review of implementation success, allowing for adaptive management over the five year period.

1. Current Status

1.1 Location

The Sapodilla Cayes Marine Reserve, part of the larger Southern Belize Reef Complex system-level planning unit, lies in the general area of 362 327 E, 1784 340 N (16˚, 8', 10.95" N; 88˚, 17', 15.15 " W), 50km east of Punta Gorda, Toledo District, and encompasses the southern-most tip of the Belize Barrier Reef (Map 1). Defined by SI 117 of 1996 (revised: SI 50 of 2009; Annexes One and Two), the Marine Reserve covers an area of 38,594 acres (approximate 155 km^2), with the eastern and western boundaries of the reserve following the 100 meter depth contours along the reef, and boundaries on the cayes being the high tide mark. It includes within its perimeter twelve sand or boulder cayes (Figure 1), considered to be among the most scenic in Belize, and held by private individuals, primarily under lease agreements with Government.

The Cayes of Sapodilla Cayes Marine Reserve

- Tom Owen's Caye East
- Tom Owen's Caye West
- Northeast Sapodilla Caye
- Frank's Caye main
- Frank's Caye east
- Frank's Caye west
- Nicholas Caye
- Hunting Caye
- Lime Caye
- Ragged Caye
- Seal Caye I
- Seal Caye II

+ two unnamed sand cayes

Figure 1

The marine component of the Marine Reserve consists primarily of submerged sand in shallow water of depths from 3 to 10 meters; a carbonate pavement on the leeside of the reef crest; the reef crest itself; and shallow patches of reefs and sea grass beds. The reef drop-off occurs on three sides, with conditions that have resulted in the establishment of three nationally and regionally important spawning aggregation sites (Nicholas Caye, Rise and Fall Bank and Seal Caye), defined and protected by Statutory Instrument in their own right (SI 161 of 2003), and a fourth (the Elbow) managed under similar regulations.

Access to the Marine Reserve is only by sea, and despite their remoteness, there is increasing tourism visitation from Punta Gorda, with boats originating primarily from the Belize mainland (Punta Gorda, Monkey River Village, and Placencia) and from Guatemala and Honduras. Boat traffic originating from Punta Gorda uses the Seal Caye channel, a 75 yards wide channel that separates Seal Caye from the "white reef" to the south. Visitors from Monkey River Village, Placencia, and further north access the Marine Reserve through the main or inner channel.

The Sapodilla Pass, a half-mile wide opening between Ragged and Lime Cayes in the south, is the most commonly used access point to and from Guatemala and Honduras, though Nicholas Cut, a

400-yard wide channel through the east reef, is also used by Guatemalan and Honduran coxswains.

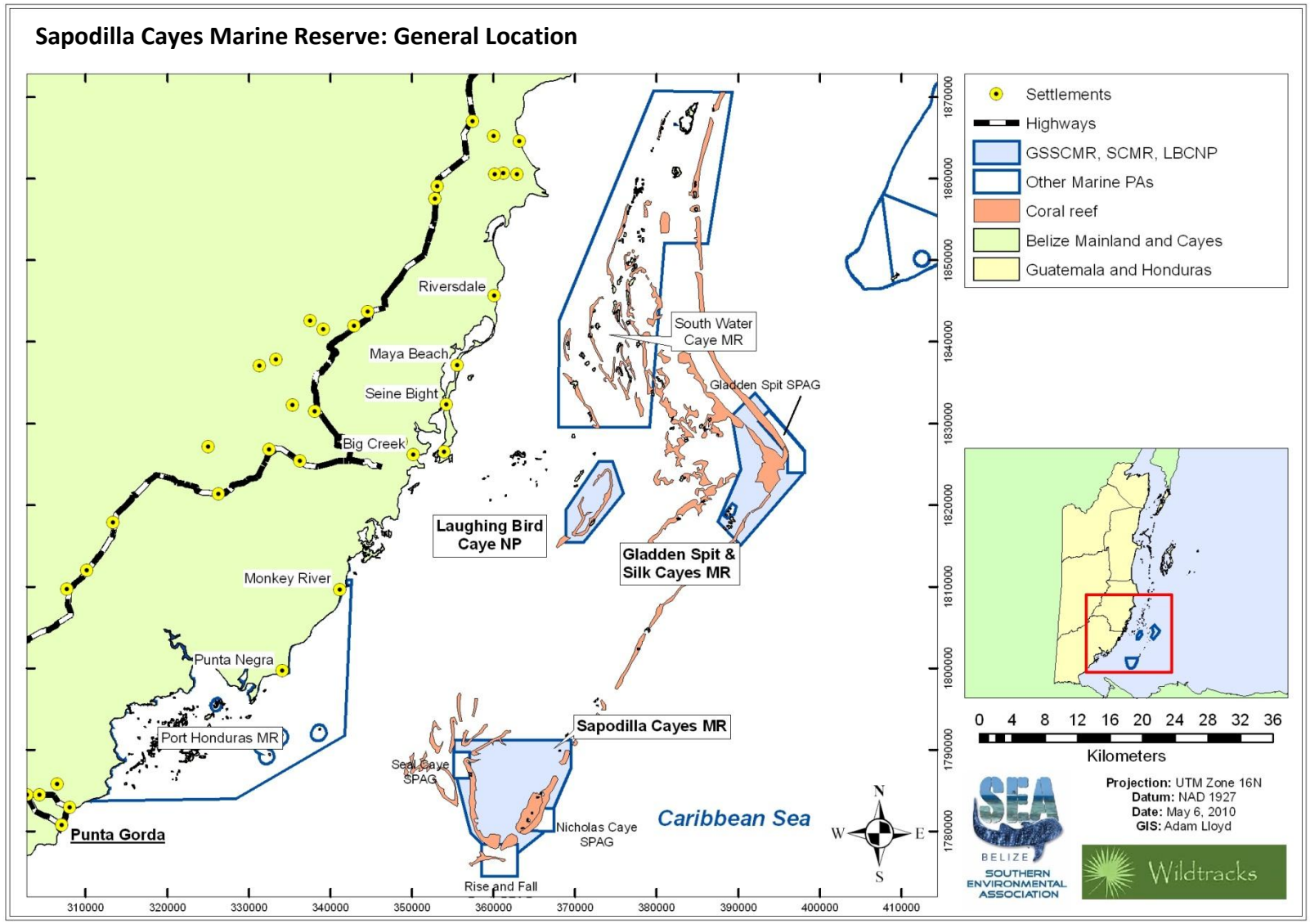
Hunting Caye provides a base for the reserve staff, and the University of Belize research facility, which hosts visiting students and researchers. Also based here are staff from SEA / Fisheries Department, focused on management of the protected area, two lighthouse keepers working under the Port Authority, and an outpost of the Belize Coast Guard.

Hunting Caye also serves as the focal point for tourism, with arriving visitors checking in at the Rangers' Station. The caye also acts as the immigration point for Honduran and Guatemalan visitors, with a resident Police Officer in the role of Acting Immigration Officer. Over the past eight years, a variety of tourism infrastructure has been constructed on the caye to try to mitigate the impacts of these and other visitors. Past infrastructure support for the Toledo Tour Guide Association and other local stakeholders includes bioremediation toilets, eco-friendly shower facilities, a new pier, and BBQ grills, as well as the building of a raised picnic area. These facilities are used not only by the tour guides and cruise ship visitors, but also by other visitors to the caye, and contribute to SEA's public use plan for the island (SEA Annual Report, 2008).

Lime, Seal and Tom Owen's Cayes are currently the only three cayes offering overnight catered accommodation for tourists (Site visit, 2010).

Whilst there are no communities directly adjacent to the marine reserve, several are considered as stakeholders. Local fishermen from Monkey River, Punta Negra and Punta Gorda have been operating within the reserve area from temporary camps on the cayes for approximately 30 years, and have long been considered to be the primary stakeholders within Belize, though use of the area has decreased significantly over the past four years.

There are also close links with communities in Guatemala (Livingston, Puerto Barrios) and Honduras – (Punta Manabique, Omoa and Puerto Cortes), with fast day tours, or sailing charters visiting the area for two to three days at a time, focused on a combination of fishing, snorkeling and diving.



Map 1: Sapodilla Cayes Marine Reserve: General Location

1.2 Regional Context

The Sapodilla Cayes Marine Reserve (SCMR) 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 km² of reef within its waters - 5.5% of the reefs of the Wider Caribbean (World Resources Institute, 2004). The Barrier Reef is included on a list of 18 richest centers of endemism and has been 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. However impacts are increasing - recent quantitative data on fish populations comparing 2002 and 2008 observations in the adjacent South Water Caye Marine Reserve indicate a staggering decline in populations of larger reef fish such as grouper, snapper, and triggerfish (Mumby, 2009[1]), increasing the importance of Sapodilla Cayes Marine Reserve's designated no-take areas within the National Protected Areas System, and the effective management of the General Use Zone, and the seasonal protection of the spawning aggregation sites.

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 staghorn and elkhorn corals (A*cropora cervicornis* and *Acropora palmata*), hawksbill turtle (*Eretmochelys imbricata*) and goliath grouper (*Epinephelus itajara*) The area also protects the endangered green and loggerhead turtles (*Chelonia mydas* and *Caretta caretta*). The SCMR also contributes towards the regional viability of important commercial species, including the Queen Conch (*Strombus gigas*) and spiny lobster (*Panulirus argus)*, and integrates protection of three recognized spawning aggregation sites: Nicholas Caye, Rise and Fall and Seal Caye.

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 being protection of the ecosystems of the marine environment (Table 1), following

[1] Report to the Belize Fisheries Department: Fishing Down the Foodweb (P. Mumby, 2009)

recognition of the regional importance of the Mesoamerican Barrier Reef System (MBRS), the majority of which lies within Belizean waters.

Table 1: International Conventions and Agreements of Relevance to Sapodilla Cayes Marine Reserve	
Convention on Biological Diversity (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. ***Sapodilla 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.***
Alliance for the Sustainable Development of Central America (ALIDES) (1994)	Regional alliance supporting sustainable development initiatives. ***Initiatives within the stakeholder communities of the Sapodilla Cayes Marine Reserve are targeted at facilitation of sustainable economic and environmental development, with the support of Fisheries Department and SEA.***
Central American Commission for Environment and Development (CCAD) (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. ***Data gathered through monitoring initiatives at the Sapodilla Cayes Marine Reserve have been shared regionally in the past through MBRS.***
Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (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. ***Sapodilla Cayes Marine Reserve and the three protected SPAG sites are an important and integral part in the national protected areas system, protecting biodiversity and threatened species, as per Belize's commitment under this Convention.***
Convention Concerning the Protection of the World Cultural and Natural Heritage (Paris, 1972)	The World Heritage Convention requires parties to take steps to identify, protect and conserve the cultural and natural heritage within their territories. ***Sapodilla Cayes Marine Reserve has been accepted as one of seven sites that together comprise the Belize Barrier Reef Reserve System World Heritage Site under the Convention. However, this WHS has recently been placed on the list of sites in Danger (WHS, 2009).***
International Convention for the Protection and Conservation of Sea Turtles for the Western Hemisphere (December 21st, 1997)	To protected and conserve sea turtle species of the Western Hemisphere. ***Sapodilla Cayes Marine Reserve protects important feeding areas for sea turtles, including the Critically Endangered hawksbill, and works in collaboration with caye owners for nest protection and monitoring.***
The UN Convention on the Law of the Sea (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.

The global importance of Sapodilla Cayes Marine Reserve was recognized in 1996, through its inclusion as one of a serial nomination of seven sites that comprise the Belize Barrier Reef System - World Heritage Site (Table 2), under the **Convention Concerning the Protection of World Culture and Natural Heritage representative of the Belize Barrier Reef Reserve System**, under criteria (iii), based on the classic examples of fringing, barrier and atoll reef types.

Table 2: The Seven Protected Areas of the Belize Barrier Reef World Heritage Site	
Site	**IUCN Category**
Bacalar Chico National Park and Marine Reserve	II (National Park) IV (Habitat/Species Management Area)
Laughing Bird Caye National Park	II (National Park)
Half Moon Caye Natural Monument	II (Natural Monument)
Blue Hole Natural Monument	III (Natural Monument)
Glover's Reef Marine Reserve	IV (Habitat/Species Management Area)
South Water Caye Marine Reserve	IV (Habitat/Species Management Area)
Sapodilla Cayes Marine Reserve	IV (Habitat/Species Management Area)

In 2009, however, Belize's World Heritage Site was placed on the danger list, following an assessment of the state of the seven marine protected areas and of the human impacts affecting them, triggered by reports of mangrove clearance in the adjacent South Water Caye Marine Reserve. The Government is currently drafting a series of strategies to address the concerns of the WHS committee, including the designation of a National Focal Point, with strengthened coordination between Government departments, through the establishment of a WHS Working Committee, as well as the strengthening of protection of terrestrial ecosystems of the cayes, the cessation of sale of lands within the World Heritage Sites and guidelines to control development of lands already under private ownership, as well as addressing the issues of overlapping oil concession areas. The future of Belize's World Heritage Site rests on this response, which is to be assessed at the World Heritage Committee at its 34th session in 2010.

Other concerns raised during the assessment that are more specifically related to Sapodilla Cayes Marine Reserve included the alteration of terrestrial ecosystems to maintain the aesthetically appealing sandy beaches, as a result of revenue generation mechanisms focused on tourism. The assessment also flagged the presence of invasive species such as *Casuarina,* coconuts and lionfish, and the limited management activities being implemented to address these.

Other regional initiatives have also been initiated, with the recognition of the increasing threats to the overall health of the reef system, the Governments of Mexico, Belize, Guatemala and Honduras (the four countries bordering the MBRS) committed themselves in June 1997 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. This has also brought a level of standardization to management and monitoring practices across the region, and provided investment into increasing management effectiveness.

Conservation of this Marine Reserve is also a step towards fulfilling Belize's international commitments under the **Convention on Biological Diversity**, signed in 1992, and 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 to the USA. 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

Sapodilla Cayes Marine Reserve is a national protected area, established in 1996 (SI 117 of 1996) under the **Fisheries Act** (1948), revised to include management zoning in 2009 (SI 50 of 2009). The protected area is currently managed by the Fisheries Department and the Southern Environmental Association, 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 are 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.

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

SAPODILLA CAYES MARINE RESERVE

SI 50 of 2009

ALL THAT portion of the Caribbean Sea being part thereof and being described as follows:

On the North bounded by an East-West line approximately 1,000 m. north of Tom Owen's Caye, on the East, South and West by the Gulf of Honduras therein enclosed, more particularly described as follows:

Commencing at a Point A Northeast of Tom Owen's Caye having scaled UTM coordinates 3 69 498 East 1791 221 North;

thence in a general westerly direction to a Point B Northwest of Seal Caye having scaled UTM coordinates 355 156 East 1791 221 North;

thence in a general southerly direction to a Point C Southwest of Seal Caye having scaled UTM coordinates 355 156 East 1787 804 North;

thence in a general Southeasterly direction to a Point D West of Ragged Caye having scaled UTM coordinates 357 21 0 East 1779 812 North;

thence in a general Southeasterly direction to a Point E Southwest of Ragged Caye having scaled UTM coordinates 359 601 East 1777 459 North;

thence in a general easterly direction to a Point F Southeast of Ragged Caye having scaled UTM coordinates 363 074 East 1777 459 North;

thence in a general northeasterly direction to a point G Southeast of Lime having scaled UTM coordinates 366 061 East 1779 812 North;

thence in a general northeasterly direction to a point H having scaled UTM coordinates 369 498 East 1787 804 North;

thence in a general northerly direction to the point of commencement.

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.

Sapodilla Cayes Marine Reserve is also 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 Sapodilla Cayes Marine Reserve, are designated under Fisheries Department as Marine Reserves, the remaining five being under Forest Department (Table 3). A serial designation also protects identified spawning aggregation sites within Belize, important for maintaining the viability of many commercial species. Three of these protected spawning aggregation sites lie in part within the boundaries of the Sapodilla Cayes Marine Reserve, and are managed as part of the protected area.

Table 3: 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[2]	38,594
Southwater Caye Marine Reserve	Fisheries Dept.	IV	118 of 1996	117,875
Swallow Caye Wildlife Sanctuary	Forest Dept. / FOSC	IV	102 of 2002	8,972

[2] Revised – SI 50 of 2009

History of Establishment

In the past, the Sapodilla Cayes have been a focus of conflicting sovereignty claims, and intensive and unregulated visitation by Honduran and Guatemalan fishermen and tour operators. This, combined with the identification of the Sapodilla Cayes as a key representative component of the Belize Barrier Reef, during the formation of the World Heritage Site, led to Belize declaring the cayes and surrounding marine environment as a protected area in 1996.

Site Status

Sapodilla Cayes Marine Reserve, originally designated under SI 117 of 1996, falls under the Fisheries Department of the Ministry of Agriculture and Fisheries, and management is guided by the Fisheries Act (1948, revised 1983) and Fisheries Department policies (Table 4). These allow for zoned multiple use, with areas open for extractive use and no-take areas, regulated under a zoning system that is embedded within the revised Statutory Instrument (SI 150 of 2009). There are a series of rules and regulations within the statutory instruments that guide all activities within the protected area – both tourism-related and commercial fishing practices.

Table 4: Categories of Protected Areas in Belize

Category	Legal Foundation	Purpose	Activities Permitted
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

The Marine Reserve also includes three of the eleven legislated spawning aggregation sites established under SI 161 of 2000 (Table 5), and considered vital for the maintenance of Belize's commercial finfish stocks. The Fisheries Department (through its on-site staff) and its partner, the Southern Environmental Association, are responsible for all management activities for the protected area and the spawning aggregation sites.

Table 5: 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.

Under the NPAPSP, government seeks to increase management effectiveness through grouping protected areas into system level management units. Sapodilla Cayes Marine Reserve is one of four protected areas (with South Water Caye Marine Reserve, Gladden Spit and Silk Cayes Marine Reserve and Laughing Bird Caye National Park) that, together, 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 6; Map 2).

System Level Management Unit	Protected Areas
Southern Belize Reef Complex *Total number of pas: 4 (including Spawning Aggregation Sites* *Total pa area: 182,447 acres* *Total seascape area:779,682 acres*	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
Maya Mountains Massif *Total number of pas: 14* *Total pa area: 1,260,800* *Total landscape area:1,260,800 acres*	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 Elijio Panti National Park; Sibun Forest Reserve; Sittee River Forest Reserve; Victoria Peak Natural Monument; Vaca Forest Reserve; (also includes Caracol Archaeological Site / IoA)
Maya Mountain Marine Corridor *Total number of pas: 10* *Total pa area: 619,933 acres* *Total landscape area:729,630 acres* *Total seascape area:100,000 acres*	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)

Table 6: 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

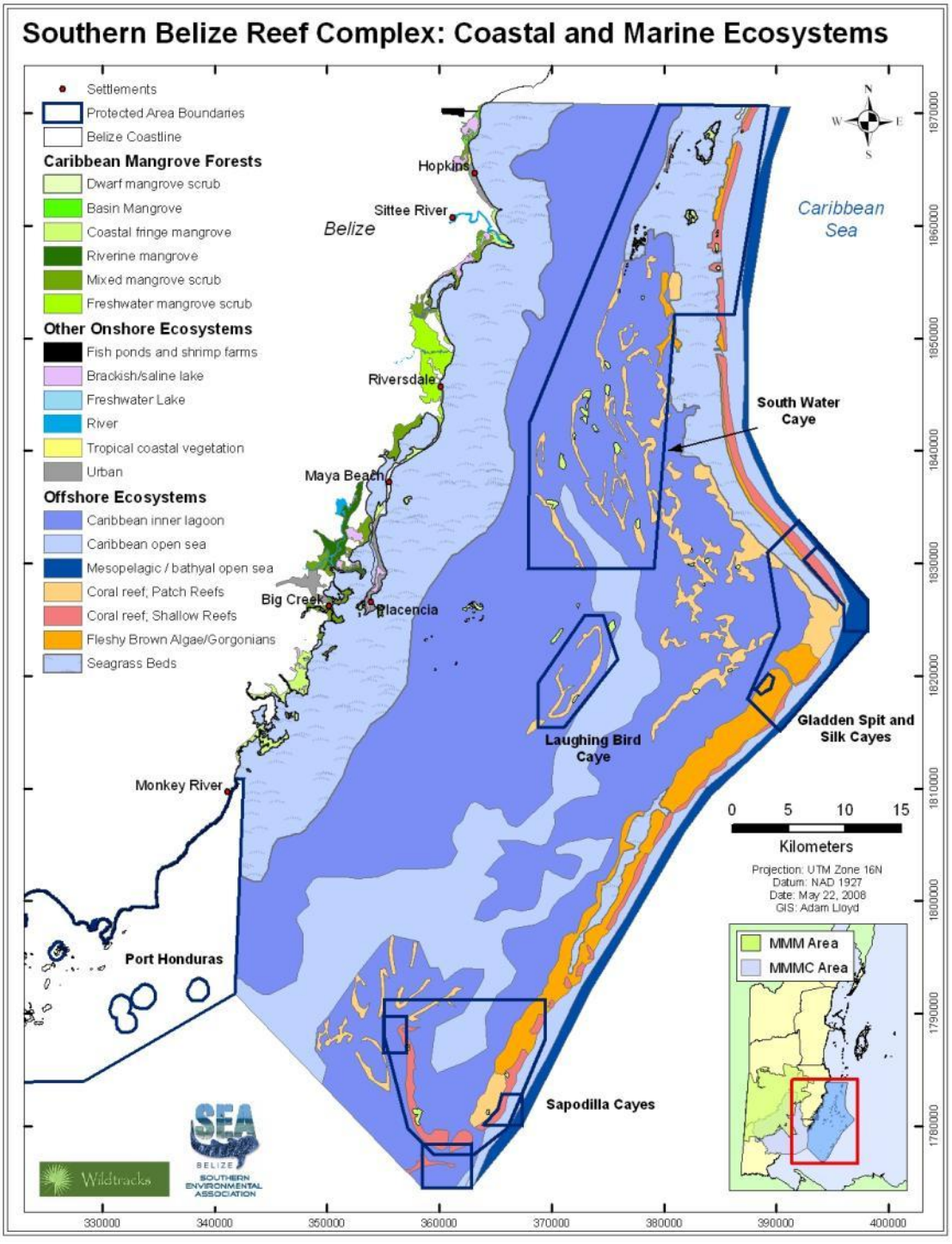
The **Southern Belize Reef Complex** (SBRC) stretches southwards from the northern boundary of South Water Caye Marine Reserve to the northern boundary of Port Honduras Marine Reserve, and south-eastwards from the coastline of Belize to the Sapodilla Cayes and the outer reef (Map 3). This area is characterized 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 Sapodilla Cayes Marine Reserve and three other marine protected areas - Gladden Spit and Silk 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 the commercial marine species. These resources are an integral part in the support of the cultural traditions of the coastal fishing communities.

> ***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*

As part of the Southern Belize Reef Complex, management of Sapodilla 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 the context of Sapodilla Cayes Marine Reserve, with privately owned / leased cayes located within 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. Whilst dredging activities have the potential to impact the Marine Reserve, of more immediate concern is that Sapodilla Cayes lies within the Island Oil Belize Ltd oil concession area - under the UNESCO review of the World Heritage Site (the Belize Barrier Reef Reserve System), a recommendation is made that protected areas within the BBRRS-WHS be excluded from mining and oil prospecting and extraction license areas.

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.

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 2), 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 2

1.3.2 Land and Sea Tenure

The Sapodilla Cayes have historically been a cause of conflict, with both Guatemala and Honduras staking a claim to the string of islands. Guatemala has a long standing claim that Belize (including the Sapodilla Cayes) is part of Guatemalan territory. Honduras, too, claims that the cayes are part of the Roatan chain of islands, which it enshrined in its constitution as part of its national territory in 1982. The 1859 treaty between Honduras and Guatemala, however, implied that Guatemala considered the Sapodilla Cayes as Guatemalan territory, a concept that Honduras didn't question when signing the treaty.

With three countries considering that they have a right to ownership and use of the cayes, the Organization of American States (OAS) facilitated negotiations that led to the Ramphal/Reichler proposals in 2002, which proposed delimitation of Belize's southern maritime territory, with agreement to a joint ecological park around the cayes should Guatemala consent to a maritime corridor in the Caribbean under the OAS-sponsored 2002 Belize-Guatemala Differendum. Belize currently claims three nautical miles of Economic Exclusion Zone in the south (instead of the international standard of twelve), with a further area between the three mile Zone and the median line between Belize and its neighbours suggested by the United Nations Convention on the Law Of the Seas (UNCLOS), pending settlement of the Guatemala conflict over ownership (Perez, 2009). Honduras and Guatemala fishermen use the Sapodilla Cayes as a reference point for their maritime limits, further confusing the situation.

In the context of Belize, which administers the cayes, Sapodilla Cayes Marine Reserve is a national protected area, included in Belize's territorial waters (Maritime Areas Act of 1992), with Fisheries Department as the 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.

The Sapodilla Cayes

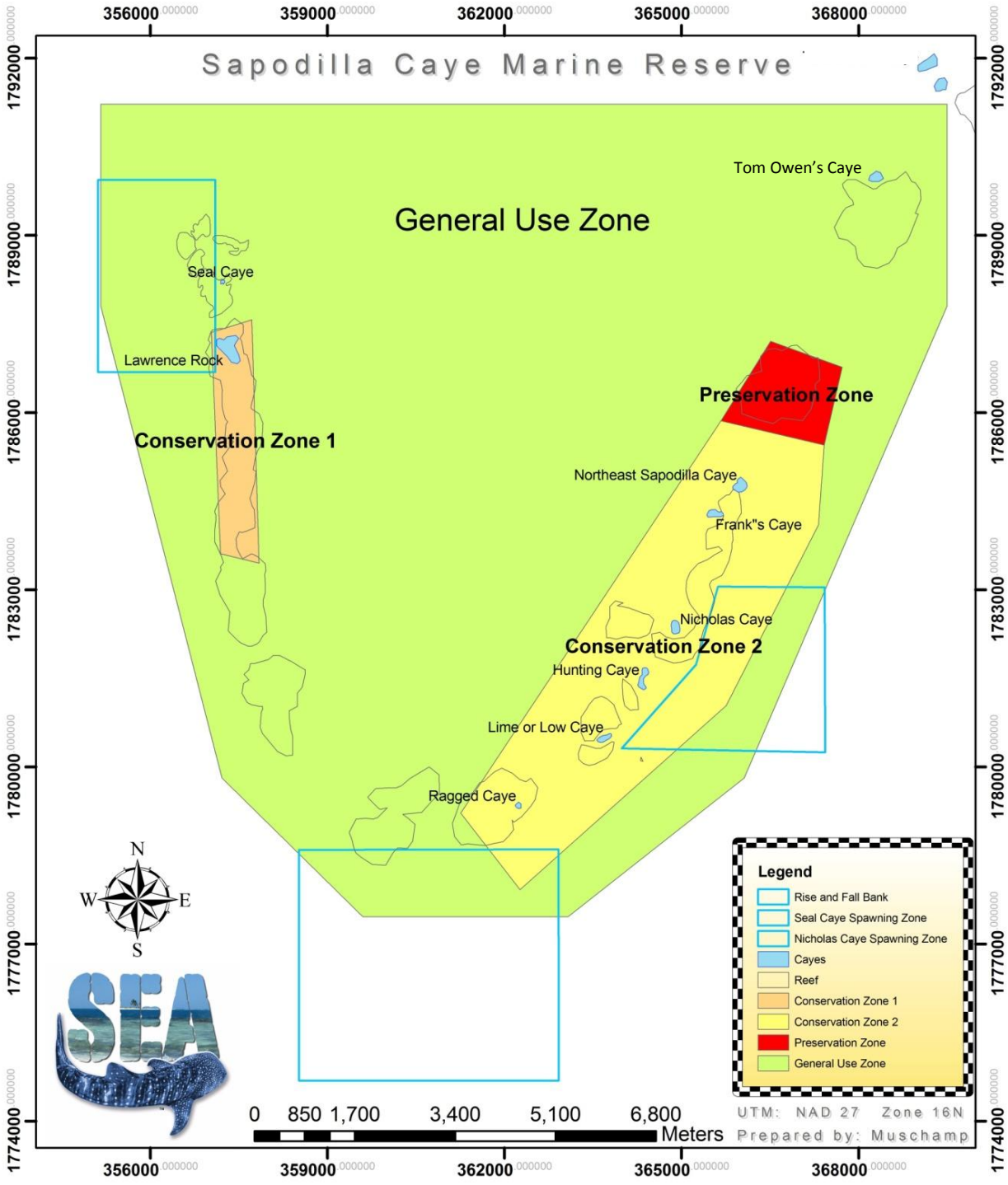
No caye is included within the management of the Marine Reserve – all have private ownership or are held under leasehold (Table 7; Map 4), partly as a mechanism by Government for tightening ownership of the cayes in light of the Guatemalan and Honduran claims. This includes transfer of lands on Hunting Caye to the Belize Tourism Board, Port Authority and Belize Fisheries Department. In the late 1990's, a moratorium was placed on the sale of national lands on all cayes in Belize, though since then, a number of cayes have been leased and surveyed within the Marine Reserve in contravention of this policy, often leading to subsequent granting as property, to then be re-sold to investors/ speculators and developers.

Caye	No.	Titles /Leases
Tom Owen's Caye	1	Alejandro Vernon – rented to ReefCI
Northeast Caye	1	Lindsay Garbutt / Kenworth Tillet – 75 yr lease
Franks Caye	1	Carrie Fairweather
Nicholas Caye	1	Machaca Group
Hunting Caye	4+	UB (2 acres), Coast Guard, Port Authority (90% of remaining southern portion), TTGA (short term lease for area with building), Fisheries Department (house lot), Mr. Fairweather (northern part)
Lime Caye	1	Dennis Garbutt – 99 yr lease
Ragged Caye	?	Was leased to Pena, but revoked. May be national land
Seal Caye	1	Black Point Enterprise (Bradley Rhinehart). Agreement with Eloy Cuevas / Monkey River

Table 7: Cayes of Sapodilla Cayes Marine Reserve

The privately owned Tom Owen's Caye has been an area of contention since the establishment of the Marine Reserve, with it alternately being declared as inside and outside the protected area boundary. This would appear to partly reflect mapping inconsistencies, with the national maps showing the caye as north of its actual location, and outside the protected area boundaries. Satellite imagery, however, shows that the location is within the Marine Reserve, as stipulated by the Statutory Instrument.

UNESCO recommendations strongly suggest that Government consider setting a system in place to remove national lands within the World Heritage Site completely from the jurisdiction of the Lands Department, thereby eliminating the chances of the issuing of leases or grants within the Belize Barrier Reef System – World Heritage Site (UNESCO, 2009). For the Sapodilla Cayes Marine Reserve, however, the cayes have been held as private or lease property for many years, a situation that would be hard to change. The one exception may be Ragged Caye.



Map 4: Sapodilla Cayes Marine Reserve: Location of cayes

1.3.3 Evaluation of Sapodilla Cayes Marine Reserve

Global Importance

Sapodilla Cayes Marine Reserve has been designated as one of seven components of the Belize Barrier Reef System - World Heritage Site, in recognition of its contribution to Belize's reef system, the largest, and possibly the least impacted reef complex in the Atlantic–Caribbean area (UNESCO, 1996). Designation was due in part to its location at the southern terminus of the Belize Barrier Reef, where the reef makes a J-shaped hook, and is considered representative of the discontinuous reefs of the southern province of the barrier reef. The protected central basin, with its scattered coral patches provide nursery and feeding habitats for at least twenty five species of international concern, recognized under the IUCN Redlist as Critically Endangered, Endangered or Vulnerable (Table 8; IUCN, 2008), including five species of coral, three species of turtle, fifteen species of fish and the vulnerable West Indian manatee. A number of the cayes have historically provided nesting sites for hawksbill, green and loggerhead turtles, important to the survival of these species within the region.

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

Table 8: Sapodilla Cayes Marine Reserve: Species of International Concern

Located in the centre of the Gulf of Honduras the Sapodilla Cayes Marine Reserve has a long regional history. Obsidian shards and broken pottery show that Mayan fishermen used the cayes in Maya times, and shipwrecks of Spanish sailing

vessels show that these boats also sailed these waters, though the evidence of this historical use has been eroded over time by the strong currents.

In recent years the Sapodilla Cayes have been a point of contention, with both Guatemala and Honduras claiming sovereignty. The SCMR has figured prominently in plans to resolve the Belize-Guatemala territorial dispute and is included as a part of a proposed tri-national park. Today the SCMR area continues to be used by Guatemalans, Hondurans and Belizeans for swimming, snorkelling, diving and fishing. This regional use and importance of the SCMR has at times complicated management of the reserve, as many of the reserves users are not located within Belizean territory.

Due to its remote location SCMR, is one of the least studied marine protected areas within the BBRRS-WHS, with substantive research activities beginning only in the past few years. These were initiated under the Toledo Association for Sustainable Tourism and Empowerment (TASTE), then through partnership with the Earthwatch Institute, and most recently, under the Conservation International Marine Management Area Science Programme. These efforts are providing information on a number of topics, including coral reef ecology, fisheries management and resilience to impacts such as climate change and the associated coral bleaching.

National Importance

Sapodilla Cayes Marine Reserve contributes to the protection of a unique example of the Barrier Reef, and was declared a marine reserve in 1996, the same year it was designated as a part of the Belize Barrier Reef World Heritage Site. The area is known for its high coral species diversity, and for the upwellings along the reef drop-off, which provide ideal conditions for spawning aggregations.

The marine reserve is one of four protected areas that form the Southern Belize Reef Complex (SBRC), which stretches which 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. This area is characterized by its 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 importance for many species of conservation concern, including the critically endangered hawksbill turtle and goliath grouper, and the endangered green and loggerhead turtles (IUCN, 2008).

Sapodilla Cayes Marine Reserve is also of economic importance to Belize as a lobster, conch and fin-fish resource for traditional fishermen from mainland fishing communities - particularly Monkey River, Punta Negra and Punta Gorda, as well as communities in Guatemala and Honduras. The marine reserve contains three nationally recognized and

protected spawning aggregation sites at Nicholas Caye, Rise and Fall Bank and Seal's Caye, as well as the locally known "Elbow," an aggregation site for mutton snapper, which is not included within the legislation, and is popularly fished during the aggregations season. Despite their closed seasonal status, all three of the recognized spawning aggregation sites have shown extraordinarily low numbers of fish, and it would appear that fishing continues during peak spawning activity. Monitoring of Nassau grouper at the Nicholas site over the past six years has yielded a peak count of only 100 fish, making these sites functionally extinct. Unlike Gladden Spit and Silk Cayes Marine Reserve to the north, whale sharks (*Rhincodon typus)* do not form seasonal aggregations within the marine reserve, but are known to travel through the marine protected area en route to feeding grounds to the north and south. The marine reserve has also been shown to have some of the highest densities of conch, with at least two known nursery sites and many documented adult aggregations. Fishermen have, in the past, dived for lobster at reefs throughout the protected area, though the recent implementation of zoning has led to many key fishing areas now being restricted.

Sapodilla Cayes Marine Reserve is of particularly high ecological and touristic value – the blue waters and the dazzling array of corals benefit a growing number of Belizean tourism operations, along with significant numbers of visitors from Guatemala and Honduras who have traditionally enjoyed travelling to the cayes for holiday. The area also has high potential education and research value, something that has only recently begun to be developed with the establishment of the Living Reef Center, owned and operated by the University of Belize and constructed with support from the Earthwatch Institute. It is hoped that this facility will act as a catalyst, attracting researchers and school educational groups to the area, though there are no immediate plans by UB to develop the station at the moment.

Several coral sand cayes within the protected area have provided historical nesting sites for hawksbill, green and loggerhead turtles. Although these nests have traditionally been raided by fishermen from Guatemala and Honduras during the nesting season, it is thought that with more consistent management presence in recent years the incidence of poaching has decreased significantly, increasing the viability of nests within the marine reserve. The sandy cayes also serve as nesting ground for a number of bird species. Lime and Ragged Caye as well as the sandbore in the SCMR serve as important rookery sites for terns. Unfortunately, many of the resident bird species have been extirpated in recent years due to unregulated use of the cayes as fish camps and poorly regulated development. At least two cayes - Seal and Tom Owens, had nesting Bridled Tern (*Sterna anaethetus*), Roseate Tern (*Sterna dougalli*), and Laughing Gull (*Leucophaeus atricilla)* colonies as recently as 1998. These tiny cayes ultimately could not continue to support both nesting seabirds and the human impacts related to the establishment of fishing camps. More recently, though, some of these ground-nesting birds have returned to nest on the cayes and sand bars within the Marine Reserve, as the focus towards tourism grows, and zoning reduces the number of fishing camps.

The Sapodilla Cayes have also lost at least one resident land bird in recent years, the Yucatan Vireo, which formerly reached its southernmost limit on the Sapodilla Cayes. Another important resident species is the Caribbean subspecies of Osprey (*Pandion haliaetus ridgewayi*). The cayes are important for Neotropical migrants, which fill the littoral forest each year as they travel to and from the wintering grounds.

1.3.4 Socio-Economic Context

Belize has a low population currently estimated at approximately 307,900 (Figure 3; CIA, 2010), of which 51.2% are urban dwellers (UN data, 2007[3]). 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 4). 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 3: 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

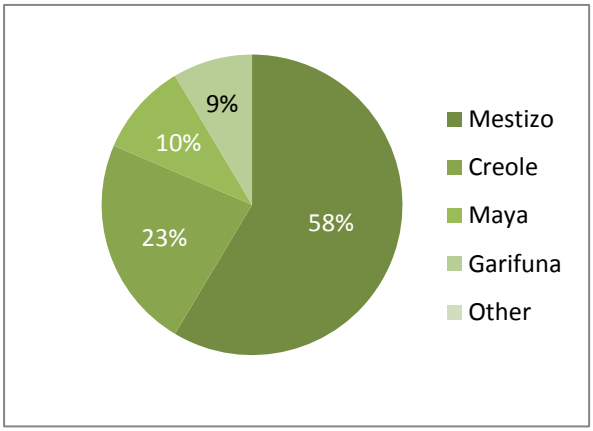


Figure 4: Belize Demographic Statistics

[3] World Statistics Pocketbook | United Nations Statistics Division

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 industry has had a significant impact on the viability of the commercial fish stocks of the marine reserve, and provides the historical context for the protected area. This traditional industry provides employment for over 2,759 fishers in Belize (Fisheries Department, 2010). The majority of the fishermen that use the area, however, originate from Guatemala and Honduras, the cayes being too far from the mainland to attract many Belize fishermen.

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. 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, though few boats reach as far south as the Sapodilla Cayes. Fishermen tend to be between 15 and 35 years of age, often

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, when quotas were developed to ensure greater sustainability. As a result, conch meat production exceeded its historical peak (2007), with 334 MT (734,600lbs) produced in 2010 (Fisheries Department, 2011).

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.

with limited education. Alternative job opportunities in many of these coastal communities, particularly those of the north, are limited, with many fishermen leaving primary school to go directly into fishing (FAO, 2005; SACD, 2009[4]).

The Fisheries Sector (including aquaculture) ranked 4th 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 rapidly becoming the major foreign exchange earner, with over 840,000 tourists arriving in Belize in 2008 (BTB, 2009). 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).

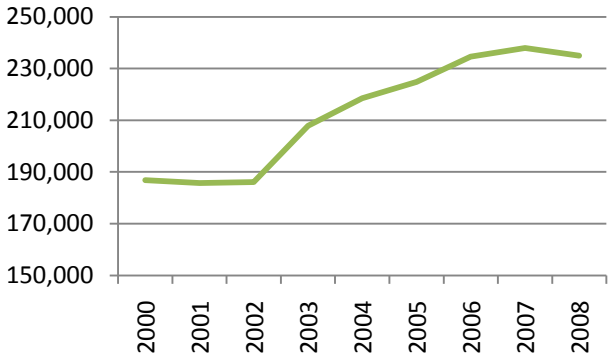


Figure 5: Belize International tourism arrivals (2000 – 2008) (BTB, 2009)

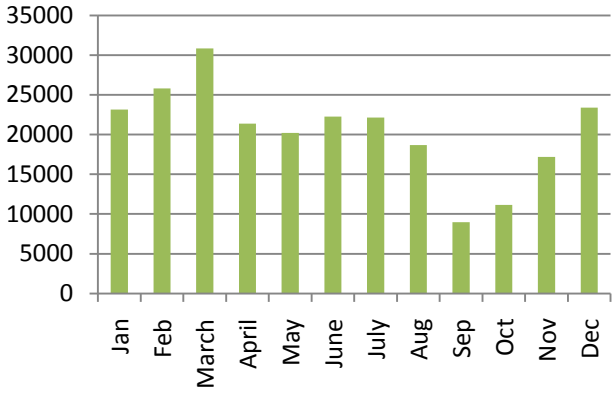


Figure 6: Belize International tourism arrivals per month

[4] Sarteneja Tourism Development Plan (SACD, 2009)

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.

Only a small percentage of these visitors (less than 1%) make it to Sapodilla Cayes Marine Reserve, primarily as day visitors. The majority of visitors originating in Belize are sports fishermen, snorkelers and divers, provide employment opportunities for local guides and tourism developments on the mainland. There are also a smaller number of visitors accessing the SCMR through "barefoot" boat charters.

In addition to visitors from Belize, the Marine Reserve also receives visitors from the neighboring countries of Guatemala and Honduras. Traditionally these visitors have made up the majority of tourism use at the SCMR, with large numbers of people using the cayes, particularly during Christmas and Easter holidays, and a variety of Guatemalan and Honduran companies offering three-day camping excursions to the Sapodilla Cayes.

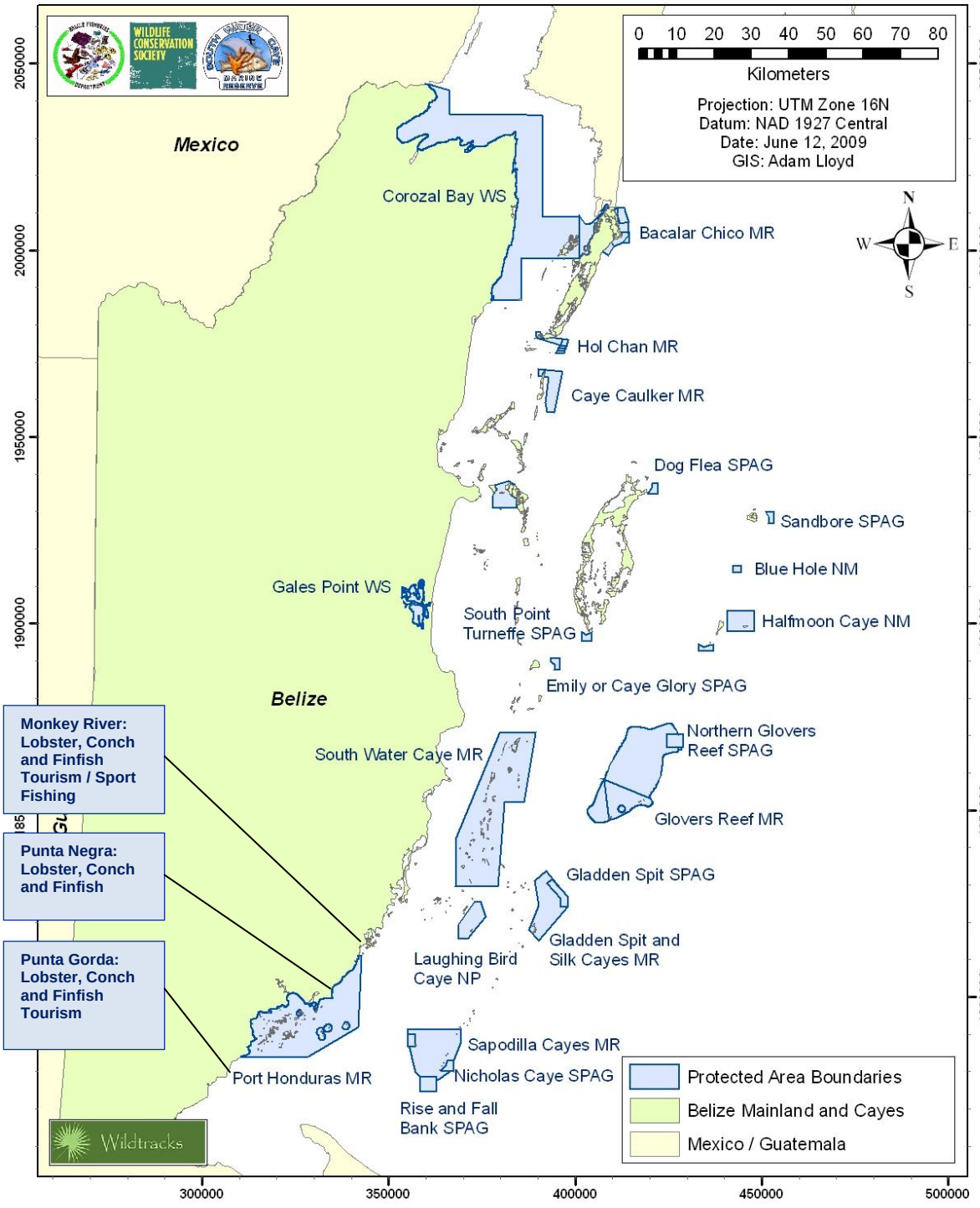
A number of communities have been highlighted as major stakeholders in the protected area, through fishing or tourism, and a basic stakeholder analysis identifies stakeholder interests and impacts (Table 10). Three primary stakeholder communities were identified and assessed for Sapodilla Cayes Marine Reserve (Table 9; Map 5). In addition, due to its location almost equi-distant from Belize, Guatemala and Honduras, a significant but unquantified number of tour operators and fishermen from the two neighboring countries use the natural resources of the SCMR.

Table 9: Stakeholder Communities (Belize) of the Sapodilla Cayes Marine Reserve

Community	Location (UTM) Distance (km)	Population (approx.)[1]	Population components	Comments
Monkey River	E16 341187 N18 09691 (23 km)	200[1]	Creole	Fly fishing
Punta Negra	E16 334998 N17 99698 (22.5km)	18[2]	Garinagu	Tourism and fly-fishing
Punta Gorda	E16 306862 N18 80471 (50km)	5,255[2]	Mixed	Tourism, commercial fishing and fly-fishing

[1] CSO, 2000 estimate [2] Perez, 2009

Primary Stakeholder Communities of Sapodilla Cayes Marine Reserve



Map 5: Sapodilla Cayes Marine Reserve: Principal Stakeholder Communities

Table 10: Stakeholder Analysis for Sapodilla Cayes Marine Reserve				
Stakeholder	**Influence or Impact of Sapodilla Cayes Marine Reserve on Stakeholder**		**Influence or Impact of Stakeholder on Sapodilla Cayes Marine**	
Community Stakeholder Monkey River, Punta Negra, Punta Gorda	▪ Management of reef and spawning aggregation site for tourism and fisheries	+	▪ Cooperation and collaboration towards effective protected areas management	+
	▪ Shifting income base from fisheries dependency to tourism, with increased economic benefits	+	▪ Greater awareness amongst community stakeholder – particularly youth – of the importance of reef and environmental services they provide	+
	▪ Focus of NGOs on education, awareness and alternative livelihoods for fishermen, associated with the protected area	+	▪ Adoption of reef tourism Best Practices through awareness and alternative livelihood training	+
	▪ Protection of reef resources in perpetuity for future generations	+	▪ Illegal fishing within the Conservation and Preservation areas	-
	▪ Exclusion from traditional fishing areas	-	▪ Anchor damage to coral and seagrass	-
Commercial Fishermen (Belize)	▪ Management of reef and spawning aggregation site for fisheries	+	▪ Some support for effective management of protected area	+
	▪ Protection of fish, lobster and conch resources within the Conservation and Preservation Zones ensuring continued viability of fishery	+	▪ Low level of cooperation or openly antagonistic towards protected area	-
	▪ Exclusion from traditional fishing areas	-	▪ Illegal fishing within the Conservation and Preservation Zones	-
			▪ Fishing impacts within protected areas (including damage to coral)	-
			▪ Anchor damage to reef	-
Commercial Fishermen (Guatemala and Honduras)	▪ Management of reef and spawning aggregation sites for fisheries	+	▪ Low level of cooperation or openly antagonistic towards protected area	-
	▪ Protection of fish, lobster and conch resources within the Conservation and Preservation Zones ensuring continued viability of fishery	+	▪ Illegal fishing within the Conservation and Preservation Zones	-
	▪ Exclusion from fishing (illegally) in Belize waters	-	▪ Illegal fishing impacts within protected areas (including damage to coral)	-
			▪ Anchor damage to reef	-

Table 10: Stakeholder Analysis for Sapodilla Cayes Marine Reserve (cont.)				
Stakeholder	**Influence or Impact of Sapodilla Cayes Marine Reserve on Stakeholder**		**Influence or Impact of Stakeholder on Sapodilla Cayes Marine Reserve**	
Tour Guides (including tour boat captains) (Belize)	▪ Benefit from having Sapodilla Cayes Marine Reserve as a major venue for snorkeling, dive and sports fishing related tourism	+	▪ Support the conservation goals of Sapodilla Cayes Marine Reserve	+
	▪ Benefit from training opportunities associated with Sapodilla Cayes Marine Reserve	+	▪ Provide interpretation for visitors, facilitating overall visitor appreciation	+
	▪ Employment in reef-based tourism initiatives	+	▪ If well trained, assist with visitor management within the protected area through in-depth briefings	+
	▪ Income from using Sapodilla Cayes Marine Reserve for tourism	+	▪ If poorly trained, can result in poor visitor management and increased impact on corals and associated fauna, anchor damage etc.	-
	▪ Benefit from SEA policy that all tour groups need to have a Belize tour guide / boat captain	+	▪ Impact behaviour of fish through feeding	-
			▪ Anchor damage to coral and seagrass	-
			▪ Illegal fishing impacts within Conservation and Preservation Zones by visitors	-
			▪ Impacts on Hunting and Lime Cayes by excursion visitors	-
Tour Guides (including tour boat captains) (non-Belize)	▪ Benefit from having Sapodilla Cayes Marine Reserve as a major venue for snorkeling, dive and sports fishing related tourism	+	▪ Provide interpretation for visitors, facilitating overall visitor appreciation	+
	▪ Employment in reef-based tourism initiatives	+	▪ If well trained, assist with visitor management within the protected area through in-depth briefings	+
	▪ Income from using Sapodilla Cayes Marine Reserve for tourism	+	▪ If poorly trained, can result in poor visitor management and increased impact on corals and associated fauna etc.	-
	▪ Negatively affected by SEA policy that all tour groups need to have a Belize tour guide / boat captain	-	▪ Ambivalent to the conservation goals of SCMR - – more prone to break regulations	-
			▪ Not familiar with the laws of Belize	-
			▪ Unfamiliar with Belize waters – increased probability of boat groundings	-
			▪ Impact behaviour of fish through feeding	-
			▪ Anchor damage to coral and seagrass	-
			▪ Illegal fishing impacts within Conservation and Preservation Zones by tour guides and visitors	-
			▪ Impacts on Hunting and Lime Cayes by excursion visitors	-

Table 10: Stakeholder Analysis for Sapodilla Cayes Marine Reserve (cont.)				
Stakeholder	**Influence or Impact of Sapodilla Cayes Marine Reserve on Stakeholder**		**Influence or Impact of Stakeholder on Sapodilla Cayes Marine Reserve**	
Local / National Tour Operators	▪ Benefit from having Sapodilla Cayes Marine Reserve as a venue for dive- and snorkeling-associated tourism ▪ Income from using Sapodilla Cayes Marine Reserve as a tourism destination	+ +	▪ Provide marketing at a national level, and send visitors to Sapodilla Cayes Marine Reserve ▪ Support the conservation goals of Sapodilla Cayes Marine Reserve ▪ Provide a financial sustainability mechanism for management of the protected area ▪ Increase the potential for exceeding the carrying capacity of the protected area	+ + + -
Guatemalan / Honduran Tour Operators	▪ Benefit from having Sapodilla Cayes Marine Reserve as a venue for dive- and snorkeling-associated tourism ▪ Income from using Sapodilla Cayes Marine Reserve as a tourism destination	+ +	▪ Provide marketing outside of Belize, and send visitors to Sapodilla Cayes Marine Reserve ▪ Provide a financial sustainability mechanism for management of the protected area ▪ Ambivalent to the conservation goals of Sapodilla Cayes Marine Reserve ▪ Increase the potential for exceeding the carrying capacity of the protected area	+ + - -
International Tour Operators	▪ Benefit from having Sapodilla Cayes Marine Reserve as a venue for dive- and snorkeling-associated tourism ▪ Income from using Sapodilla Cayes Marine Reserve as a tourism destination	+ +	▪ Provide marketing at a national level, and send visitors to Sapodilla Cayes Marine Reserve ▪ Support the conservation goals of SCMR ▪ Provide a financial sustainability mechanism for management of the protected area ▪ Increase the potential for exceeding the carrying capacity of the protected area	+ + + -
BTIA	▪ Benefit from having Sapodilla Cayes Marine Reserve and as a tourism draw,	+	▪ Providing national and international marketing of Sapodilla Cayes Marine Reserve ▪ Support the conservation goals of Sapodilla Cayes Marine Reserve	+ +

Table ..: Stakeholder Analysis for Sapodilla Cayes Marine Reserve (cont.)				
Stakeholder	**Influence or Impact of Sapodilla Cayes Marine Reserve on Stakeholder**		**Influence or Impact of Stakeholder on Sapodilla Cayes Marine Reserve**	
General Belize Public (excluding primary stakeholder communities)	▪ Maintenance of fish, lobster and conch stocks ▪ Maintenance of spawning aggregation and whale shark congregation ▪ Environmental services ▪ Cultural and aesthetic appreciation ▪ Increased awareness through education	+ + + + +	▪ Support of the general public will strengthen the position of protected area ▪ Lack of support may increase chances of dereservation	+ -
Visitors: Tourists	▪ Enjoy Sapodilla Marine Reserve as a tourism destination ▪ Benefit from education and awareness opportunities	+ +	▪ Entrance fee contributes towards the goal of sustainability ▪ Provide marketing nationally and internationally by word of mouth, if happy with level of product ▪ Presence deters illegal fishing within the Conservation Zone and Spawning Aggregation Sites ▪ Negatively impact marine and terrestrial environments	+ + + -
Visitors: Researchers	▪ Benefit from being linked to Sapodilla Cayes Marine Reserve ▪ Benefit from access to a virtually pristine reef environment, spawning aggregation sites ▪ Benefit from historic baseline information on past research activities within protected areas	+ + +	▪ Conservation management benefits from data gathered, greater knowledge of marine and terrestrial environments and species within area ▪ Benefit from increased research activity within area ▪ Presence deters illegal fishing within the Conservation Zone and Spawning Aggregation Sites ▪ Possible impact of research activities on marine environments	+ + + -
Sailboat Charter Companies	▪ Benefit from protection of Sapodilla Cayes Marine Reserve as a destination	+	▪ Support the conservation goals of Sapodilla Cayes Marine Reserve ▪ Impacts of sewage and detergent, bilge water. grey water and oil ▪ Visual impact of non-traditional sailing boats ▪ Anchor damage on mooring sites ▪ Potential for grounding on the reef ▪ Lack of compliance to rules and regulations due to limited awareness	+ - - - - -

Table 10: Stakeholder Analysis for Sapodilla Cayes Marine Reserve (cont.)				
Stakeholder	**Influence or Impact of Sapodilla Cayes Marine Reserve on Stakeholder**		**Influence or Impact of Stakeholder on Sapodilla Cayes Marine Reserve**	
Belize Fisheries Department	▪ Part of Belize's marine protected areas system, for maintenance of commercial species ▪ Provides fisheries management for fishing Industry ▪ Generates revenue for the Fisheries Department	+ + +	▪ Provides staff, fuel and training for surveillance and enforcement of SCMR	+
Government of Belize	▪ Provides fisheries management for fishing Industry ▪ Provides environmental services ▪ Sapodilla 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 WHS ▪ Income generation of significant foreign revenue ▪ Provides employment opportunities in stakeholder communities	+ + + + +	▪ Political support (currently being strengthened through the NPAPSP) ▪ Lack of political support ▪ Uncertainty of long term future commitment	+ - -

1.4 Physical Environment of Management Area

1.4.1 Climate

Temperature and Rainfall

The Sapodilla Cayes Marine Reserve lies only 35 miles due east from Punta Gorda, but has a distinct climate that differs from the mainland. Meteorological, oceanographic, and biological conditions have been recorded within the Southern Belize Reef Complex, in the more northerly South Water Caye Marine Reserve (at Carrie Bow Caye) since 1993, following its selection as a long term monitoring site, 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), in the absence of site-specific data, this is probably the most applicable to sapodilla Cayes Marine Reserve.

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).

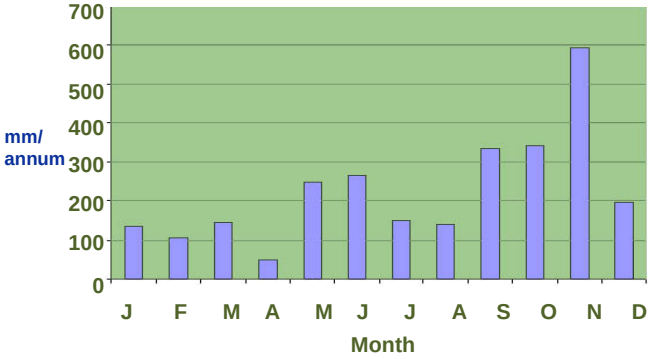


Figure 7: Rainfall - Carrie Bow Caye (2002 – 2004)

Annual air 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 11; Caribbean Coral Reef Ecosystems Program, 2005)

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 11: Mean Temperature and Rainfall (2002 – 2004) Carrie Bow Caye, 2002 - 2004

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 Sapodilla 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 nine hurricanes and four tropical storms that have passed within a 50-km radius of Sapodilla Cayes Marine Reserve (Table 12; 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.

Name	Cat.	Year	Date Passed SCMR
Not named	H1	1918	26th August
Not named	TS	1934	8th June
Not named	H1	1941	28th September
Not named	TS	1943	22nd October
Not named	H1	1945	4th October
Abby	H1	1960	15th July
Anna	H1	1961	24th July
Francelia	H2	1969	3rd September
Laura	TS	1971	21st November
Fifi	H2	1974	19nd September
Kyle	TS	1996	12th October
Mitch*	H2	1998	29th October
Iris	H4	2001	9th October
Felix	H5	2007	5th September

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 12: Hurricanes affecting Sapodilla Cayes Marine Reserve (<50km radius) (www.nhc.noaa.gov)

Hurricanes can also result in major changes to the shapes and sizes of cayes and sandbars within the marine reserve, as well as causing damage to infrastructure – aerial reconnaissance estimated structural damage to properties on the Sapodilla Cayes after Hurricane Iris to be between 25 and 30% (CEDRA, 2001).

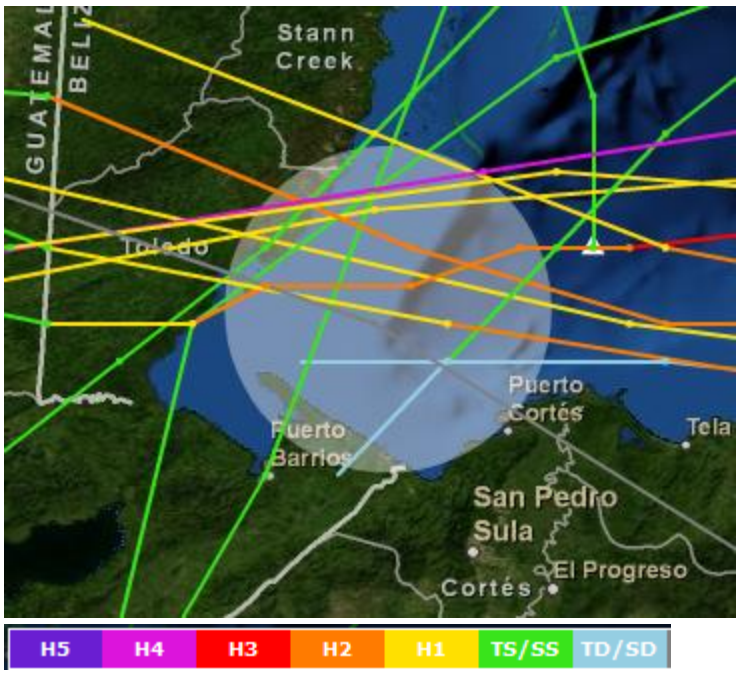
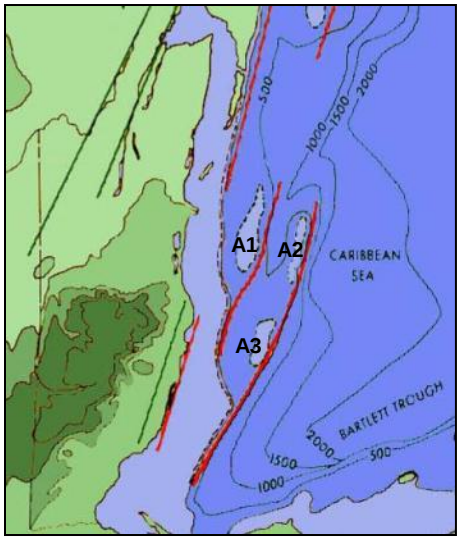


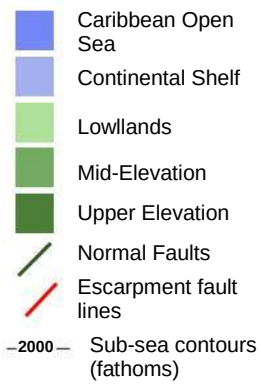
Figure 8: Sapodilla Cayes Marine Reserve: Tropical Storms / Hurricanes within a 50km of the Marine Reserve

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, to then stop 400km east west of the Sapodilla Cayes for 2 days, adjacent to the Bay Islands of Honduras. Even though it did not hit Belize directly, its proximity did tremendous damage. The windward side of the Sapodilla Cayes experienced heavy beach erosion. The sea turtle nests that did not hatch before the hurricane impacts were washed away. Also during this storm, vegetation on Tom Owens II and Seal Caye II was severely affected. Tom Owens II is now reduced to a small coral caye with regenerating vegetation. Seal Caye II is now nothing more than a small coral spit.

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





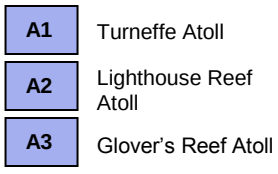


Figure 9: Fault lines that run parallel to the Belize coastline, forming the base of the reef

runs parallel to the coast, dropping off to the east to a depth of about 1 km (Figure 9). 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 Sapodilla Cayes and the southern part of the Belize mainland are formed of Pleistocene limestone bedrock. During the Pleistocene era, when sea levels were higher, much of what is now land on the Sapodilla Caye was reef. Modern sediments include mainly white sandy sediments on the beaches and reef lagoon bottom composed of fragments of reef animals and calcareous algae. In the southern province of the coastal waters, in which Sapodilla Cayes Marine Reserve is located, the barrier reef is less well formed than in the central province, at Gladden Spit and Silk Cayes Marine Reserve. The breaks between sections of reef crest allow the cooler waters of the Caribbean Sea to flow onto the coastal shelf, reducing water temperatures, and increasing connectivity.

1.4.3 Bathymetry

Belize has an extensive maritime area of 10,000km^2 (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.

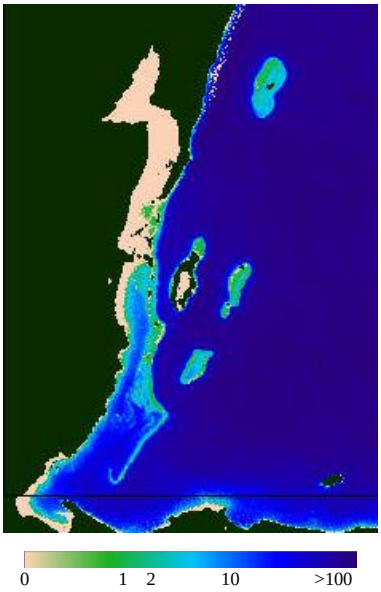
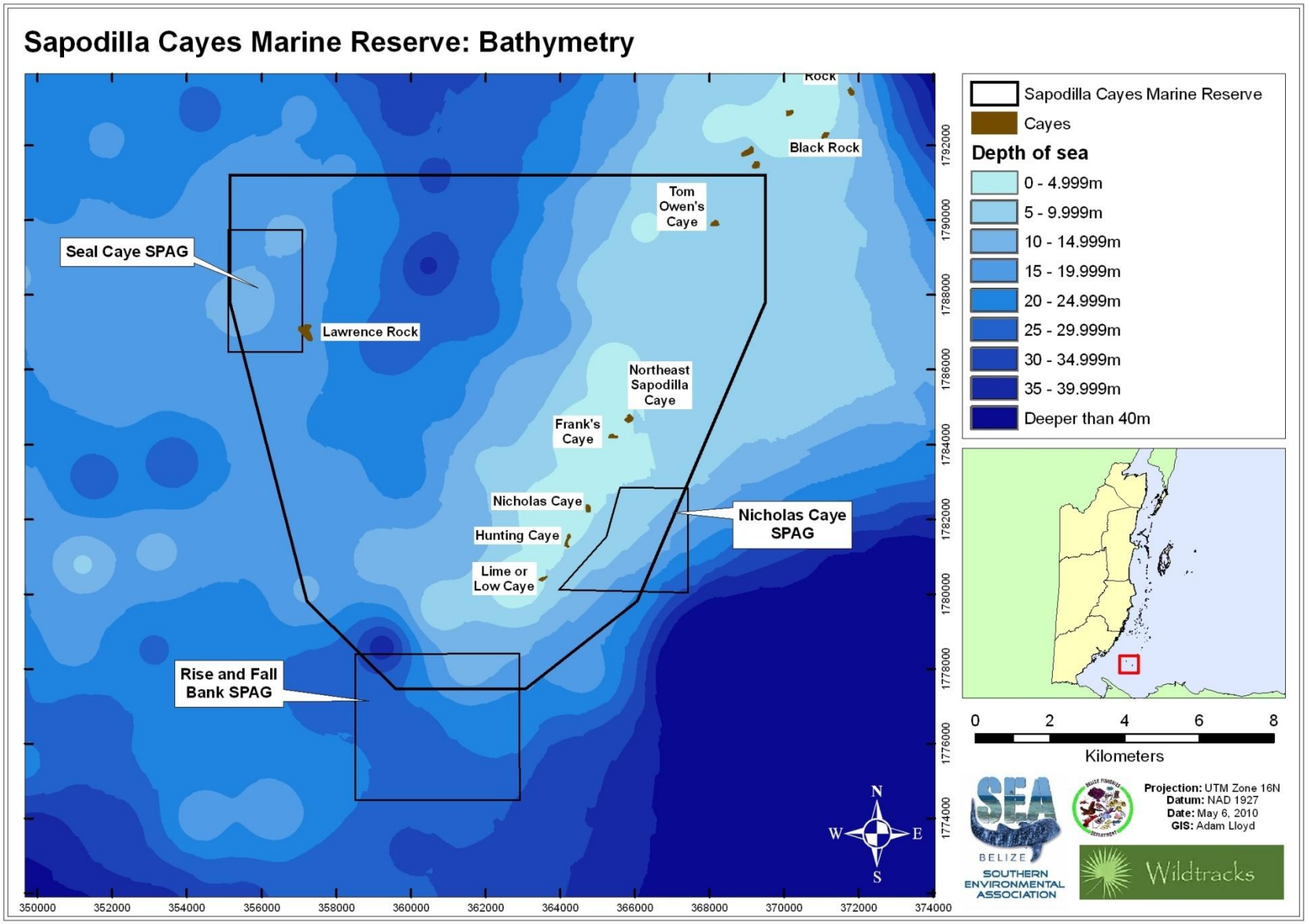


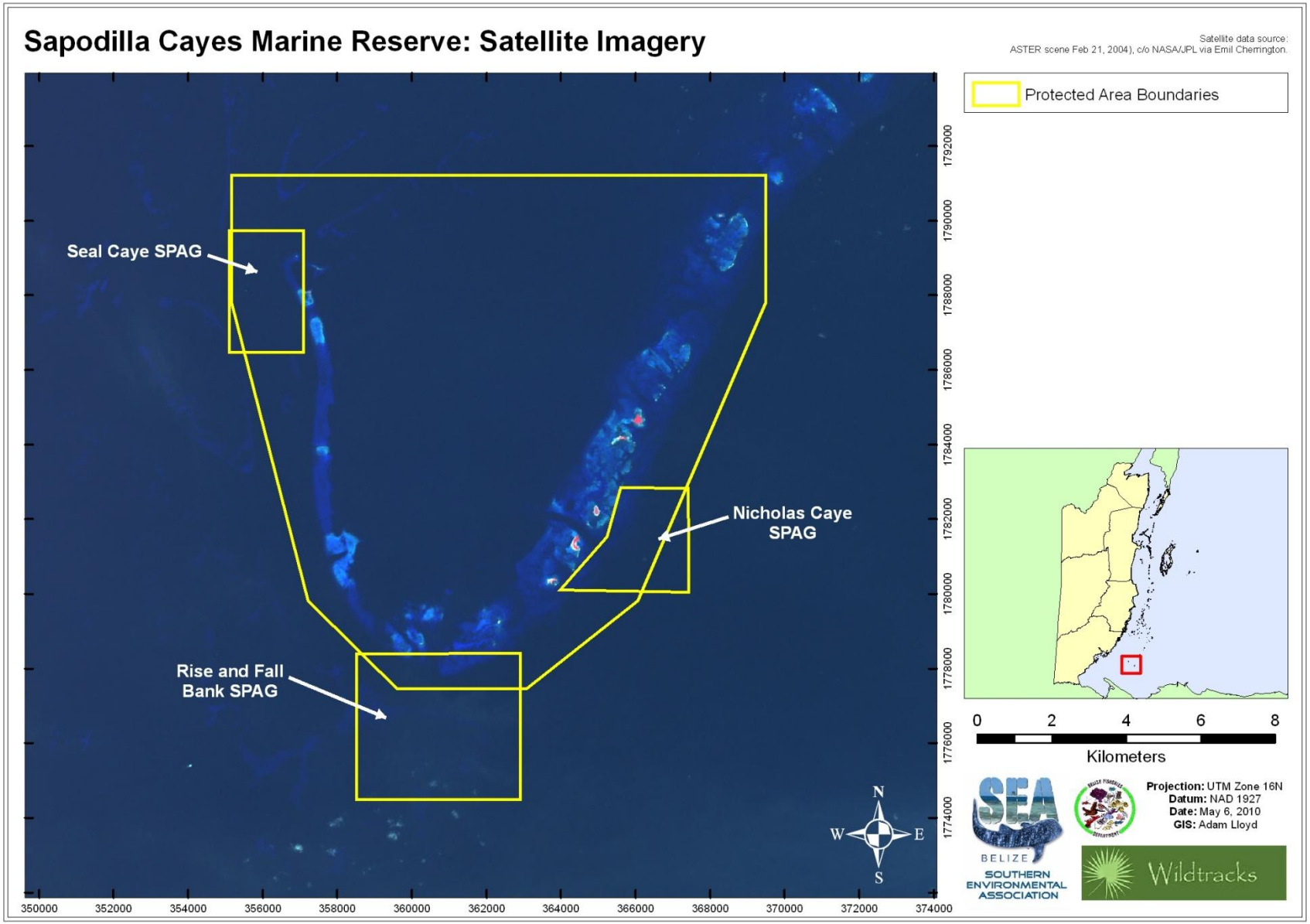
Figure 10: Water Depth (SeaWiFS, 1999)

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 reserve area lies well within the Southern Province, which extends for about 59 km from Gladden Spit to the Sapodilla Cayes and is distinguished by shallow-water reefs, which occur as fringes around the cayes. The depth of the water over these reefs is less than 5 meters, forming exposed reefs during low tides. Depth contours for the inner coastal 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 10; Maps 6 and 7).

The southern 6 kilometers of the barrier reef consists of a series of large shoal patches intersected by deep channels (Stoddart et. al., 1982). Standing on these patches are seven carbonate islands known as the Sapodilla Cayes - Tom Owens, Northeast Sapodilla, Frank's, Nicholas, Hunting, Lime and Ragged Cayes. Instead of ending abruptly, the reef turns westward for 3.7 km and makes a sharp U-turn toward the north to form an additional 9 km of reefs and several small cayes and reef patches (Stoddart et. al., 1982). Seal Cayes, the smallest cayes within the reserve, are located on the northern end of the J-shaped hook.



Map 6: Sapodilla Cayes Marine Reserve: Bathymetry



Map 7: Sapodilla Cayes Marine Reserve: Relief (Satellite)

The basin enclosed within the Sapodilla reef reaches a maximum depth of 40-50m and exhibits unusual topography. The seabed consists of a complex mosaic of circular sediment pockets and *Montastrea* reef. Discrete sediment pockets have a diameter of approximately 10m, unquantified depth and are distributed regularly across the bottom. Neither the geology or sediment dynamics of this unusual area are completely understood.

1.4.4 Tides and Water Movement

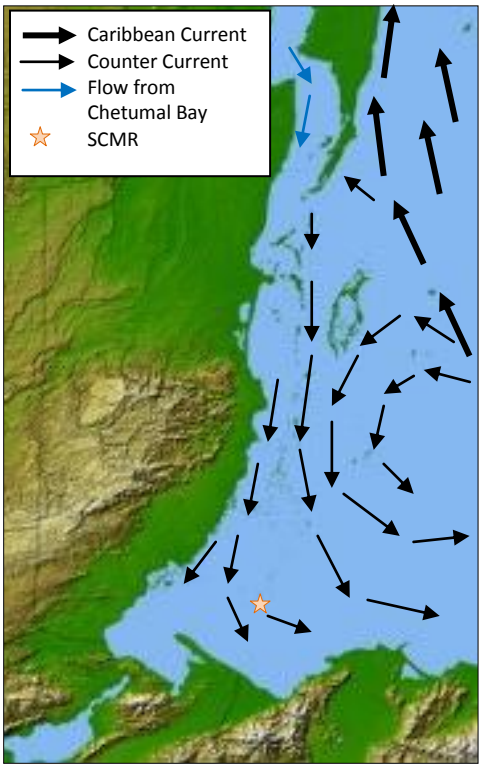


Figure 13: Currents of the Belize Reef (after Ezer et. al., 2005)

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 Sapodilla 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.

These currents also transport large amounts of garbage, carried in the water stream from the Belize, Guatemala and Honduran coastline. Much of this would appear to be shredded, suggesting that part of the source is a garbage processing plant that is releasing shredded plastics and Styrofoam into the water column, either on the coast, along river banks or, it has been suggested, from passing cruise ships. Large numbers of banana stems are also carried in the currents after heavy rain falls, washed down the rivers. The scale impact of these currents is especially evident during the rainy season when large quantities of trash are washed ashore on the cayes within the SCMR. It is generally thought that the vast majority of this debris is coming from the larger watersheds of Guatemala and Honduras.

Floating shredded garbage in the water currents (Photo: Dr. Annelise Hagan /SEA)

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 clockwise gyre in the Gulf of Honduras area, including much of the coastal waters of Belize, which flows south / southwest-wards past the Belize coastline and Barrier Reef (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.

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 45 miles/ 72km to the north) to provide an indication of conditions within Sapodilla Cayes Marine Reserve (Table 13).

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

Water Temperature

Temperatures at Sapodilla Cayes Marine Reserve can reach 27^{o}C on the leeward side of the cayes during calm, hot days, with the average water temperature being 25^{o}C in areas where there is good water exchange (Nightingale / TASTE, 2004), with mean monthly measurements during the period 1994 - 1996 ranging between 25.4°C – 30.3°C.

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.

Increasing water temperature has 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 Carrie Bow Cay 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 Sapodilla Cayes Marine Reserve.

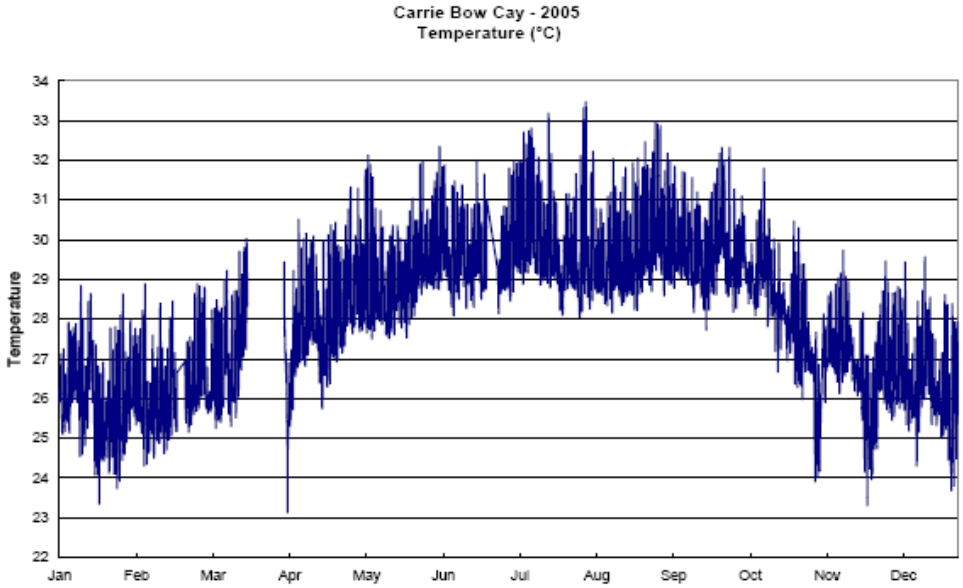


Figure 14: Water Temperature at Carrie Bow Caye (http://cbc.riocean.com, accessed 2009)

Sedimentation / Turbidity

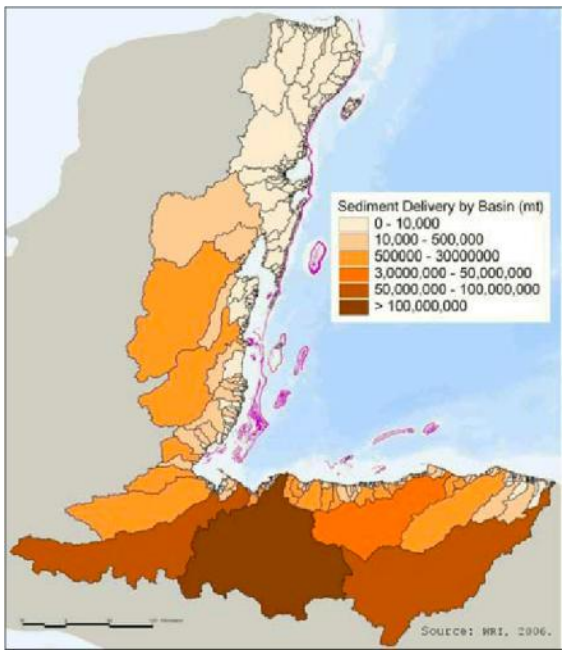


Figure 15: Sediment Delivery by Watershed Basin (Burke et. al. 2006)

Sedimentation and agrochemical contamination from mainland watersheds have been highlighted as perhaps one of the greatest impacts on the Belize reef, after climate change. Sapodilla Cayes Marine Reserve lies east of five major watersheds originating in Belize – Rio Grande, Golden Stream, Deep River, Punta Ycacos and Monkey River (Figure 15; Maps 8 and 9), which drain some of the principal banana growing areas of southern Belize. 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. This is overshadowed by the watersheds emptying into the Gulf of Honduras from Guatemala and Honduras (particularly the Ulua, Motagua, Patuca and Aguan) where land use change has removed much of the natural vegetation from the formerly forested slopes (Burke et. al. 2006).

Sediment core analysis of two sites within the Belize reef system (Turneffe Atoll and Sapodilla Cayes), indicate that watershed 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 (Carilli et. al. 2009).

Generally occurring in September/October, these events impact water turbidity and quality within the Marine Reserve, as seen following the passage of Hurricane Mitch in October 1998 and Hurricane Iris in 2001.

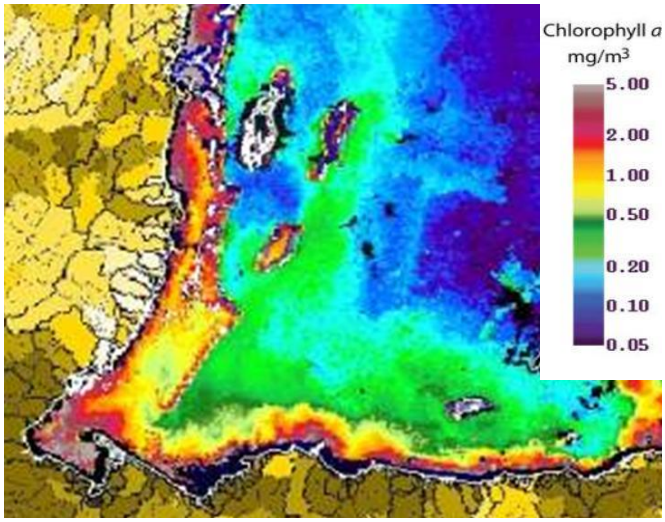
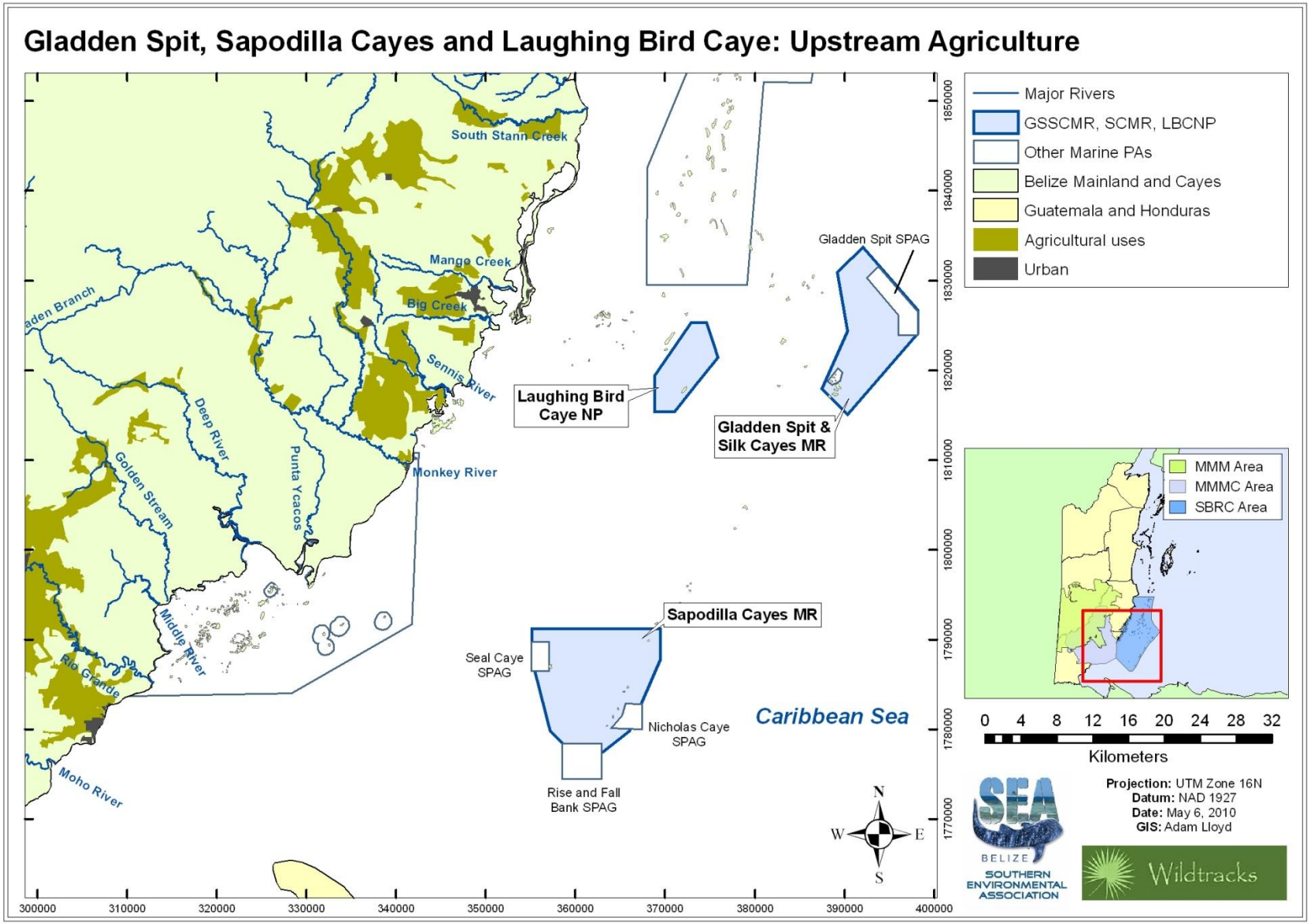


Figure 16: SeaWifs Chlorophyll α. After Shank et. al. 2010/ Soto et. al. 2009

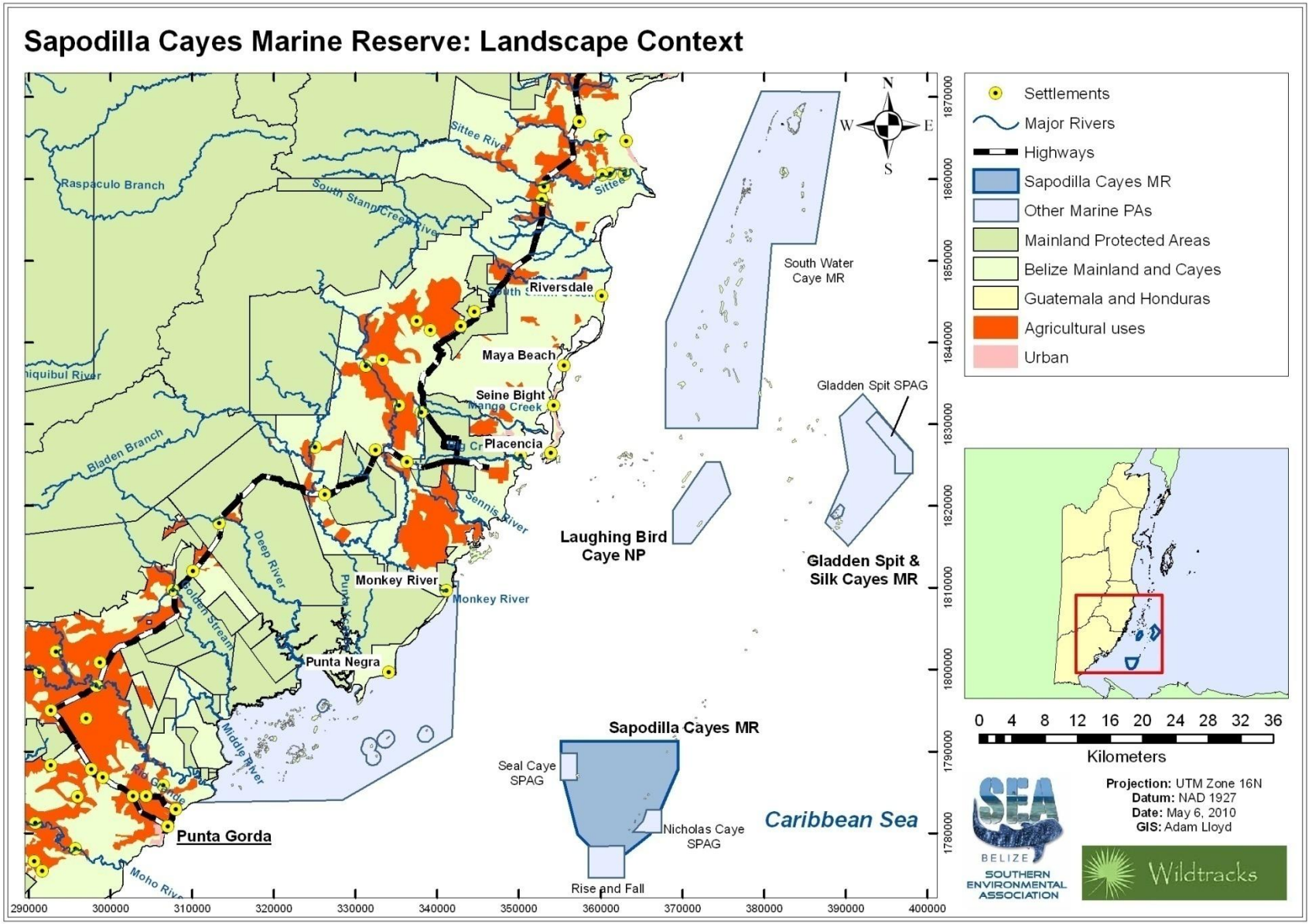
- More than 80 percent of sediment, and more than half of all nutrients (both nitrogen and phosphorous) entering the Mesoamerican Reef originate in Honduras
- Guatemala was identified as a source of about one-sixth of all sediments and about one-quarter of all nitrogen and phosphorous entering coastal 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*

SeaWifs ocean colour images also shows that a large pulse of river water extends from the Guatemalan and Honduran rivers, stretching as far north as Gladden Spit, and even out as far as Glover's Reef Atoll, during these storm events (Figure 16; 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 (WRI, 2006).



Map 8: Sapodilla Cayes Marine Reserve: Watersheds



Map 9: Sapodilla Cayes Marine Reserve: Landscape Context

Salinity

Salinity varies dependent on the time of year, with lower salinity during the wet season (Figure 17). The salinity of normal seawater is 36 parts per thousand (ppt) and, except very close to the mainland, normal salinity persists throughout the Belize continental shelf, including the Sapodilla Cayes area (Rath, 1996). Salinity in the reef lagoon averages 37.2 ppm. However, during the rainy season it can drop to 33 ppm (Nightingale, SCMR Draft Management Plan). Due to the location of the Sapodilla Cayes Marine Reserve equidistant from Belize, Guatemala and Honduras it is not uncommon for large outflows of freshwater to reach the Sapodilla Cayes during the rainy season. These flows often create a colder flow of fresh water of up to a meter deep to reach the waters of the SCMR. These freshwater flows are often accompanied by large amounts of debris washing out of the neighbouring watersheds.

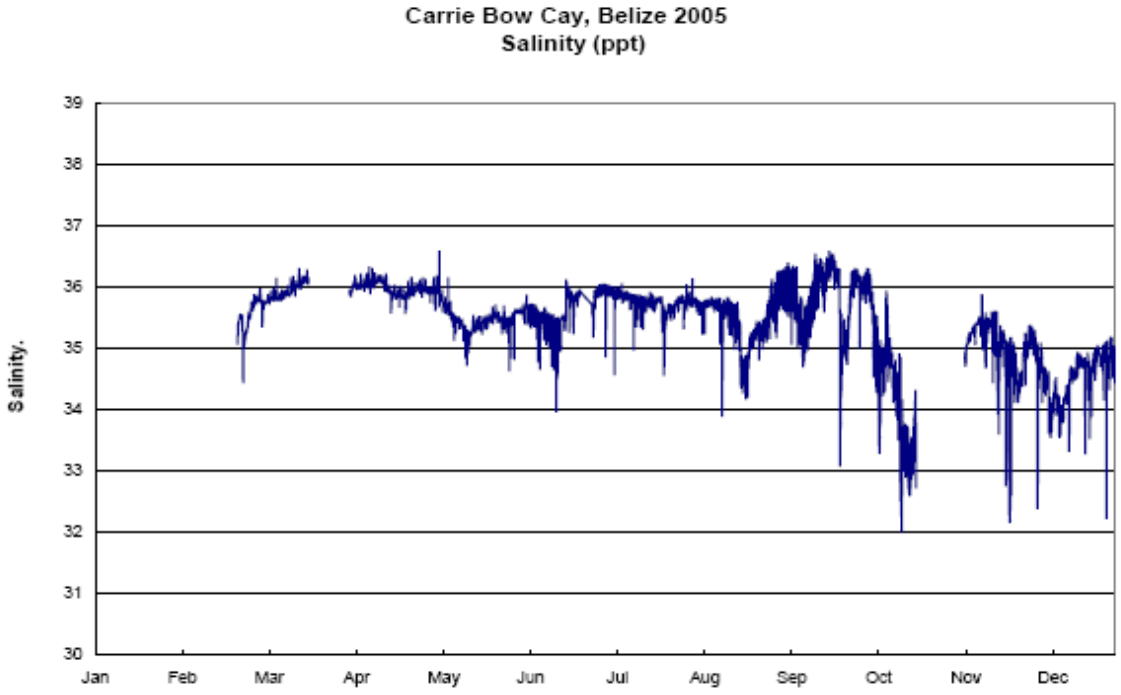


Figure 17: Salinity at Carrie Bow Caye (http://cbc.riocean.com, accessed 2009)

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

Sapodilla Cayes Marine Reserve encompasses the southern-most tip of the Belize Barrier Reef, and surrounds twelve palm-fringed sand or mangrove cayes, considered to be among the most scenic within Belize, and still support remnants of highly endangered littoral forest. The beaches provide nesting sites for all three of Belize's most frequently seen marine turtle species – hawksbill, green and loggerhead. The reef is known for its high diversity of coral species, and the marine reserve is considered an excellent example of reefs of the southern coastal waters province. The reef drop-off occurs on three sides, with conditions that have resulted in the establishment of three nationally and regionally important spawning aggregation sites.

1.5.1 Ecosystems and Flora

Sapodilla Cayes Marine Reserve stretches 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 west, east and south of the 'hook' provide the geomorphology and oceanographic current conditions required by many species for the formation of spawning aggregations (Heyman et. al. 2008). Deep water species such as whale sharks are known to travel parallel to the reef, passing inside the boundaries of Sapodilla Cayes Marine Reserve.

Epipelagic Zone (0m – 200m)

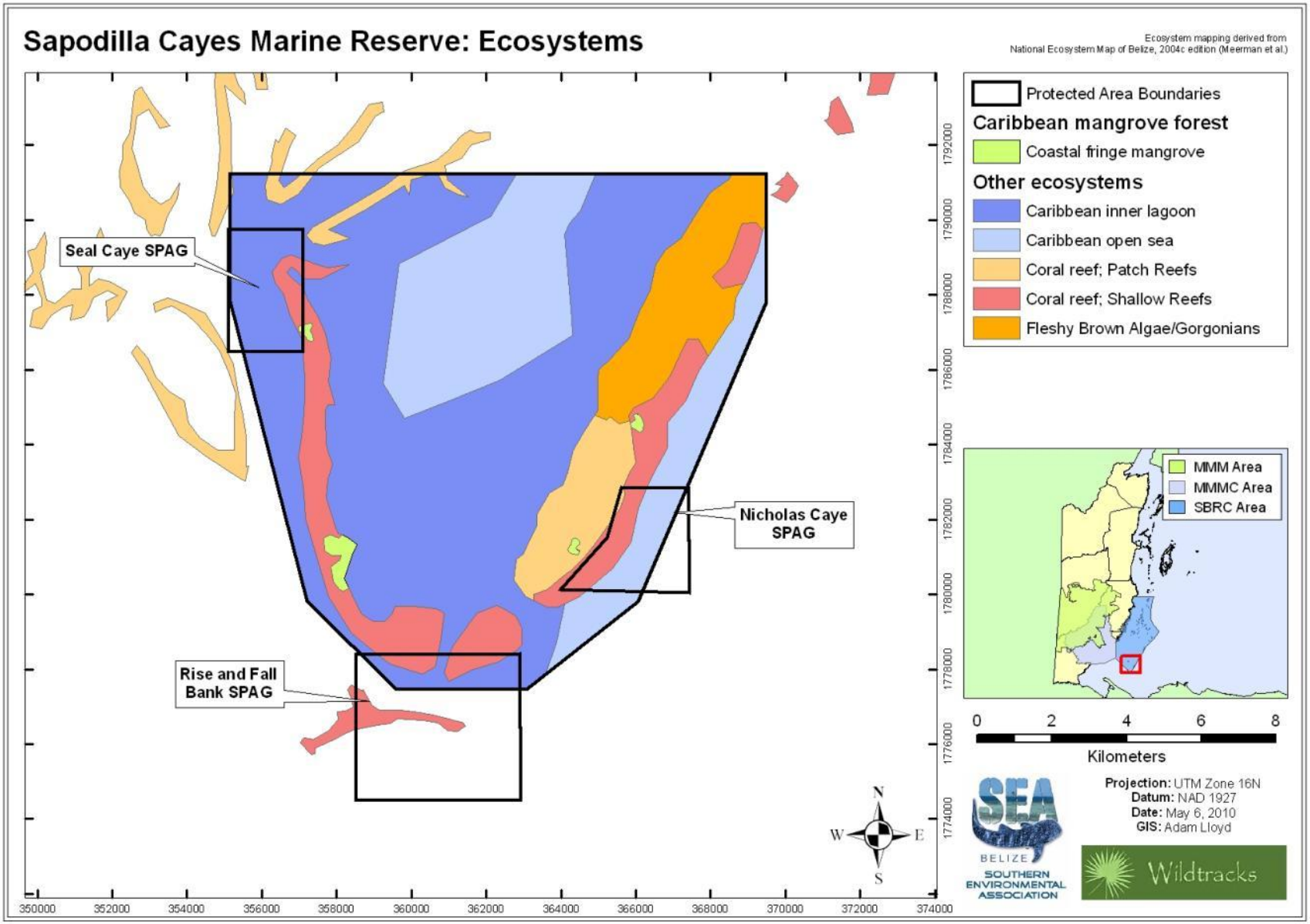
The Epipelagic Zone ranges from 0 to 200m depth, and includes the shallow waters of the inner lagoon and the deeper waters of the fore reef. Within this zone there are an array of ecosystems that have evolved in response to the degree of exposure and impact of wave action, current direction and intensity, light intensity and light spectra, and are defined by their species composition, formation and substrate characteristics. Six broad ecosystems have been identified and mapped (Map 10; Meerman, 2004):

- Fore-reef (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

The marine components are further categorized by into seven primary categories and twenty-one sub-categories (Table 14; Map 10; Mumby and Harborne,1999).

Ecosystems of Gladden Spit and Silk Cayes Marine Reserve				
	Meerman (2004)		**Mumby and Harborne (1999)**	
Terrestrial	Herbaceous Beach Community	Sandy Beaches		
		Littoral Forest		
Epipelagic	Reef	Shallow Coral Reef	Fore Reef	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
		Sparse Algae / sand		Green algae
				Lobophora
				Euchmea and *Amphiroa*
				Bedrock / rubble and dense gorgonians
				Bedrock / rubble and sparse gorgonians
			Bare substratum dominated	Rubble and sparse algae
				Sand with sparse algae
				Mud / bedrock
Mesopelagic / Bathypelagic	Open Sea	Caribbean Open Sea	Caribbean Open Sea	Bathyal
				Mesopelagic

Table 14: Ecosystems of Sapodilla Cayes Marine Reserve



Map 10: Sapodilla Cayes Marine Reserve: Ecosystems (coarse)

Coral Reef

Located in the southern regions of the Belize Barrier Reef System, Sapodilla Cayes Marine Reserve encompasses the end of the barrier reef, and does not show the well developed barrier reef formation seen in the northern portion of Gladden Spit and Silk Cayes Marine Reserve. The J-shape of the reef as it terminates at the SCMR results in significant variations in the development and type of reef structure within the marine protected area. However, the core habitats, Fore Reef, Reef Crest, and Back Reef are all present.

Fore-reef

The fore-reef lies on the outer side of the reef crest, facing the open sea, and includes the upper and lower reef slopes, extending out to a depth of 14-22m on three sides of the protected area. This structure follows the reef as it curves inwards to form the 'J'. Reef morphology shows a strong gradient from north to south along the 'J', with the northern reef being better structured, characterized by better developed spur and groove formations and terrace structure before dropping sharply into deep water. The more southerly reef is less developed moving around the J-shaped hook, lacking the steep drop-off, and falling to only 25 to 30 meters, and is more lagoonal in character (Shank et. al., 2010).

Along the eastern side of the 'J' there is moderate spur and groove development. 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. 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.

Along the more western side the fore-reef drops towards the barrier reef lagoon, with a number of banks and promenades located outside the marine protected areas western boundaries. The reef along this section is "a more lagoonal community with no terrace, more fragile reef structures" (Shank, et al., 2010). This section of the fore-reef is much more similar to back reef formations in other areas along the Belize Barrier Reef.

With the Sapodilla Cayes Marine Reserve are numerous channels which provide connectivity between the deeper cooler sea waters and the shallower protected back reef areas. These channels allow for greater exchange of water between the reef lagoon and reef wall. Some of these channels include: Sapodilla Pass between Ragged and Lime Cayes, Nicholas Cut separating Nicholas and Hunting Cayes, and Seal Caye Channel lies just south of Seal Caye. The presence of these channels is the major factor for the more fragmented barrier reef within the SCMR.

The better developed east-facing fore-reef is an important tourism resource, attracting divers from all parts of the world to Belize, and providing a recreational destination for tours originating in Guatemala and Honduras.

Reef Crest and Reef Flats

The reef crest and reef flats lie behind the fore-reef, and are considered typical of high energy surf zones around the Caribbean. Within the Marine Reserve, the reef crest is relatively fragmented, and is bisected by a number of larger reef channels, which allow greater connectivity between the coastal shelf and the deeper waters beyond the reef.

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. The reef crest has suffered significant hurricane damage over the years, with increasing hurricane frequency, size and intensity predicted for the future which, when combined with increasing disease and bleaching, has already resulted in the more opportunistic lettuce coral (*A. tenuifolia*) appearing as the predominant species, replacing the previously dominant elkhorn coral (*A. palmata*) (McField, et al. 2008 (ed. Wilkinson et. al.)).

Back Reef

The Back Reef includes a continuum of habitats from the algae-encrusted coral rubble near the reef crest to the sandy muds of the *Thalassia* meadows and scattered patch reefs, in waters ranging from 0.3 to 6m deep, and is sheltered on three sides by the 'J' shaped reef crest. There are numerous channels in the fore-reef at the SCMR which also provide connectivity between fore-reef and back reef zones as well as greater water exchange.

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, interspersed among the seagrass meadows of the back reef. Some of the sites located in the shallower sheltered waters behind the reef crest support patch reefs of incredible diversity, with high live coral cover, making them popular attractions for snorkelers.

Benthic Cover

Live coral cover is a popular measure for coral reef health. At the SCMR 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. According to 2007-2008 assessments of 96 sites across Belize, percentage live coral cover for the Sapodilla Cayes Marine Reserve averaged 9.9% (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 survey in 2009 estimates the average live coral cover of the marine protected area at 8% (Shank et. al., 2010). The percentage of live coral cover is low both nationally and regionally and very low when compared to historical estimates of 60% live coral cover from the late 1970's (Figure 18; SEA, SOP 2008). Despite these low averages, it is worth noting that there are sites within the marine reserve that exhibit exceptional coral cover and diversity. SEA site surveys for 2007, found live coral cover ranging from 13%

to 46%, averaging 26%, with the highest coral cover at the Last Day site at 46%, indicating key areas of extremely high coral cover. In 2010, total live coral cover averaged 32% over the two sites surveyed, ranging from 29.8% at Vigilence Reef and 33.8% and Seal Caye.

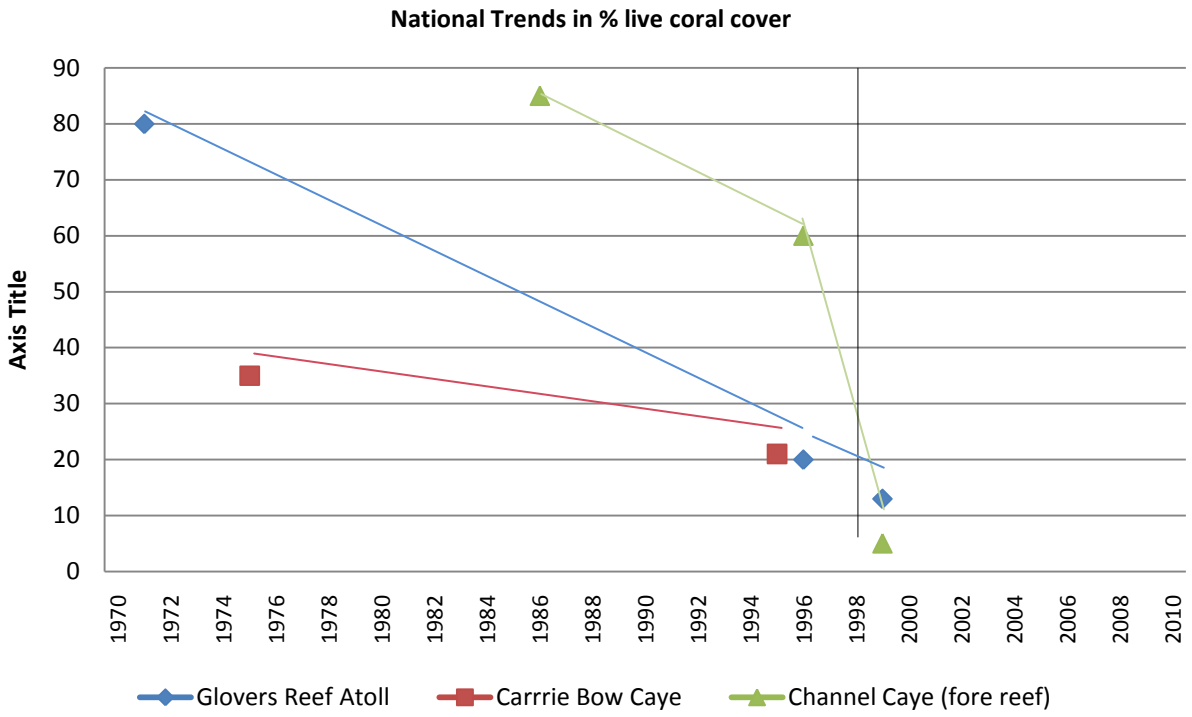


Figure 18: Historical trends in percent live coral cover at three sites within the Belize Reef system

Since 2006 there have been a number of surveys that have examined percent algal cover. These studies have shown a range of algal cover from a low of 14% to a high of 34.1% (McField, et al. 2008 (ed. Wilkinson et. al.)). An average algal cover of 25.1% (including turf algae), from random sampling within the SCMR in 2009 (Shank et. al., 2010), though the most recent SEA data suggests a lower macro algal cover of 12%.

SEA has also examined overall benthic cover at its monitoring sites. These seven sites selected strategically from the shallow back reefs at the SCMR show relatively lower macroalgal cover and much higher coral cover. Benthic cover components vary between the selected monitoring sites (Figure 19), and data does not include turf algae or bare rock. In these sites, algal composition averaged about 14%, with a ratio of live coral to macro algae cover of greater than 2:1. It should be noted, however, that the monitoring sites were strategically selected for their relatively good condition.

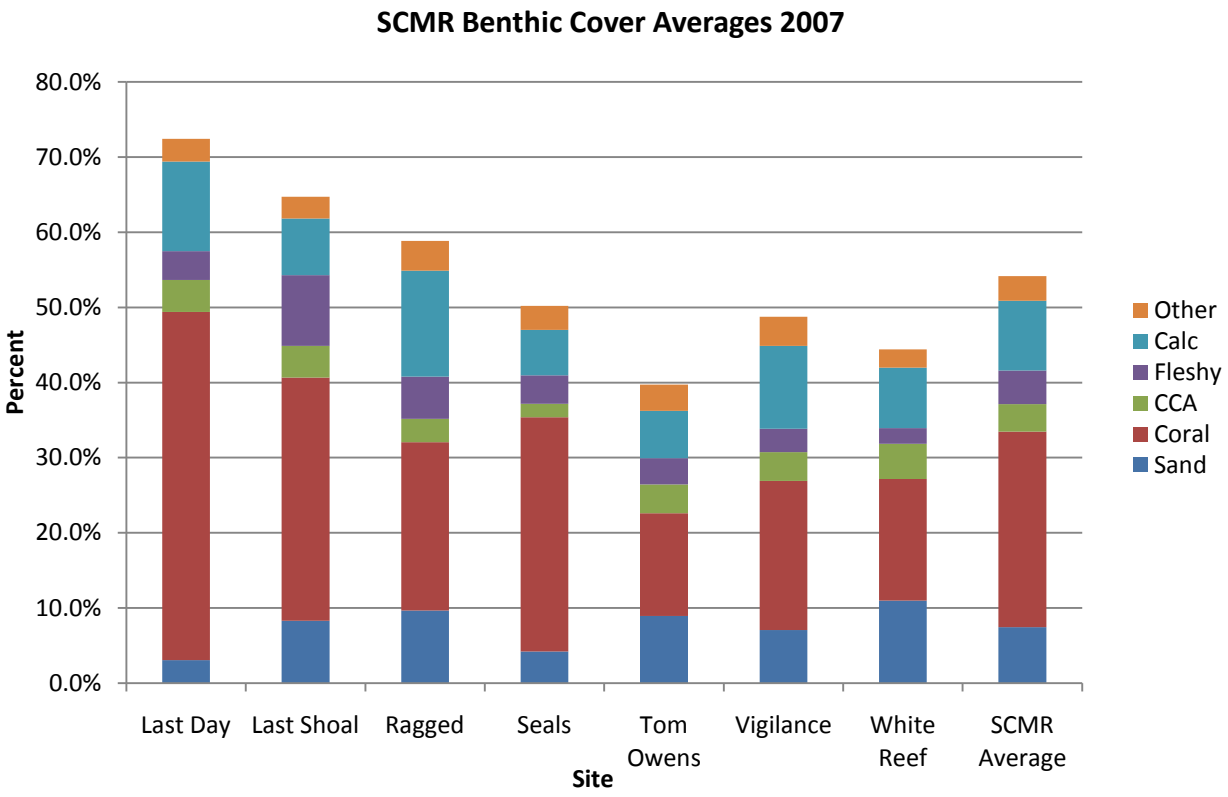


Figure 19: Sapodilla Cayes Marine Reserve: Benthic Cover Averages (SEA / TASTE data, 2007)

Coral Diversity

Sapodilla Caye Marine Reserve hosts nine species of coral considered critically endangered or endangered on the global scale (Table 15; IUCN, 2010).

Although a thorough survey of coral diversity has not been conducted, at least 21 coral species have been regularly recorded on the back reef of SCMR with an individual site average of 12 different species per site, consistent with other surveys done across the MBRS region (Salgado et al., 2006). The majority (57%) of sites have 13 species with the minimum being 10 species per site (White Reef). On average, the massive reef building corals *Agaricia tenuifolia* and *Montastrea annularis* make up the majority of corals encountered at each site (26.1% and 21.1% respectively) (Figure 20). These occur along with, *Montastrea faveolata, Porites asterodies* and *Porites porites.*

Sapodilla Cayes Marine Reserve Coral Species of International Concern	
Critically Endangered	
Staghorn Coral	*Acropora cervicornis*
Elkhorn Coral	*Acropora palmata*
Endangered	
Lamarck's Sheet Coral	*Agaricia lamarcki*
Pillar Coral	*Dendrogyra cylindrus*
Elliptical Star Coral	*Dichocoenia stokesii*
Fire Coral	*Millepora striata*
Star Coral	*Montastraea annularis*
Star Coral	*Montastraea faveolata*
Montastraea coral	*Montastraea franksi*
Rough Cactus Coral	*Mycetophyllia ferox*

Table 15: Coral Species of International Concern of Sapodilla Cayes Marine Reserve

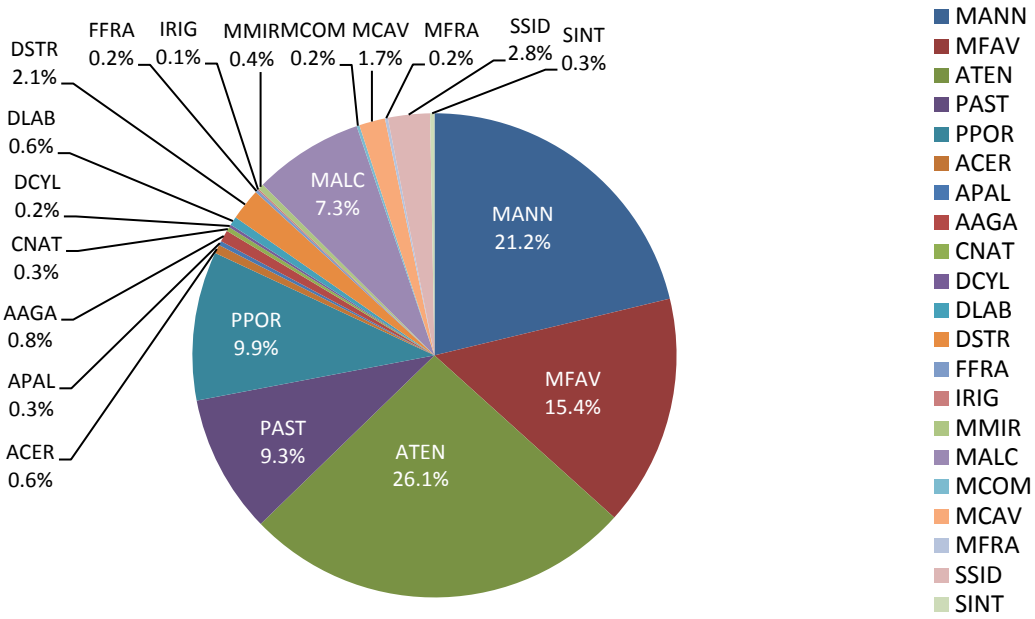


Figure 20: Sapodilla Cayes Marine Reserve % Coral Cover (Average)

Species	Last Day	Last Shoal	Ragged	Seal	Tom Owens	Vigilance	White Reef	Average
Stephanocoenia intersepta (SINT)					3.00			0.3
Siderastrea siderea (SSID)	1.5	1.8	4.7		16.7		0.7	2.8
Porites porites (PPOR)	22.8	8.0	9.5	3.9	1.1	9.9	6.9	9.9
Porites astreoides (PAST)	5.1	9.8	14.2	6.6	1.1	17.6	9.0	9.3
Montastraea franksi (MFRA)				1.3				0.2
Montastraea faveolata (MFAV)	15.2	11.7	6.8	29.6	21.1	16.2	9.7	15.4
Montastraea cavernosa (MCAV)	1.5	0.6	1.4	2.0	7.8	0.7	0.7	1.7
Montastraea annularis (MANN)	12.2	31.9	11.5	43.4	23.3	16.9	11.1	21.2
Millepora complanata (MCOM)						0.7	0.7	0.2
Millepora alcicornis (MALC)	2.5	4.9	8.1	5.3	4.4	8.5	18.8	7.3
Diploria labyrinthiformis (DLAB)	0.5	1.8		1.3				0.6
Diploria strigosa (DSTR)	3.0	1.2	0.7	0.7	12.2	0.7		2.1
Favia fragum (FFRA)		0.6				0.7		0.2
Isophyllastrea rigida (IRIG)					1.1			0.1
Madracis mirabilis (MMIR)	1.5	0.6						0,4
Dendrogyra cylindrus (DCYL)							1.4	0.2
Colpophyllia natans (CNAT)	0.5			0.7		0.7		0.3
Agaricia tenuifolia (ATEN)	32.5	25.8	41.9	3.9	1.1	25.4	41.0	26.1
Agaricia agaricites (AAGA)			0.7		6.7	0.7		0.8
Acropora palmata (APAL)	1.0			0.7				0.3
Acropora cervicornis (ACER)		1.2	0.7	0.7		1.4		0.6
Number of species	13	13	11	13	12	13	10	21

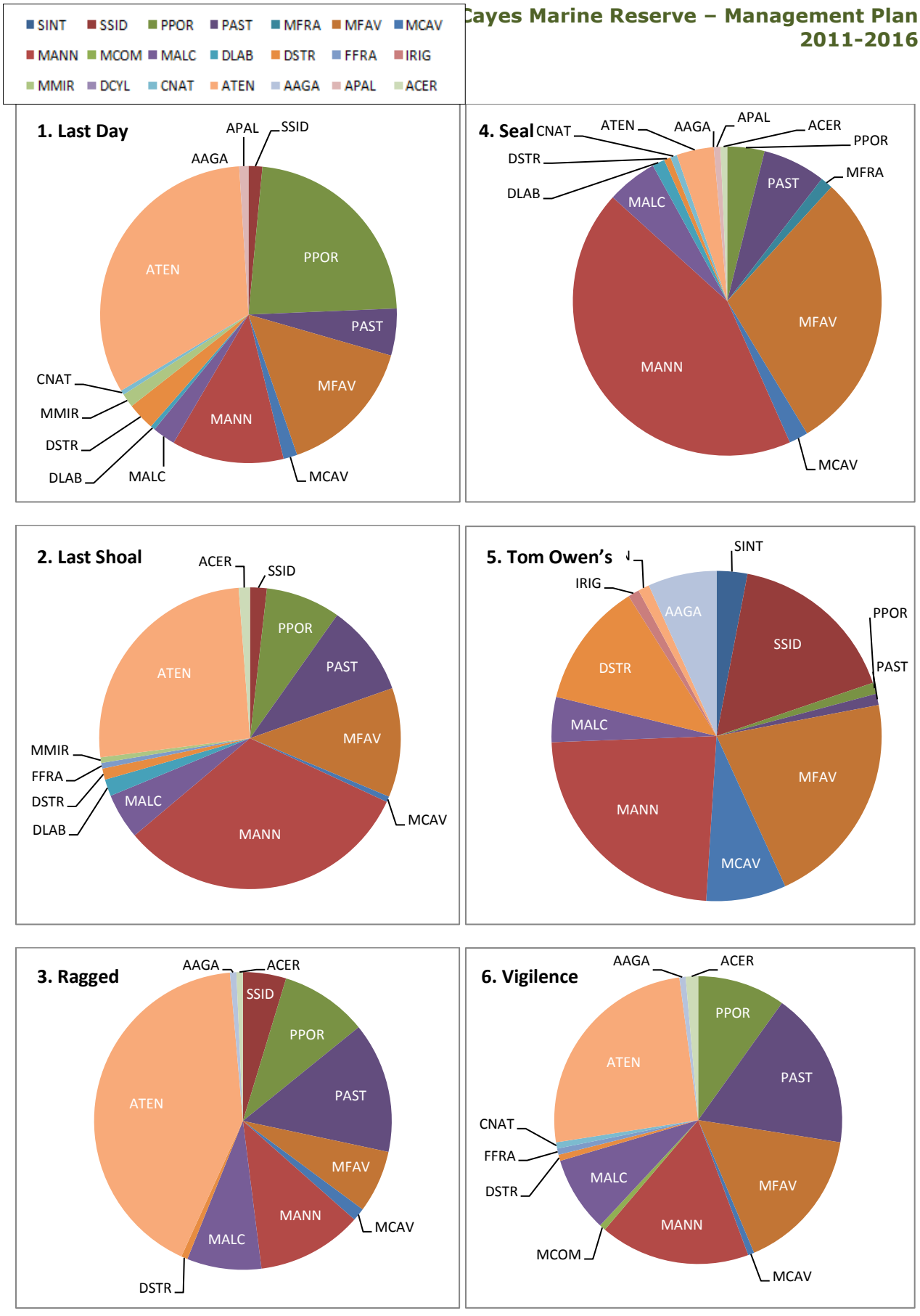


Figure 21: Relative live coral cover at sites within Sapodilla Cayes Marine Reserve (SEA data, 2009).

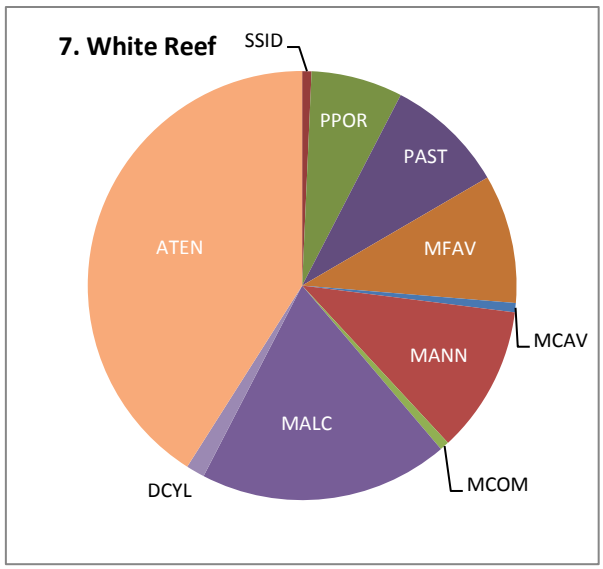


Figure 21: Relative live coral cover at sites within Sapodilla Cayes Marine Reserve - continued (SEA data, 2009).

In combination, these five species made up 50% of the corals encountered at almost all of the sites and, on average, over 80% of the corals encountered were one of these five species. Fire coral (*Millepora spp*.) made up about 5% of the remaining corals at most sites (SEA, 200).

Analysis of coral diversity at the seven strategically selected back reef sites indicated that there were differences in coral composition and abundance between sites. (Figures 20 and 21). Four species were found at only one of the sites surveyed: *Stephanocoenia intersepta* (Tom Owen's), *Montastraea franksi* (Seal), *Isophyllastrea rigida* (Tom Owen's), and *Dendrogyra cylindrus* (White Reef).

Coral Health

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 the Sapodilla Caye 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_2 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. Although data about the effect of the 1995 bleaching event is not available for SCMR, it is likely the corals within the park would have followed the similar trends.

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

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 (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. At the Sapodilla Cayes it is likely that effects from the 1998 were on a par with that experience across the Southern Reef as Hurricane Mitch remained stationary for almost two days less than 120 kilometres (75 miles) from the SCMR, producing violent seas and having significant impacts on the corals.

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.)). A 2009 study compared growth rates of corals at four locations, including the Sapodilla Cayes, before and after the 1998 bleaching event. The study showed that corals in areas with higher levels of anthropogenic stress, such as overfishing and pollution, were less likely to return to previous growth rates after a bleaching event (Carilli et.al, 2009).

Bleaching of Belize's corals was observed again in 2005. Mean bleaching was recorded at 27.9%, with approximately 6.5% mean mortality (McField, et al. 2008 (ed. Wilkinson et. al.)). Although coral bleaching during 2005 was observed at multiple sites across Belize, the extent and effects of bleaching during the 2005 event was not considered significant (McField, et al. 2008 (ed. Wilkinson et. al.)).

Since 2007, the Southern Environmental Association has conducted bleaching monitoring at the SCMR. In 2008 the National Coral Reef Monitoring Network implemented a national bleaching monitoring program, with the highest percentage of bleaching (30%) observed at the Sapodilla Cayes, recorded during October of 2008 (SEA, 2009). Even with these higher rates of recovery from bleaching events has been good, with bleaching being reduced to a minimal average of 3% six months later in April. The lowest bleaching level was recorded at site BL3003 (0.5%), the highest at the Seal Caye site (6.4%).

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 Sapodilla Cayes Marine Reserve show lower levels of bleaching than those that live at deeper levels (Figure 22).

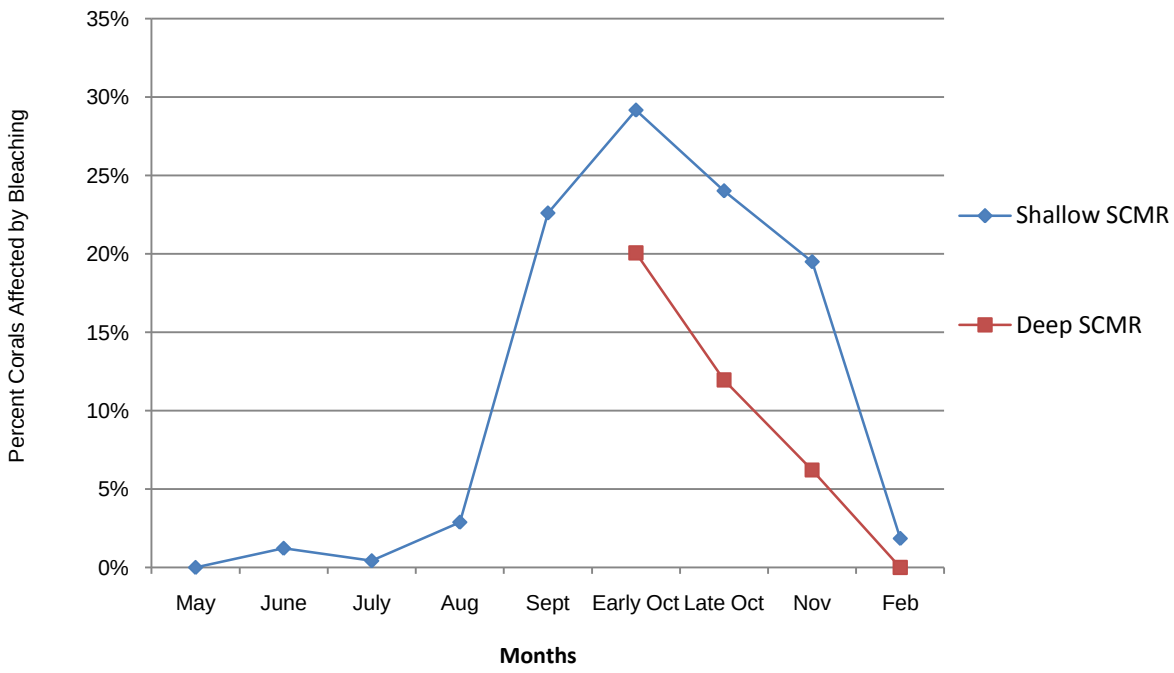


Figure 22: Sapodilla Cayes Marine Reserve: Coral Bleaching – annual trend

Coral Reef Trends

A snapshot of the changing status of the coral reefs at the Sapodilla Cayes Marine Reserve (Table 16) shows that there are glimmers of hope with some sites of exceptional coral diversity and live coral cover, the overall picture, however, indicates a need for greater management efforts particularly directed at mitigating manageable anthropogenic impacts. It also highlights some of the past gaps in monitoring and accessibility to data that exist, and the importance of ensuring that this information is kept up to date on an annual basis, if trends are to be identified.

SCMR	2006 Average	2008 Average	2009 Average	2010 Average
Live coral cover	26%			31.8% average (ranging from 29.8% to 33.8%) (two survey sites)[5].
Coral diversity	21	18	18	
% coral bleaching (1st qtr)			FEBRUARY Overall 1.85%	APRIL Overall: 1.1%
% coral bleaching (3rd qtr)	3.0% (over the period from June-Sept)	OCTOBER Shallow 29.16% Deep 20.06% Overall 24.61%	7.3%	
Recent coral mortality	1.0%	0.4%	0.3%	0.9%
Density of herbivores		1250.01 - 4650g /100m^2 (SEA data)		
Density of commercial fish		700 - 1399 g/100m^2 (SEA data)		
Coral recruits		3.4/m^2 (SEA data)	6.0/m^2 (Shanks, 2009)	
Macroalgal cover		12.0%	12.0%	12.0%

Table 16: Trends in Coral Reef Health

Seagrass

The shallow reef of the sheltered lagoon supports varying densities of turtle grass (*Thalassia testudinum*), interspersed with sparse strands of manatee grass (*Syringodium filiforme*). The shallow waters associated with the reef complex between Tom Owen's Cayes and Ragged Caye, is dominated by seagrass, with a number of dominant algal species - *Penicillus capitatus*, *Rhipocephalus phoenix* and *Udotea flabellum.* The only common coral species is *Manicina areolata*.

[5] SCMR sites are not random...chosen for healthy corals. Shank et. al. estimate for percentage live coral cover average over the years 2006 – 2009 was 8%

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 Sapodilla Cayes Marine Reserve are considered to be in very good condition, with minimal human impacts, (SEA, 2010). Potential management issues could arise in high use snorkeling areas where visitors and tourists may frequently stand on living seagrass (Claudett et al. 2009).

Terrestrial Ecosystems

A total of 33 naturally occurring native species of plant, have been reliably identified as currently occurring within the littoral forest and herbaceous beach community of the cayes of Sapodilla Cayes Marine Reserve (Site visit, 2010; Annex Four). Whilst earlier surveys recorded up to 95 species (Stoddart, 1982) many of these were non-native; however past and present natural and human impacts have resulted in huge changes in the flora of the cayes over the years, particularly with the historical introduction of the coconut palm for oil, and more recently, the clearance of beaches for tourism access and aesthetics.

Sapodilla Cayes Marine Reserve is one of the few places remaining in Belize where littoral forest is relatively well represented - probably Belize's most threatened ecosystem, this ecosystem is highlighted under Belize's National Protected Areas System Plan as being significantly under-represented within the current protected area system, with only 8.6% of the national coverage being under protection, as compared with the national target of 60% for this ecosystem.

The flora of island ecosystems is dynamic in species occurrence and stature – changes often reflecting both natural cycles and anthropogenic impacts. Species of the littoral forest and of the herbaceous beach community play critical roles in the stabilization of the cayes, and in providing suitable habitats for nesting birds and sea turtles – including species that are endangered and / or have very limited distributions. National populations of several of the plant species found on the cayes of the Marine Reserve have undergone significant decline in recent years, as coastal beaches are cleared and developed for coconut plantations, tourism and residential use. Four of the cayes within the Marine Reserve are considered to still retain some form of Littoral Forest cover (Table 17), though there has been a transition to non-native species – coconuts, almonds, with the degradation or disappearance of species such as saltwater palmetto, seagrape and beach vines. Nicholas Caye, in particular, has been highlighted for the change in vegetation and the reduction in wildlife with the disappearance of the native fruiting trees and other vegetation. However, they still play a crucial role in the continued survival of these ecosystems.

The presence of fringing red mangroves on Seal and Franks Cayes is considered particularly important for the viability of the reef, providing a nursery site for many marine species, including a number of important commercial species.

Vegetation Assessment per Caye				
Caye	Littoral Forest		Mangrove	
	Historical	Present	Historical	Present
Seal	<5% - some littoral forest species: *Cordia, Coccoloba* buttonwood & herbaceous flora. **Exotics:** Coconuts (few)	<5%% - scattered *Cordia*, *Coccoloba,* buttonwood & herbaceous flora. **Exotics:** Coconuts (few)	95% - red & white mangrove, buttonwood	80%, underbrushed red mangrove, buttonwood
Tom Owen's	80% - Buttonwood, cordial, with scattered coconuts. Dense herbaceous ground cover	0% - all natural vegetation removed. **Exotics:** Coconut, almond	<5% - scattered red mangrove present in 1960 and 1972 surveys.	0% - all removed
North East	35% - Buttonwood mixed with littoral forest species (*Citharexlyum, Thrinax, Coccoloba, Ficus*) extending around shoreline. *Tournefortia* absent. **Exotics:** Coconut plantation covering central bajo – approx 65% of island.	15% - Ficus, Pachira, Sophora & other littoral species regenerating in central bajo – colonizing outwards into dying coconut plantation. Tournefortia now present on north coast. **Exotics:** Coconut, almond, noni	None recorded	None recorded. Some buttonwood near southern shoreline.
Frank's	<5% - restricted to the shorelines with buttonwood, seagrape and palmetto. **Exotics:** Coconut - Central portion of main island was coconut plantation.	0%, scattered specimens of buttonwood, palmetto, seagrape & Ficus. **Exotics:** Coconut, almond, casuarinas, noni, avocado, custard apple, legumes	<10% - red, black & white mangroves, + buttonwood thickets, mostly around periphery	15% - eastern islet (tall red mangrove basin, fringing mangrove, white mangrove), regenerating over past coconut plantation. Dense red mangrove on eastern tip of main island (grown into previously wider channel) + scattered individuals (red) on northern shoreline. Recent mangrove scrub regeneration on southern coast has been removed.

Vegetation Assessment per Caye				
Caye	Littoral Forest	Mangrove	Caye	Littoral Forest
	Historical	Present	Historical	Present
Hunting	<5% - very limited small patch on parts of shoreline. >95% of island covered with coconut plantation with dense spider lily cover. **Exotics:** coconut	>50%: littoral forest / bajo assemblage regenerating on northern 40% of island and on <10% SE tip. **Exotics:** coconut, almond, casuarinas, noni, *Scaevola plumieri*	0% - none recorded	None recorded
Lime	15% - stands of palmetto and buttonwood. 85% coconut plantation, with scattered specimens of littoral forest flora.	<5% - remnants at north **Exotics:** coconut, almond, noni, *Scaevola plumieri*	0% - re-colonizing red mangrove seedlings recorded in 1960, gone by 1972.	None recorded
Ragged	0%, but with some buttonwood shrubs. A few coconut trees, casuarinas and herbaceous beach flora. **Exotics:** Coconuts	0% - only herbaceous beach vegetation (+ coconuts). No casuarinas or buttonwood. **Exotics:** coconut	0% - none recorded	0% - no mangroves.
Sandbore	Not assessed	0% - only herbaceous beach vegetation, plus *Tournefortia* and *Suriana maritima* (only specimens seen on any of the islands. **Exotics:** coconut	Not assessed	0% - no mangroves.

Table 17: Past and present vegetation of the Sapodilla Cayes

1.5.2 Fauna

Fish

Of the over 230 species included in the current species list (Annex Four), four 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*) and great and scalloped hammerheads (*Sphyrna mokarran* and *lewini*) (Table 18). All three of these species have been, and continue to be, impacted by commercial fisheries.

Fish Species of International Concern	
Critically Endangered	
Goliath Grouper	*Epinephelus itajara*
Endangered	
Nassau Grouper	*Epinephelus striatus*
Great Hammerhead	*Sphyrna mokarran*
Scalloped Hammerhead	*Sphyrna lewini*
Vulnerable	
Queen Triggerfish	*Balistes vetula*
Hogfish	*Lachnolaimus maximus*
Mutton Snapper	*Lutjanus analis*
Cubera Snapper	*Lutjanus cyanopterus*
Yellowmouth Grouper	*Myctoperca interstitialis*
Whitelined toadfish	*Sanopus greenfieldorum*
Splendid toadfish	*Sanopus splendidus*
Whale Shark	*Rhincodon typus*
Rainbow Parrotfish	*Scarus guacamaia*

Table 18: Fish Species of International Concern of Sapodilla Cayes Marine Reserve (IUCN, 2010)

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). 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. The reefs of Sapodilla Cayes Marine Reserve have a relatively moderate population of medium parrotfish,[6] with a maximum density of 29g/m^2 and an average of 12g/m^2 (Shank et. al. 2010) – densities of 25.5g/m^2 have been shown to effectively reduce algal cover in the Bahamas (Mumby et. al., 2006).

[6] On a scale of None, Low, Poor, Moderate, High (Shank et. al., 2010

Sharks are also an important part of the ecosystem at the SCMR, however it is feared that their numbers have also declined significantly due to heavy fishing during the Lenten season - as of 2007 there were still two active shark fishing camps located in Southern Belize (Graham, 2007), and pressure on shark populations is known to have increased since then. The endangered great and scalloped hammerheads (*Sphyrna lewini*) are both still fished in Belize, despite their globally threatened status. A further eleven shark species have also been confirmed as present within the Marine Reserve (SEA data; R. Graham, pers. com.).

Sharks of SCMR

Bull shark
Lemon shark
Caribbean reef shark
Tiger shark
Caribbean sharpnose shark
Whale shark
Nurse shark
Black tip shark
Silky shark
Scalloped hammerhead
Great hammerhead
Bonnethead
Blacknose shark

R. Graham, pers. com.

The threatened 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 the adjacent Gladden Spit and Silk Cayes Marine Reserve. At the Sapodilla Cayes Marine Reserve, whale sharks can also routinely be observed feeding as they pass through the deeper waters off the barrier reef. The Sapodilla Cayes may have been named in part due to the presence of whale sharks, known by local fishermen as "Sapodilla Tom".

Mammals

Four species of dolphin have been reported from within the adjacent South Water Caye Marine Reserve - 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*).

Antillean (or West Indian) manatees (*Trichechus manatus manatus*) are known to use the cayes in the adjacent Port Honduras Marine Reserve and are known to use the inner cayes near Gladden Spit. Residents of the SCMR have reported sighting manatee at Frank's Caye and Seals Cayes within the SCMR. 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 17th 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 slaughter 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

The Sapodilla Cayes provides crucial habitat for wide range of migratory birds (Table 19), but many of the resident species have been extirpated in recent years due to increasing impacts from hurricanes and human activities - unregulated use of the cayes as fish camps and tourism developments, causing shifts in nesting locations in the last 10 years. There is no full species list to date, as comprehensive surveys still need to be completed during the migratory season.

Bird Species of Sapodilla Cayes Marine Reserve	
Brown booby	*Sula leucogastor*
Brown pelican	*Pelecanus occidentalis*
Magnificent frigatebird	*Fregata magnificens*
Great blue heron	*Ardea herodias*
Green heron	*Butorides virescens*
Osprey	*Pandion haliaetus*
Peregrine Falcon	*Falco peregrinus*
Ruddy turnstone	*Arenaria interpres*
Laughing gull	*Larus atricilla*
Sandwich tern	*Thalasseus sandvicensis*
Bridled tern	*Onychoprion anaethetus*
Yellow warbler	*Dendroica petechia*
Magnolia warbler	*Dendroica magnolia*
Bay-breasted warbler	*Dendroica castanea*
Common yellowthroat	*Geothlypis trichas*
Mourning warbler	*Oporornis philadelphia*
Blackburnian warbler	*Oporornis philadelphia*
Willow flycatcher	*Phylloscopus trochilus*
American redstart	*Setophaga ruticilla*
Swainson's thrush	*Catharus ustulatus*
Melodius blackbird	*Dives dives*
Great tailed grackle	*Quiscalus mexicanus*

Table 19: Bird Species of Sapodilla Cayes Marine Reserve (*L. Jones. 1998: Z. Walker. site visit. 2010)*

Although the number of nesting birds has decreased from historical numbers, at least four cayes (Seal Tom Owens, Lime and Ragged) and the shifting sand shoals continue to serve as important nesting locations for a variety of tern and gull colonies, with bridled terns, roseate terns, and laughing gulls all reported as nesting in the area within the last three years (SEA staff; Walker site visit, 2010). Numbers and locations of nests fluctuate, with aggregations of nesting birds moving between cayes from year to year (SEA data, Figure 23).

The Sapodilla Cayes is also home to a wide range of migratory birds, but many of the resident species have been extirpated in recent years due to unregulated use of the cayes as fish camps, and more recently, development of the cayes for various purposes.

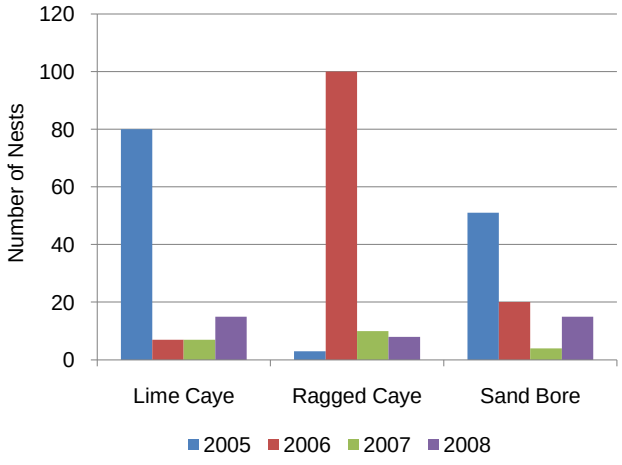


Figure 23: Sapodilla Cayes Marine Reserve: Number of bird nests per caye

The Caribbean subspecies of Osprey (*Pandion haliaetus ridgwayi*), an important predator of the marine environment and indicative of the health of the trophic structure, also nests on the cayes. This subspecies has a limited global distribution, with Belize representing the southern extent of its range, and should be closely monitored. The Sapodilla Cayes have also lost at least one resident land bird in recent years, the Yucatan Vireo, which formerly reached its southernmost limit on the Sapodilla Cayes (Jones, pers. com.).

Apart from the resident and former resident bird species, the Sapodilla Cayes are an important stopover point for migrants as they move south in autumn and north in spring between North American breeding grounds and Central and South American wintering grounds. Literally thousands of migrant songbirds, notably wood warblers, tanagers, thrushes, and tyrant flycatchers, pass through the outer Cayes, including Lighthouse Reef, Glovers Reef and the Sapodilla Cayes, each spring and fall. These Cayes provide stopping-off points with critical forage and shelter for these hordes of migrants as they pass through on their long semi-annual journeys. Along with the songbirds come the predators, including peregrine falcons, which support themselves by feeding on the migrating songbirds as they too migrate between northern and southern latitudes. The peregrine and its smaller relative, the merlin, migrate almost exclusively through the cayes of Belize and Honduras, for the most part avoiding the mainland in order to take advantage of this abundant prey resource.

Reptiles

The conservation priorities for the herpetofauna of Sapodilla Cayes Marine Reserve relate to the three species of sea turtle known to use the area: the critically endangered hawksbill (*Eretmochelys imbricata*) and the endangered green turtles (*Chelonia mydas*), and loggerhead (*Caretta caretta*). As elsewhere, sea turtle numbers have plummeted in recent decades, having been exposed to intense 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 with only the hawksbill still nesting within the Marine Reserve, and in reduced numbers. 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 cayes increasing the critical importance of maintaining those characteristic of the cayes of Sapodilla Cayes Marine Reserve that increase nesting success, and balancing this with land ownership conflicts, tourism activities and development in the area.

Turtle monitoring
(*Photo: Annelise Hagan / SEA)*

SEA collects data on the number and location of nests, and has also collected limited data on nesting success, showing an estimated average nesting success of between 68-81% between 2005 and 2007

Turtle hatchling on Sapodilla Cayes beach
(Photo: J. Finch)

(State of the Parks, 2007). More recently, SEA has initiated more intensive monitoring the beaches of the Sapodilla Cayes for turtle nesting activity throughout the season (March to October). In 2010, turtle nesting was particularly prevalent on Lime Caye (at least 11 nests) and Nicholas Caye (at least 6 nests), with 3 nests also observed at Hunting Caye (Table 20; SEA, 2010).

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, the 18 nests recorded in 2010 probability represent only 4 or 5 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.

Caye	Species	No. nests
Nicholas	Hawksbill	4
	Loggerhead	1
	Green	1
Lime	Hawksbill	11
	Loggerhead	
	Green	
Hunting	Hawksbill	3
	Loggerhead	
	Green	

Table 20: Number of sea turtle nests at the SCMR in 2010

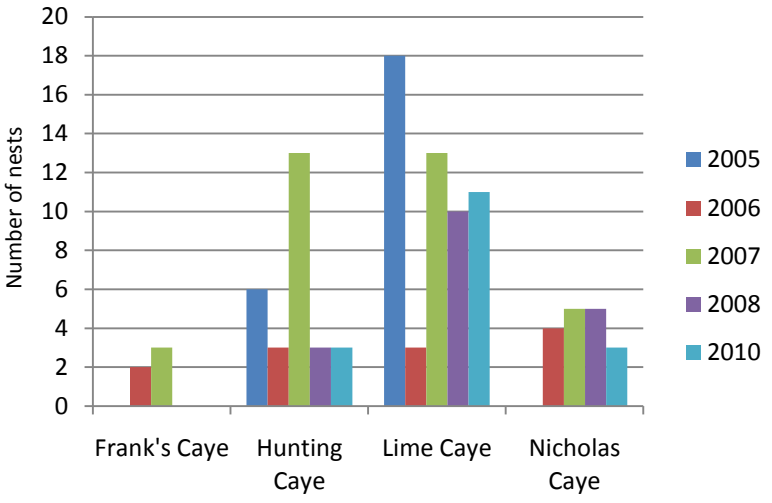


Figure 24: Number of sea turtle nests at the SCMR from 2005-2010 (excluding 2009)

Loggerhead and green turtles still frequent the waters of the Sapodilla Cayes Marine Reserve, and are reported as nesting on Nicholas Caye (SEA data, 2010), though earlier studies suggested that they had stopped using the area (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.

Rangers and biologists have been monitoring turtle nesting populations at the Sapodilla Cayes Marine Reserve for the past five years (Figure 24). This has included recording the number of nests and where possible calculating nesting success.

Three terrestrial reptile species were recorded on the Sapodilla Cayes during the site visit (2010) – the brown anolis (*Anolis sagreiI),* St. George's island gecko (*Aristelliger georgeensis*)*, and* the green iguana (*Iguana iguana*)*,* the latter introduced to Hunting and Lime Caye by tour guides. The boa (*Boa constrictor*) has also been reported in the past (Jones, 1998-2002 report; Finch, pers com), as have American crocodiles (*Crocodylus acutus*) (SEA staff, 2010).

St. George's island gecko (*Aristelliger georgeensis*), considered to be a human commensal (Lee, 2000), was recorded on Hunting Caye and is expected to occur on the other cayes of the Sapodilla range (Walker, pers. com.). The brown anole (*Anolis sagrei*) is abundant throughout all habitats on the Sapodilla Cayes, and widely distributed throughout the western Caribbean, generally also considered a human commensal, though it does occur throughout the littoral forest patches and on uninhabited coastal islands.

1.5.3 Economically Important Species

The Sapodilla 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[7]). 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). During community consultations with traditional lobster fishermen, more than one participant stated that there would not be sufficient lobster or conch to sustain the community of Sarteneja in the future - 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[8]).

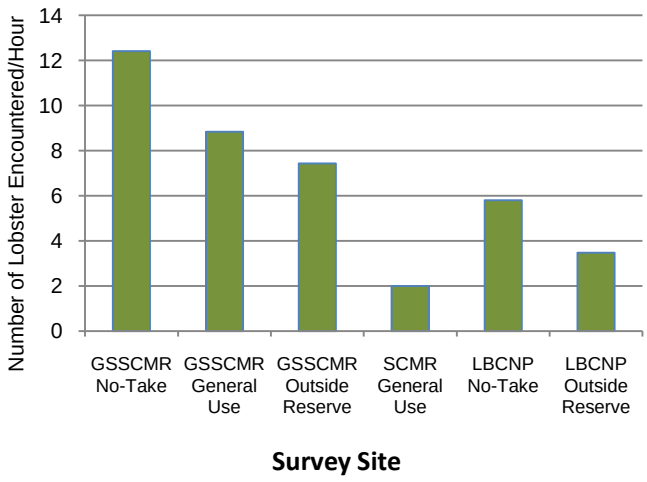


Figure 25: Comparison of Lobster Encounters at GSSCMR, SCMR and LBCNP in 2008

Lobster has traditionally been a major fisheries target at the Sapodilla Cayes Marine Reserve. Most lobster fishermen within the SCMR use hook sticks to free dive for lobster, although there has been some interest in the use of shades and traps. Over the past few years commercial species monitoring has been occurring within the SCMR. These studies have shown relatively low numbers of lobster within the reserve, approximately 2 lobster observed per hour. When compared to Laughing Bird Caye National Park and Gladden Spit and Silk Cayes Marine Reserve, lobster encounter rates within the SCMR seem low. This could be due to increased fishing pressure within the SCMR (Figure 25).

[7] Ministry of Agriculture and Fisheries Annual Report, 2008

[8] Adele Catzim: Data produced by the Belize ISIS Enterprises Ltd. with support from the Betty Moore Foundation, through Conservation International

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. 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.

Sapodilla Cayes Marine Reserve is well known throughout Belize for its high densities juvenile conch. SEA has conducted significant monitoring of conch populations within the Sapodilla Cayes Marine Reserve. This research has shown that although the SCMR still lags behind both Gladden Spit and Silk Cayes Marine Reserve and Laughing Bird Caye National Park in terms of abundance of mature conch, the known nursery sites within the Marine Reserve show some of the highest densities of juvenile conch. Densities at one of the known nursery sites has been over 3000 individuals per hectare a figure that indicates the importance of the SCMR in maintaining a viable conch population.

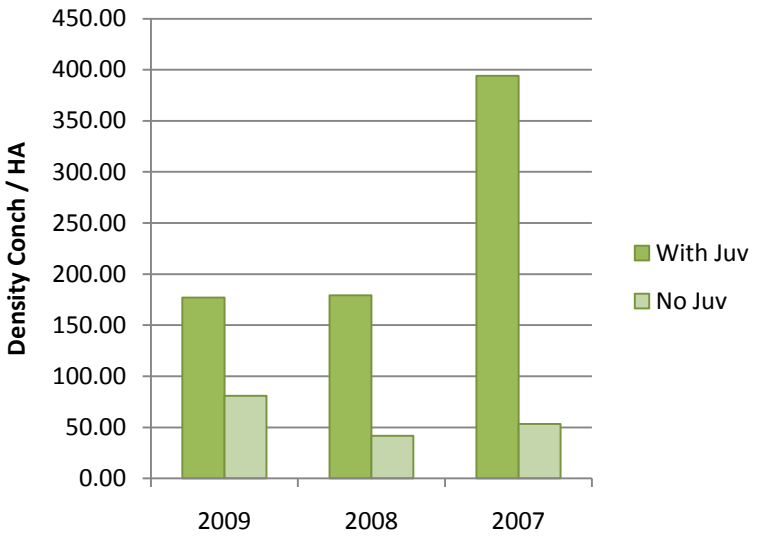


Figure 26: Sapodilla Cayes Marine Reserve: Density per ha for conch

Year	Conch Density/ha	
2009	177.08	Including Juveniles
	81.02	Excluding Juveniles
2008	179.40	Including Juveniles
	41.67	Excluding Juveniles
2007	394.23	Including Juveniles
	53.42	Excluding Juveniles

Finfish are also extracted from the general use zones within the marine protected area, mostly by spear fishing and hand line, providing important resources for a small number of traditional fishermen. The number of traditional fishermen who depend upon the fisheries of the Sapodilla Cayes Marine Reserve has declined over the past ten years with a significant majority of the traditional fishers moving into sports fishing or targeting other areas. This has been coupled with what is perceived to be an increase in fishing pressure from fishermen from the neighboring countries of Guatemala and Honduras. Species traditionally targeted include groupers (*Epinephelus* sp. and *Mycteroperca sp.)*, snappers (*Lutjanus sp.* and *Ocyurus* sp.), hogfish

(*Lachnolaimus maximus*), king mackerel (*Scomberomorus cavalla*), great barracuda (*Syhyraena barracuda*), and jacks (*Alectis sp.*, *Caranx sp.* and *Trachinotus sp.)* (FAO, 2010).

Within Belize, 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, and dropping to 52,316 lbs in 2006, (Belize Fisheries Dept. 2002; Ministry of Agriculture and Fisheries, 2007) - a drop of approximately 54% over five years. Species harvested for local consumption include grunts (Haemulidae), mullets (Mugilidae), porgies (Sparidae), triggerfish (Balistidae), and tarpon (Megalopidae).

Sapodilla Cayes Marine Reserve: Commercial fish catch – snapper (Photo J. Finch)

Management of the Sapodilla Cayes Marine Reserve extends to three nationally protected spawning aggregations sites; Rise and Fall Bank, Seals and Nicholas. These three sites which lie within or adjacent to the marine protected area. Each of the spawning aggregations hosts a different mixture of spawning species including: snapper, grouper, and other reef fish. Monitoring of the spawning sites has been occurring at the SCMR since at least 2002.

Monitoring has traditionally been focused on the known Nassau grouper aggregation at the Nicholas site, helping to provide managers with a basic understanding of the status of the spawning aggregations. Data has been collected by The Nature Conservancy, Belize Fisheries Department, Toledo Association for Sustainable Tourism and Empowerment and now SEA, and shows extremely low numbers of Nassau grouper returning to the site each year during the peak months of December to February. Peak counts for Nassau grouper observed at the Nicholas site between 2002 and 2009 have numbered between 25 to 120 groupers on average (Figure 27) – with this site being considered ecologically extinct. Over the years of monitoring actual spawning behavior for Nassau grouper (*Epinephelus striatus*) has never been observed. Other species that

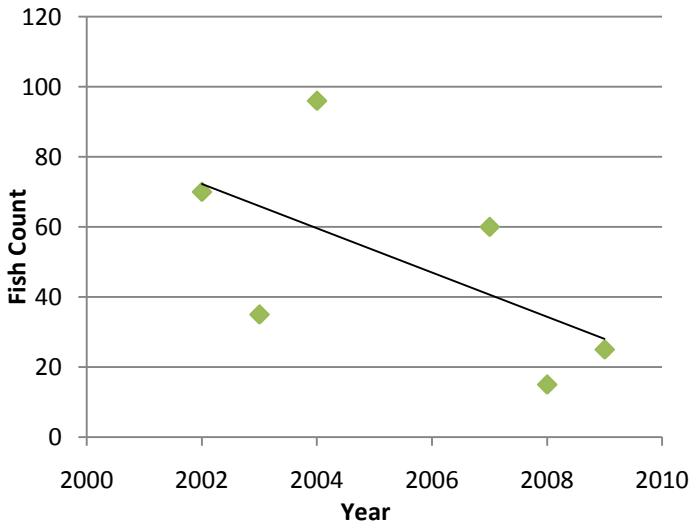


Figure 27: Peak Counts for Nassau grouper at the SCMR 2002-2009 (SEA Data, 2010)

observed aggregating at the Nicholas site include; black grouper (*Mycteroperca bonaci*), red hind (*Epinephelus guttatus*), tiger grouper (*Mycteroperca tigris*), yellowfin grouper (*Mycertoperca venenosa*) and various other reef fish.

Unfortunately much less information is known about the two remaining protected aggregations sites; Seal and Rise and Fall Bank. The Seal Caye site is well known by local fishermen during snapper spawning season and further monitoring is necessary to determine their status.

Finally in addition to the three protected spawning locations a popular spawning site called the "Elbow" is still fished by a handful of traditional fishermen during the April-June moons. This site is known for mutton snapper and is located at the southern boundary of the reserve. Traditional fishermen also talk of additional spawning sites for Red Hind and Yellowtail snapper located around the SCMR. It is thought that the bulk of the spawning sites within the SCMR have been heavily exploited by fishermen from Guatemala and Honduras, with minimal use by local Belizean fishermen. With the "Elbow" and the Seal site being the exception, being still fished by a handful of Belizean traditional fishermen during the April-June moons.

Except for the whale shark (for which there is a complete ban on fishing under the Fisheries Act), there is the general recognition in Belize that sharks, in general, are under pressure from over-fishing. Sharks have a close stock-recruitment relationship, long recovery times in response to over-fishing, produce few offspring and take long to reach sexual maturity, resulting in low biological productivity. This, in combination with complicated patterns of size/sex segregation and seasonal migration, raises national concerns about the sustainability of the shark fishery, particularly at 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 is also conducted throughout Southern Belize, and sharks are caught as by-catch in traditional long-line fishing in the deeper channels to the west and east of the protected area. Common species caught include bull, hammerhead, nurse, reef and lemon sharks. The dried shark fins and salted or frozen shark meat is 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). At this time, an estimated twenty-five fishermen from various coastal communities were identified as being involved, with the greatest capture 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, and is therefore not monitored or regulated.

In the last few years, harvesting pressure on sea cucumbers has increased, with illegal incursions from Guatemala and Honduras.

1.6 Cultural and Stakeholder Use of Sapodilla Cayes Marine Reserve

1.6.1 Community and Stakeholder Use

Commercial Fishing

Whilst there are no communities directly adjacent to the Marine Reserve, several have been considered as long term stakeholders. Sixty fishermen from the mainland communities of Monkey River, Punta Negra and Punta Gorda were identified in 2004 as having operated for over 23 years in the protected area from temporary camps on the cayes (TASTE / Nightingale, 2004). The majority of these fishermen were members of the Rio Grande Fishermen's Cooperative, operating out of Punta Gorda. They established fishing camps on the many of the cayes including, Tom Owen's, Northeast, Frank's & Seal Cayes. During The majority of Belizean fishermen in the 1980's and 1990's fished primarily along the mainland coast and the reef north of Tom Owen's Caye, only using the resources within the protected area to supplement their income

More recently, however, these cayes have been targeted for tourism development, with fishermen being evicted as cayes became privately owned or leased. A combination of the increasing cost of fuel, lack of a base from which to fish, and the implementation of no-take zoning within the marine protected area, has made it less economical for traditional Belizean fishermen to use the area any more. The majority of the fisheries extraction in 2010 was from illegal fishermen from the neighbouring Guatemalan and Honduran coastal towns.

Other historical commercial use has included seaweed harvesting, use of the cayes for coconut plantations and noni. More recently, a market has opened up in Guatemala for sea cucumbers, with extensive illegal harvesting in the southern waters of Belize. The Belize Government has addressed this through legislation restricting extraction to specific license holders, and

Military Base

In 1964, when Belize gained self-government from England, the government took ownership of the Sapodilla Cayes from private hands, on the basis of "national security purposes" (1976 Provisional Index to the Cayes of Belize). However, it was not until Belize gained Independence in September 1981 (and the military threat from Guatemala on Belize's sovereignty became evident), that the Government of Belize established a military base on Hunting Caye (TASTE / Nightingale, 2004), with the principal duties of monitoring the activities of sea and air vessels within the southern territorial waters of Belize. This base houses a rotating corps of about ten members of the Belize Coast Guard and the Belize Defence Force who conduct patrols within the area.

Immigration

Hunting Caye is considered a port of entry for visiting tourists from Guatemala and Honduras. This "unofficial" check-point came about as a result of a verbal agreement made between the Government of Belize, Guatemala and Honduras to facilitate the influx of tourists from these countries (TASTE / Nightingale2004). Given this arrangement there has always been some system of tracking visitors to the reserve at Hunting Caye. Beginning in 1994, before the declaration of the Marine Reserve, a ten dollar US entrance fee for foreign visitors was implemented. Fees were collected by the Belize Tourism Board who stationed one staff member on Hunting Caye specifically to collect entrance fees and track visitation. In 2005 the Belize Fisheries Department took over the responsibility of accessing entrance fees and checking foreign tourists into and out of the Marine Reserve.

Port Authority / Lighthouse

Given the history of shipwrecks in 1893 the British Government constructed a lighthouse on Hunting Caye to facilitate the passage of merchant ships along the southern coast of Belize and into the Gulf of Honduras The present lighthouse on Hunting Caye, is located on the south-eastern point of the caye and stands 65 feet tall with a range of 12 miles. It was renovated in 1983, and continues to serve its function as an international maritime navigational marker, operating on solar energy. The lighthouse is staffed by two employees of the Belize Port Authority who live in a two-story house constructed on Hunting Caye.

Lighthouse on Hunting Caye
(Photo: Paul Walker)

1.6.2 Recreation and Tourism Use

The majority of the visitors to the Sapodilla Cayes Marine Reserve originate from Guatemala or Honduras. Guatemalan and international tourists arrive on charter trips from Santo Tomas or Puerto Barrios (Guatemala) or by private vessel. Whilst most Honduran visitors would visit the reserve on their own private vessels (mostly cabin cruisers). Belize live-aboard charter boats from The Moorings and TMM, which operate out of Placencia, also visit the area. All boats that enter the Marine Reserve must check in and pay visitation fees at Hunting Caye. Visitation records, however, have not been consistent, the last viable figures being from 2004 (Figure 28) - ongoing, accurate record-keeping needs to be prioritized.

Traditionally the Sapodilla Cayes has been a common excursion destination for Guatemalans and Hondurans during national and religious holidays. There is increased cultural use of the Marine Reserve as a recreational resource at Easter, with many Hondurans and Guatemalans visiting the area, and camping overnight on Lime, Hunting or Nicholas Caye (Gale, 2004). Traditionally these two to four day

excursions would bring people and facilities from Guatemala or Honduras to set up during the holiday periods. In recent years there has been a decrease in these types of visitors with Lime caye now being the primary destination for these groups. Tourism visitation during this period was the major impetus for the construction of bio-remediation toilets and showers on Hunting Caye in an attempt to minimize the impacts of such large influxes of visitors.

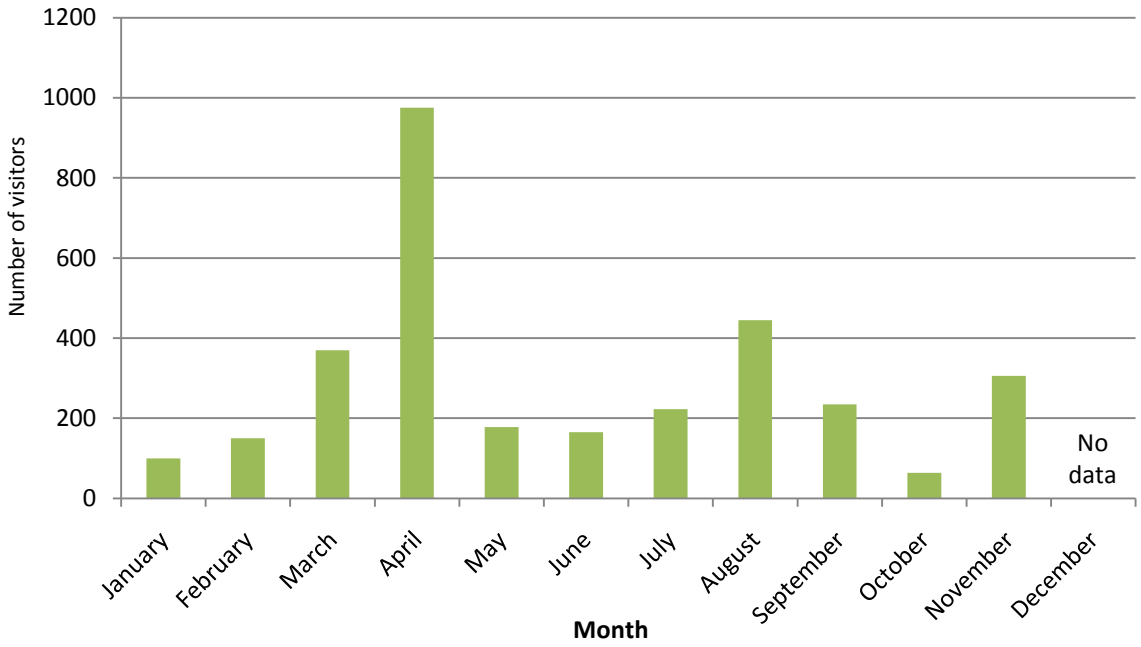


Figure 28: Sapodilla Cayes Marine Reserve: Pattern of Monthly Visitation (Fisheries Dept. 2004)

The area has also been used by smaller cruise ships for some time. In 2006 regular visits by the Seabourne cruise line began. The vessel "Seabourne Legend," makes six trips annually, bringing approximately 200 cruise visitors to Hunting Caye for day excursions. SEA has facilitated these visits, assisting in the building and maintenance of facilities including a series of palapas, a new pier, and grill as well as providing staff for these visits, as a direct support for the Toledo Tour Guide Association (TTGA) and other local stakeholders. This has been a valuable asset to the TTGA.

Seabourne Legend visiting Hunting Caye
(Photo: Jocelyn Rae Finch)

SEA, and formerly TASTE, have been instrumental in trying to support increased visitation by tourists originating in Belize and engagement by Belizean tour guides at the SCMR. This has included the construction of significant new infrastructure including a kitchen/bar on

Hunting Caye, the development of toilet and shower facilities and continued efforts to promote the use of Belizean tour guides whenever possible.

1.6.3 Educational and Research Use

SEA recognizes the importance of hands-on experience in reaching out to its stakeholders, and Sapodilla Cayes Marine Reserve has been the focus of SEA's Education and Outreach Programme in 2010, providing a site for hosting school trips. This activity, which has been ongoing throughout the history of the Marine Reserve, starting in 2003 under TASTE, 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, including Sapodilla Cayes Marine Reserve, to experience the reef environment and discuss management issues.

Students during an educational visit to one of SEA's marine protected areas (*Photo: J. Mendez / SEA*)

The trips were facilitated by 62 Field Directors – parents and teachers - who were provided with the skills to lead small groups of students in these reef exploration activities, following a basic curriculum provided by SEA.

These activities have provided SEA with a firm foundation and model for use of Sapodilla Cayes Marine Reserve as an educational resource, strengthening stakeholder support for management of the protected area. The distance from the mainland, however, makes school trips to the Marine Reserve expensive, reducing the viability of using it as an educational location. These trips are also important as the SCMR is not a Marine Reserve that is easily accessible or frequently visited by Belizeans.

In addition to the Marine Reserves value as an educational resource for local people, the area also has high potential education and research value, something that has only recently begun to be developed. In 2006 the University of Belize in conjunction with Earthwatch Institute began construction of the Living Reef Centre. The centre is owned and operated by the University of Belize and consists of dorm facilities and a kitchen with the potential for a computer room and laboratory space. It is hoped that this facility will act as a catalyst, attracting researchers and school educational groups to the area, though there are no immediate plans by UB to develop the station at the moment. Currently the centre has two staff members who maintain the facilities and host visiting groups from the University of Belize.

In 2005 with interest from a private investor Earthwatch Institute began what would be a three year program of support for research initiatives in Southern Belize and at the Sapodilla Cayes Marine

Reserve. The collaboration was a successful one as it looked to match the scientific knowledge of Earthwatch sponsored scientists and research groups with the skills and research needs of local NGOs. At the SCMR this included the sponsoring of three years of research teams who worked under with TASTE's direction to implement comprehensive monitoring of coral reef health and coral bleaching. It also resulted in the development of the Living Reef Centre which can provide accommodations, and potentially research facilities, for visiting scientists as well as school groups and other tourists. The collaboration with Earthwatch also brought a number of researchers to the Sapodilla Cayes who might not have otherwise been able to access or conduct research projects in the area. A number of these collaborations, especially with John Cigliano/Richard Kilman are on-going despite Earthwatch's departure from Belize in 2008.

The Living Reef Centre has been an important educational resource for hosting local stakeholders and students. The Centre has hosted a number of local groups for training programs. The Community Researcher program, started by TASTE and further enhanced by SEA with support from COMPACT, which trained a number of local stakeholders in research and monitoring techniques so that they could assist with biological monitoring used the centre and the marine resources of the SCMR to train local people. The Toledo Tour Guide Association has also used the facilities to offer marine training programs to some of their members.

1.6.4 Cultural / Historical Use

Archaeological Sites

The mainland coast and many of the offshore cayes of Belize, were once used as fishing stations, commercial posts, settlement areas, and burial and ceremonial centres by the ancient Maya (TASTE / Nightingale, 2004 (John Morris, 1994)), and provide information on maritime trade during the Post Classic Period (1000 AD to 1600 AD). Several cayes exhibited isolated archaeological features uncovered during the Point Placencia Archaeological Project (PPAP) expedition in 1985-1986, with several eroded shards and obsidian discovered on Tom Owen's, Northeast Sapodilla and Hunting Caye. Pottery shards unearthed on Lime Caye were identified as an historic midden during the same study (TASTE / Nightingale, 2004).

Shipwrecks

The reefs and currents around the Sapodilla Cayes area have led to several grounding, both past and present, leading to the installation of the lighthouse on Hunting Caye. Two hundred and fifty metres north of Tom Owen's Cayes lies a shipwreck tentatively identified as a Spanish Merchantman, dated between 1580 and 1780. The visible remains consist of ballast, three anchors and 3 cannons (originally six cannons were located, but three were reported missing in 1981). Preliminary excavations revealed that cultural material is preserved beneath the ballast (TASTE / Nightingale, 2004).

A more recent shipwreck thought to date to the 1970's is located on the fore reef between Hunting and Lime Cayes. This metal wreck is well preserved and is home to an abundance of schooling fish. In recent years corals have begun to colonize the wreck making it a popular destination for tourists and day-snorkelers

2. Conservation Planning

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.

2.1 Conservation Targets

Conservation targets are species, species assemblages or ecosystems that have been 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 needs of the system as a whole.

Potential Conservation Targets for Sapodilla Cayes Marine Reserve

- Sea turtles
- Spawning Aggregation Sites
- Whale sharks
- Resident and Migratory Birds
- Mangroves
- Seagrass
- Coral reef communities
- Sandy beaches
- Littoral Forest
- Commercial finfish species
- Sharks
- Conch and lobster
- Ragged Caye and sand bore
- Sea cucumber
- Seaweed
- Dolphins

2.1.1 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 eight 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.

Final Conservation Targets for Sapodilla Cayes National Park

- Littoral Forest
- Herbaceous Beach Vegetation / Sandy Beaches
- Coral Reef Communities
- Seagrass
- Commercial / Recreational Species
- Spawning Aggregations
- Sea cucumbers (non-traditional marine products)
- Sharks

Sapodilla Cayes Marine Reserve: Littoral Forest		
Conservation Target	**Justification**	**Species / ecosystems nested in this target**
Littoral Forest	Tropical littoral forests are classified with herbaceous beach communities within the Belize Ecosystem Map as ***Tropical Coastal Vegetation on recent sediments*** (Meerman and Sabido, 2001). Probably Belize's most threatened ecosystem, tropical littoral forest, this ecosystem is highlighted under Belize's National Protected Areas System Plan as being significantly under-represented within the current protected area system, with only 8.6% of the national coverage being under protection, as compared with the national target of 60% for this ecosystem. Natural vegetation has been modified and/or cleared extensively on all cayes of the Sapodilla area to make way for coconut plantations, and more recently for tourism and residential development. Four of the cayes within the Marine Reserve are considered to still retain some form of Littoral Forest cover, though there has been a transition to non-native species – coconuts, almonds, with the degradation or disappearance of species such as saltwater palmetto, seagrape and beach vines. Nicholas Caye, in particular, has been highlighted for the change in vegetation and the reduction in wildlife with the disappearance of the native fruiting trees and other vegetation. The littoral forest is an important component of the Neotropical migratory bird route, with species moving down the outer Atolls of Lighthouse Reef and Glover's Reef, on to the Sapodilla Cayes, and from there to Guatemala and Honduras, where they again hook up with the mainland and its "infinite" resources (L. Jones, pers. com.).	Nested within the Littoral Forest target are a series of associated plant species (**Annex four:** Plant Species list for Sapodilla Cayes). Some work has been conducted on birds of the Sapodilla Cayes over the years, with over 130 species recorded (Annex …: Jones, survey data 1998–2002). Whilst some of these are resident, the cayes also attract large numbers of migrants, many congregating on a single caye during daylight hours to restock on nutrients before continuing their migratory route. This target also includes **red mangroves,** which is important in providing a nursery sites for many marine species. Red mangrove is currently found on 2 cayes - Seal and Franks Cayes, though in 1960, it was reported that mangrove seedlings were colonizing Lime Caye – these had disappeared by 1970 (Stoddart et. al., 1982). Franks Caye has the largest extent of mangroves in shallow water, whilst Seal Caye has mangroves extending into deeper water, though these are considered to be potentially under threat from future tourism development. Mangrove restoration activities have been attempted on Hunting Caye, though these are uncoordinated with other management activities, and are limited in scale. Three terrestrial reptile species were recorded on the Sapodilla Cayes during the site visit (2010) – the brown anolis (*Anolis sagreil), Aristelliger georgeensis,* the green iguana (*Iguana iguana*), the latter introduced to Hunting and Lime Caye by tour guides. The boa (*Boa constrictor*) has also been reported in the past (Jones, 1998-2002 report; Finch, pers com), as have American crocodiles (*Crocodylus acutus*) (SEA staff, 2010).

Littoral Forest Indicators						
Category / Key Attribute	**Indicator**	**Poor**	**Fair**	**Good**	**Very Good**	**Current Indicator Status**
Size Size / extent of characteristic community	Total area of littoral forest ▪ ***SBRC Indicator***					**Current Status:** To be determined
Landscape Context Connectivity among communities and ecosystems	Level of fragmentation within littoral forest system ▪ ***SBRC Indicator***	Some cayes have no natural vegetation cover	All cayes have at least 15% natural vegetation cover	All cayes have at least 25% - 50% natural vegetation cover	All cayes have at least 50% natural vegetation cover	**Current Status:** FAIR
Condition Community architecture	% Littoral Forest in natural condition ▪ ***SBRC Indicator***	<50% of Littoral Forest shows human impacts	50 - 74% of Littoral Forest shows human impacts	75% - 99% of Littoral Forest shows human impacts	No Littoral Forest shows human impacts	**Current Status:** To be determined
Condition Abundance of food resources	Abundance and diversity of migratory birds ▪ ***SBRC Indicator***	Few migratory birds stop over	Abundance and diversity of migratory birds reduced	Current abundance and diversity of migratory birds	Increased abundance and diversity of migratory birds	**Current Status:** GOOD? This indicator is based on the theory that migratory birds will stay longer if more resources are available, leading to higher densities
Size Size / extent of characteristic community	Total area of mangrove ▪ ***SBRC Indicator***					**Current Status:** To be determined
Condition Community architecture	% Mangrove in undisturbed condition ▪ ***SBRC Indicator***		Current status			**Current Status:** To be determined
Condition Ecosystem Functionality	Abundance and diversity of juvenile fish in mangroves			Current status		**Current Status:** To be determined

<table>
<tr><th colspan="3">Sapodilla Cayes Marine Reserve: Sandy Beaches</th></tr>
<tr><th>Conservation Target</th><th>Justification</th><th>Species / ecosystems nested in this target</th></tr>
<tr><td>Sandy Beaches</td><td>The sandy beaches 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 Tropical Coastal Vegetation on recent sediments (Meerman, 2004). The herbaceous beach community is considered very important for the stabilization of the turtle nesting beach, and providing shelter for ground nesting birds. The sandy beaches are reported to provide nesting sites for hawksbill and possibly green turtles - numbers are considered stable, but decreased historically (SEA data, 2009).

Sapodilla Cayes is also considered important for congregating and ground nesting birds – Sand Bar, an ephemeral sand caye adjacent to Ragged Caye, hosts large numbers of laughing gulls, and sooty terns, and Seal Caye has been highlighted for bridled and roseate terns. The sandy beaches are also an important aspect for visitors who use the Sapodilla Cayes on a regular basis. However, maintenance of the open sandy areas for tourism use can result in poor nesting conditions for turtles and birds, and beach erosion, reducing the value for the wildlife.

The location and extent of beach area found on each of the cayes fluctuates significantly on an annual basis in accordance with currents and storm action. Over the past ten to fifteen years there have been significant changes to the beaches on the cayes within the SCMR. Hurricane Mitch had a substantive impact reducing the size of Tom Owens East Caye and Seal Caye II, while it substantially expanded the beaches on Nicholas Caye (D. Garbutt, personal communication.)</td><td>The critically endangered hawksbill (IUCN, 2010) nests on the beaches of a number of the cayes, with over 100 nests reported from the Pompion-Ranguana-Sapodilla Cayes area (southern SBRC) in 1989, 60 of these being on Nicholas Caye (Smith, 1989). By 1990, figures for the entire Sapodilla range had dropped to 20 nests (Smith, 1992). The number of turtle nests per year over the current four years of data shows an increase, at an average of 38, representing potentially only 10 to 12 adult females, though these are not identified down to species, and may well include loggerhead and green turtles, both also known to nest on the cayes. A 2010 survey provided data on current nests within the SCMR, with all three species reported as nesting on Nicholas Caye, whilst only Hawksbills were reported from Lime and Hunting Cayes
<table>
<tr><th colspan="6">Number of Turtle Nests Recorded Per Caye</th></tr>
<tr><th>Caye</th><th>2005</th><th>2006</th><th>2007</th><th>2008</th><th>2010</th></tr>
<tr><td>Hunting Caye</td><td>12</td><td>7</td><td>13</td><td>15</td><td>3</td></tr>
<tr><td>Lime Caye</td><td>32</td><td>3</td><td>16</td><td>8</td><td>11</td></tr>
<tr><td>Frank's Caye</td><td></td><td>29</td><td>3</td><td>10</td><td></td></tr>
<tr><td>Nicholas Caye</td><td></td><td></td><td>5</td><td></td><td>5</td></tr>
<tr><td>Total</td><td>44</td><td>39</td><td>37</td><td>33</td><td>19</td></tr>
</table>
*SEA, 2010 Annual Report
Bridled terns and laughing gulls are breeding on Ragged Caye (SEA data; Site Visit, 2010), and possibly Seal and Tom Owens Cayes, large congregations of 400 Roseate terns have been reported but nesting has not been confirmed for this species in the SCMR (Jones, survey data, 1998). Laughing gulls also nest on Lime Caye and Sand Bar, showing a shifting pattern of both numbers and locations between 2005 and 2008.</td></tr>
</table>

Sandy Beach Indicators						
Category / Key Attribute	**Indicator**	**Poor**	**Fair**	**Good**	**Very Good**	**Current Indicator Status**
Size Size / extent of characteristic community	Total extent of beaches and beach communities ▪ ***SBRC Indicator***					**Current Status:** To be determined
Condition Community architecture	% of sandy beach altered for tourism					**Current Status:** To be determined
Condition Community architecture	% beaches and beach communities in natural condition ▪ ***SBRC Indicator***					**Current Status:** To be determined
Condition Presence / abundance of key species	Number of turtle nests per species ▪ ***SBRC Indicator***					**Current Status:** Turtle nests: 18 Hawksbill, 1 Loggerhead and 1 Green (2010 data)
Condition Presence / abundance of key species	Number of ground nesting bird species					**Current Status:** Default (To be determined)
Condition Presence / abundance of key species	Number of nests per bird species					**Current Status:** Bird nests (not defined to species) Lime Caye – 15 nests; Ragged Caye - 8 nests; Sand Bore – 15 nests (2008 data)

Sapodilla Cayes Marine Reserve: Coral Reef Communities		
Conservation Target	**Justification**	**Species / ecosystems nested in this target**
Coral Reef Communities	Sapodilla Cayes Marine Reserve is a distinctive reef feature, with the reef forming a J-shaped hook at the terminus of the Belize Barrier Reef. The SCMR includes one of only 5 sites of 140 in Belize to rate as GOOD (Healthy Reefs, 2008). The relatively high coral cover and diversity at numerous sites, along with the great variability in physical parameters, may increase the Marine Reserve's resilience to climate change, though this is thought to be tempered by slow growth rates, considered to be a result of higher levels of anthropogenic stress (Carilli et. al., 2009). Within the 'no take' areas of the MPA (the Preservation Zone and Conservation Zones I and II), the coral reef acts as a source, essential to the maintenance of the traditional fishing industry, particularly for spiny lobster and finfish populations. It is also one of the more important tourism resources Belize has to offer, and contributes towards incomes in coastal communities throughout the SBRC as well as Guatemala and Honduras. A healthy reef can be characterized by relatively high live coral cover, moderate cover by crustose coralline algae and short turf algae, and low cover by fleshy macroalgae (Healthy Reef Initiative, 2007). The regional MAR live coral cover average and the average for Belize are both 11% (Status of Coral Reefs of the World, AIMS, 2008). ***SEA Data, Status of Protected Areas Report, 2010:*** SCMR 2008 average live coral cover: 10 - 19.9% (FAIR), SCMR 2008 recent coral mortality: estimated at < 2% (GOOD). SCMR macroalgal cover: 12% SCMR 2008 highest % coral bleaching: Average of 30% in October SCMR Commercial fish biomass: 700 - 1399 g/100m^2 (FAIR) SCMR Parrotfish fish biomass: 1250.01-4650 g/100m^2(FAIR)	The reef ecosystems of the SCMR include fore-reef, back-reef, reef slope, and patch reef. These reef types are composed of many scleractinian coral species, including ten critically endangered or endangered species: **Staghorn Coral** *Acropora cervicornis* **CR** **Elkhorn Coral** *Acropora palmate* **CR** **Lamarck's Sheet Coral** *Agaricia lamarcki* **EN** **Pillar Coral** *Dendrogyra cylindrus* **EN** **Elliptical Star Coral** *Dichocoenia stokesii* **EN** **Fire Coral** *Millepora striata* **EN** **Star Coral** *Montastraea annularis* **EN** **Star Coral** *Montastraea faveolata* **EN** **Montastraea Coral** *Montastraea franksi* **EN** **Rough Cactus Coral** *Mycetophylia ferox* **EN** This provides a diverse range of habitats for a multitude of fish and invertebrates, including commercially important species, of which at least three that are IUCN red listed as critically endangered or endangered: **Goliath Grouper** (*Epinephelus itajara*) **CR** **Nassau Grouper** (*Epinephelus striatus*) **EN** **Great Hammerhead** (*Sphyrna mokarran*) **EN** Herbivores such as the large parrotfish (Scaridae – *Scarus coelestinus, Sparisoma chrysopterum* and *S. virida)* 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.

Coral Reef Community Indicators						
Category / Key Attribute	**Indicator**	**Poor**	**Fair**	**Good**	**Very Good**	**Current Indicator Status**
Landscape Context Connectivity among communities & ecosystems	Current IRHI of resilient sites identified in the 2006 WWF/ TNC rapid reef assessment : SE1 WR1 ▪ ***SBRC Indicator***	**Site WR1:** IRHI 2.17 (2009)	**Site SE1:** IRHI 2.63 (2009)			**Current Status:** These sites were identified as potentially resilient due to their high coral cover, low macroalgae abundance, low disease, high fish populations, low recent mortality, large amount of herbivores, and high recruitment. The resilient sites were generally healthy and recovered from localized bleaching events (NCRM). Two sites (SE1 and WR1) **IRHI =** Integrated Reef Health Index (Healthy Reefs, 2007)
Landscape Context Environmental Factors	Water quality ▪ ***SBRC Indicator***					**Current Status:** 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).
Condition Population Structure and Recruitment	% Average live coral cover ▪ ***SBRC Indicator*** ▪ ***SOPA Indicator***	<10%	10 - 19.9%	**20 - 39.9%** 32% (SEA data, 2010)	>40%	**Current Status:** FAIR (SEA data, 2008) GOOD (SEA data, 2010) NB: Shank et. al. (2010) reports a lower % (8%), using a less biased site selection criteria
Condition Presence / abundance of key species	% Recent coral mortality ▪ ***SBRC Indicator*** ▪ ***SOPA Indicator***	>4%	2-4%	**< 2%**	0%	**Current Status:** SEA data, 2008. Healthy reefs goal is to maintain MAR average of below 2% recent mortality, 20% old mortality and standing dead below 5%.
Condition Presence / abundance of key species	Level of coral recruitment ▪ ***SBRC Indicator*** ▪ ***SOPA Indicator***	> 2 / m^2	**2 recruits /m^2 – 4.99/m^2**	5 recruits/m^2 – 9.99/m^2	≥10 recruits/m^2	**Current Status:** Figures range from 3.4/m^2 (SEA data, 2008) to 6.0/m^2 (Shanks, 2009)
Condition Presence / abundance of key species	Commercial fish biomass ▪ ***SBRC Indicator*** ▪ ***SOPA Indicator***	<700 g/100m^2	**700 - 1399 g/100m^2**	1400–2799 g/100m^2	>2800 g/100m^2	**Current Status:** SEA data, 2008 (MBRS); Healthy Reefs data differs on ratings - MAR averages about 4600g/100m^2; with about 1100g /100 m^2 for commercial fish. Target is a 20% increase.

Coral Reef Community Indicators						
Category / Key Attribute	**Indicator**	**Poor**	**Fair**	**Good**	**Very Good**	**Current Indicator Status**
Condition Presence / abundance of key species	Parrotfish biomass ▪ ***SBRC Indicator*** ▪ ***SOPA Indicator***	1-1250g /100m^2	**1250.01 - 4650g /100m^2**	>4650g / 100m^2		**Current Status:** SEA data, 2008
Condition Species Dominance	% Macroalgal cover ▪ ***SOPA Indicator***			**12%**		**Current Status:** SEA data, 2008
Condition Coral Bleaching	Average % coral exhibiting bleaching per annum ▪ ***SOPA Indicator***					**Current Status:** SEA data, 2008
Condition Coral Bleaching	% survey sites showing coral bleaching per annum ▪ ***SOPA Indicator***	>10%	5-10%	<5		**Current Status:** SCMR: 2007 - Over the five months of monitoring only 34 (composed of 7 species) of the 1036 individual coral colonies monitored (3.3%) showed any signs of bleaching (paling to fully bleached).

Sapodilla Cayes Marine Reserve: Seagrass		
Conservation Target	**Justification**	**Species / ecosystems nested in this target**
Seagrass	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). Seagrass beds are especially important as a nursery habitat for many species. This target focuses on the seagrass beds of Sapodilla 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. Seagrass monitoring has started (2010), and it is hoped that it will continue under the SeagrassNet programme. However, there is currently insufficient information on seagrass extent.	Two species of seagrass are present within the Sapodilla Cayes Marine Reserve – Turtle Grass (*Thalassia testudinum*) and Shoal Grass (*Syringodium filiforme*). Seagrass beds are essential for the **Queen Conch** *(Strombus gigas)*, one of the most important commercial species extracted from the sea. Density is an important indicator for conch population viability as it is thought that at densities of less than 50 individuals/ha, successful reproduction is not likely (Stoner & Ray-Culp, 2000). Healthy Reef Goal: Adult conch populations of 300 – 800 individuals per hectare. Seagrass is also important for the juveniles of many commercial fish species. **Parrotfish** (Family: Scaridae)**,** herbivores that play a critical role in maintaining the reef, also rely on the seagrass beds as juveniles. Nested targets also include the Vulnerable **West Indian manatee** (*Trichechus manatus)* (IUCN, 2010) the largest of Belize's herbivorous marine mammals, as well as the endangered green turtles (*Chelonia mydas*). These species play an important role in maintaining seagrass beds and increase the productivity of this ecosystem through grazing.

Seagrass Indicators						
Category / Key Attribute	**Indicator**	**Poor**	**Fair**	**Good**	**Very Good**	**Current Indicator Status**
Size Size / extent of characteristic community	Extent of seagrass				***90 – 100% Current status***	**Current Status:** > 95% - Some clearance from edge of cayes
Size Size / extent of characteristic community	% seagrass cover	< 50%	50% - 75%	75% - 90%	***90%- 100%***	**Current Status:** > 95% (SBRC, 2008). % cover = average of % of $1m^2$ quadrat in seagrass monitoring sites within SCMR occupied by seagrass
Landscape Context Environmental Factors	Water quality ▪ ***SBRC Indicator***					**Current Status:** Unknown. ▪ 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 ▪ Prefers temperature b/w 20-30˚C. Temperature above 35˚C will kill it ▪ Prefers light levels 18 – 40.5 lumens/m^2
Condition Community architecture	% seagrass impacted by anthropogenic activities					**Current Status:** Unknown
Condition Presence / abundance of key species	Abundance of green turtles within SCMR per annum / ha					**Current Status:** Unknown
Condition Primary Productivity	Seagrass density	0 - 29%	30-49%	50-79%	***80 - 100%***	**Current Status:** 80-90% (SBRC, 2008).

Sapodilla Cayes Marine Reserve: Commercial / Recreational Species		
Conservation Target	**Justification**	**Species / ecosystems nested in this target**
Commercial/ Recreational Species	Commercial and recreational species provide the basis for a fishing and sport 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 lives. The presence of large fish species is a good indication of a healthy reef. The two invertebrate species of highest commercial importance extracted from the SCMR are the **Caribbean Spiny Lobster** (*Panulirus argus*) and **Queen conch** (*Strombus gigas*), 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. 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.	This target, commercial marine species, covers fin fish, lobster and conch – fished primarily by fishermen of Punta Gorda, Guatemala and Honduras. Sport fishing species are also included. Nested targets include **Caribbean Spiny Lobster** (*Panulirus argus*) and **Spotted Lobster** (*Panulirus guttatus*) (to a much lesser extent), as well as **Queen conch** (*Strombus gigas*). Overall due in large part to the high density of conch nursery sites the average CPUE in SCMR was 36 conch per man hour. However, if the nursery site is removed the average number of conch encountered per man hour drops to almost 10 (SEA data; Status of Protected Area report, 2009). SBRC is estimated to average 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. Commercial finfish are also nested under this target, including hogfish, grouper, snapper and grunts. The targeted export species include groupers (*Epinephelus* sp. and *Mycteroperca sp.)*, snappers (*Lutjanus sp.* and *Ocyurus* sp.), hogfish (*Lachnolaimus maximus*), king mackerel (*Scomberomorus cavalla*), great barracuda (*Syhyraena barracuda*), and jacks (*Alectis sp.*, *Caranx sp.* and *Trachinotus sp.*). **Parrotfish** (Scaridae – *Scarus coelestinus, Sparisoma chrysopterum* and *S. virida)* –(NB: parrotfish are not considered commercial species, but are fished illegally)

Commercial / Recreational Species Indicators						
Category / Key Attribute	**Indicator**	**Poor**	**Fair**	**Good**	**Very Good**	**Current Indicator Status**
Landscape Context Environmental Factors	Water quality ▪ ***SBRC Indicator***					**Current Status:** Unknown. Optimal water temperatures lie within 25 - 29°C. Monthly averages that exceed 0.5°C above the historical average for that month are likely to cause bleaching
Condition Presence / abundance of key species	Abundance of juvenile fish (nursery functionality) ▪ ***SBRC Indicator***					**Current Status:** Unknown
Size Population Size and Dynamics	Commercial fish biomass ▪ ***SBRC Indicator*** ▪ ***SOPA Indicator***	<700 g-100m^2	**700 - 1399 g-100m^2**	1400–2799 g-100m^2	>2800 g-100m^2	**Current Status:** SEA data, 2008. MBRS data; Healthy Reefs data differs on ratings - MAR averages about 4,600g/100m sq; with about 1,100g /100m sq for commercial fish. Target is a 20% increase.
Size Population Size and Dynamics	Conch density	< 50/ha	50 – 200/ha Excl. nursery	200 – 500 / ha	>500 / ha (Incl. nursery)	**Current Status: 2009:** 579.86/ha including nursery, 99/ha excluding nursery (SEA data, closed season survey, 2009) **2007:** (SEA data, 4 seasons): Although the number of conchs at some sites was extremely high, especially at the well known nursery near Seal Caye, at most sites there were relatively few individuals encountered. The overall average for conch density was around 252 individuals/ha with the Seal Caye site included and 98 individuals/ha excluding the Seal Caye site.

Commercial / Recreational Species Indicators						
Category / Key Attribute	**Indicator**	**Poor**	**Fair**	**Good**	**Very Good**	**Current Indicator Status**
Size Population Size and Dynamics	Lobster density					**Current Status:** Unknown
Size Population Size and Dynamics	CPUE per year per boat - recreational	<100lbs	100 - 199	200-299	>300lbs	**Current Status:** Unknown. Catch will indicate presence/absence of species, weight and size.
Size Population Size and Dynamics	Parrotfish biomass ▪ ***SBRC Indicator*** ▪ ***SOPA Indicator***	1-1250g /100m^2	**1250.01 - 4650g /100m^2**	>4650g / 100m^2		**Current Status:** SEA data, 2008

Sapodilla Cayes Marine Reserve: Spawning Aggregation Sites

Conservation Target: Spawning Aggregation Sites

Justification for Target Selection

Many of the groupers and snappers form large spawning aggregations at predictable times and places, making them very vulnerable to fishing pressure. In 1998, Nassau grouper spawning in Belize was estimated to have declined by 81% over a 10 year period. These aggregation sites are critical to the maintenance of these fish species and, in Belize, are seasonally protected under SI 161 of 2003. Four sites are located within SCMR – three protected under the SI - Rise and Fall Bank, Nicholas Caye and Seal Caye – and one outside – the Elbow.

Protected spawning aggregation sites (both through SI and through surveillance and enforcement presence) increase viability of commercially important fin-fish species such as grouper, snapper and jack, during the reproductive stage of their life cycle, providing important benefits to the fishing sector.

SPAG Site	Vulnerability	Ecological Importance
Rise and Fall Bank	3	1
Nicholas Caye	2	3
Seal Caye	2	2

(1) Vulnerability: (Existing and future fishing pressure)
1. Low vulnerability
2. Medium vulnerability
3. High vulnerability

(2) Ecological Importance: (Based on the number of species and individuals spawning at the site)
1. Low importance
2. Medium importance
3. High importance

MBRS SPAG Monitoring Recommendations, Heyman et. al. 2003

Species, Communities or Ecological Systems

Rise and Fall Bank	
Dog snapper	*Lutjanus jocu*
Schoolmaster	*Lutjanus apodus*
Yellowtail Snapper	*Ocyurus chrysurus*
Red Hind	*Epinpehelus guttatus*
Black grouper	*Mycteroperca bonaci*
Tiger grouper	*Mycteroperca tigris*
Horse-eye jack	*Caranax lotus*
Nicholas Caye	
Cubera Snapper	*Lutjanus cyanopterus*
Dog Snapper	*Lutjanus jocu*
Mutton Snapper	*Lutjanus analis*
Schoolmaster	*Lutjanus apodus*
Yellowtail Snapper	*Ocyurus chrysurus*
Nassau Grouper	*Epinephelus striatus*
Black grouper	*Mycteroperca bonaci*
Tiger grouper	*Mycteroperca tigris*
Yellowfin Grouper	*Mycteroperca venenosa*
Red Hind	*Epinpehelus guttatus*
Trunkfish	*Lactophrys trigonus*
Seal Caye	
Cubera Snapper	*Lutjanus cyanopterus*

Nassau Grouper numbers at Nicholas Caye

2003	2004	2005	2006	2007	2008	2009	2010
52	50	80	48	80	100	25	30

Spawning Aggregation Indicators						
Category / Key Attribute	**Indicator**	**Poor**	**Fair**	**Good**	**Very Good**	**Current Indicator Status**
Condition Population Structure and Recruitment	Number of large, adult fish species at SPAG sites	< 25% of the spawning population are LARGE adults	25% - 35% of the spawning population are LARGE adults	36% - 50% of the spawning population are LARGE adults	>50% but <75% of the spawning population are LARGE adults	**Current Status:** Monitoring at Nicholas Caye, for Mutton, cubera and dog snapper, and Nassau and black grouper Mutton Snapper Cubera Snapper Dog Snapper Nassau Grouper Black Grouper
Condition Species Composition / Dominance	Diversity of species at SPAG sites	< 5 species	5 – 9 species	10 – 15 species	>15 species	**Current Status:** Monitoring at Nicholas Caye. SCMR: Nicholas Caye: 10 species Rise and Fall Bank: 7 species Seal Caye: 1 species The Elbow: 1 species If there are too few species at the site, this may alter spawning behaviour
Condition Presence / abundance of key species	Abundance of juvenile fish (nursery functionality) ▪ ***SBRC Indicator***					**Current Status:** Unknown

Sapodilla Cayes Marine Reserve: Conservation Targets		
Conservation Target	**Justification**	**Species / ecosystems nested in this target**
Sharks	Sharks have been chosen to represent wide ranging marine vertebrates (including dolphins) – species that require large seascapes for viable populations, and because it is recognized that there is significant pressure on the shark populations of the Sapodilla Cayes area from transboundary fishing incursions from Guatemala and Honduras Fishing pressure has not been quantified but is considered to be high and continuous based on recaptures of tagged sharks and proximity to neighboring countries with high consumption of shark meat. Sharks are top predators in the marine environment - wide ranging species that are critical for the maintenance of the coral reef ecosystem through the regulation of populations of their prey species. Nationally, sharks are under increasing fishing pressure, with demand for shark meat from neighbouring countries, especially during the Lenten season, and growing international demand from countries such as China for both the shark meat and fins. Sapodilla Cayes Marine Reserve hosts over21 species of sharks and rays, including the world's largest fish, the whale shark (*Rhincodon typus*) considered vulnerable to extinction, (IUCN, 2010), and is highly migratory, travelling thousands of kilometers, and occurs throughout tropical and warm temperate waters around the globe. In the Sapodillas, whale sharks feed on schools of pelagic baitfish occurring in deeper waters beyond the reef drop-off. This area constitutes the second site in Belize where whale sharks can be encountered with a reduced degree of predictability (after Gladden Spit). Acoustic telemetry coupled with underwater listening receivers placed at two sites along the Sapodilla Cayes has revealed that Caribbean reef sharks move from Lighthouse Reef Atoll to the reef near Nicholas Caye and whale sharks tagged In the Bay Islands of Honduras and at Gladden Spit frequently move along the fore-reef edge of the Sapodilla range. Adult lemon sharks (*Negaprion brevirostris*) were captured in reef passes in the marine reserve and tracked using satellite location only tags for several days until the sharks were recaptured by Guatemalan fishers operating inside the reserve during rainy season months, indicating that fishing pressure for sharks and at the Sapodillas is strong year round.	***Sharks*** Bull shark Lemon shark Caribbean reef shark Tiger shark Caribbean sharpnose shark Whale shark Nurse shark Black tip shark Silky shark Scalloped hammerhead Great hammerhead Bonnethead Blacknose shark ***Rays*** Southern stingray Caribbean whiptail stingray Longnose stingray Yellow stingray Giant manta Chilean devil ray Devil ray Spotted eagle ray

Shark Indicators						
Category / Key Attribute	**Indicator**	**Poor**	**Fair**	**Good**	**Very Good**	**Current Indicator Status**
Size Size / extent of population	Number of sharks per species per annum as determined by tour guides					**Current Status:** To be determined
Size Size / extent of population	Number of sharks per species per annum as determined by the research /monitoring team					**Current Status:** To be determined
Condition Presence / abundance of key species	Diversity of sharks recorded in UW monitoring by guides and research team					**Current Status:** To be determined. Currently 13 species of sharks, 8 species of rays (R. Graham, pers. com. 2010)
	Diversity of sharks recorded in fisheries independent surveys by the research team					
Size Size / extent of population	Number and location of whale sharks recorded per annum					**Current Status:** To be determined
Frequency	Number of arrests of illegal fishing/fishers in the MPA with shark products					**Current Status:** To be determined

2.1.2 Assessment of Conservation Target 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

Sapodilla Caye Marine Reserve Conservation Target Assessment			
Conservation Target	**Current Rating**	**Goal**	**Justification for Rating, Goal and Indicator**
Littoral Forest	**FAIR**	**FAIR**	***Justification:*** There are still remnants of Littoral Forest on the cayes - however, many of these cayes are privately owned, and therefore not included within the legislation. Increased clearance of vegetation for tourism is therefore predicted
			Goal: To maintain and improve current condition and extent of Littoral Forest
			Indicators: Area of Littoral forest; area of unimpacted littoral forest; presence of native caye species; numbers and species of migratory birds per migration (fall and spring)
Sandy Beach	**GOOD**	**GOOD**	***Justification:*** Relatively unimpacted sandy beaches are present within the Sapodilla Cayes, but are disappearing slowly, with increasing tourism and development impacts, and through natural erosion. Many of these cayes are privately owned or under lease, and therefore not included within the MPA, and increasing clearance of vegetation for tourism is predicted
			Goal: To maintain and improve current condition and extent of Sandy Beaches
			Indicators: % of sandy beaches in good conditions (unimpacted by human activities); number of turtle nests;
Seagrass	**VERY GOOD**	**VERY GOOD**	***Justification:*** There are very few impacts on seagrass extent and condition within the protected area;
			Goal: To maintain seagrass as VERY GOOD
			Indicators: Extent of seagrass; condition of seagrass; number of dredging permits issued within SCMR; number of areas dredged within SCMR
Coral Reef Communities	**FAIR**	**FAIR**	***Justification:*** The coral reef has high diversity, but there is a general trend of declining condition, due partly to climate change/ global warming, and exacerbated by anthropogenic impacts. Live coral cover is estimated at between 10 and 19%, with maximum bleaching of 30% recorded in October 2008. Recent coral mortality is rated as GOOD, at under 2% for 2008 (SEA data, 2009)
			Goal: Maintain and improve the condition of coral reef communities, with implementation of strategies for reduction of impacts and increased resilience
			Indicators: Live coral cover; recent mortality; recent coral recruitment; maximum bleaching %; parrotfish biomass; *Diadema* abundance; shark abundance

Sapodilla Caye Marine Reserve Conservation Target Assessment			
Conservation Target	**Current Rating**	**Goal**	**Justification for Rating, Goal and Indicator**
Commercial/Recreational Species	**FAIR**	**FAIR**	***Justification:*** SCMR includes both General Use and No Take zones, though surveillance and enforcement has been challenging. There is reduced use of area by traditional fishermen as stocks are now low. Populations thought to still have the capacity to recover, but only if action is taken soon.
			Goal: To maintain and improve current population levels of commercial species
			Indicators: Densities of conch, lobster and specific finfish; Number of fishing violations
Spawning Aggregation Site	**FAIR**	**GOOD**	***Justification:*** Three spawning aggregation sites are located within SCMR, but all have been heavily impacted by fishing pressures, and strategies are urgently required to address this if these sites are to be maintained. POOR for Nassau Grouper
			Goal: To maintain and improve the viability of the spawning aggregation sites of SCMR.
			Indicators: Number of species using each spawning aggregation site; Number of individuals per species;
Sharks	**POOR**	**FAIR**	***Justification:*** Shark numbers are thought to be declining, particularly with transboundary fishing incursions to provide fins for the shark fin export market located in Guatemala.
			Goal: Maintain and improve the populations of wide ranging large marine vertebrates within SCMR
			Indicators: Number of shark species and individuals using SCMR
Sea cucumbers / Seaweed (non-traditional marine resources)	**POOR**	**GOOD**	***Justification:*** The increasing interest in harvesting of sea cucumbers over the last three years has led to an exponential harvest rate, particularly through illegal incursions by Guatemala fishermen, and harvesting by Belize fishermen for sale to the Guatemalan market, resulting in a rapid reduction of populations within SCMR. Seaweed has already been over harvested to the point of near extinction within the SCMR.
			Goal: Recovery of sea cucumber and seaweed populations within the SCMR and development and implementation of sustainable harvest mechanisms
			Indicators: Population density of sea cucumbers; Extent / density of seaweed

The results of the workshop output on Conservation Target viability are summarized (Table 21):

Table 21: Conservation Targets – Current Ratings and Goals		
Conservation Target	**Current Rating**	**Goal**
Sharks	**POOR**	**FAIR**
Sea cucumbers / Seaweed	**POOR**	**GOOD**
Spawning Aggregations	**FAIR**	**GOOD**
Coral Reef Communities	**FAIR**	**FAIR**
Littoral Forest	**FAIR**	**FAIR**
Commercial/Recreational Species	**FAIR**	**FAIR**
Sandy Beach	**GOOD**	**GOOD**
Seagrass	**VERY GOOD**	**VERY GOOD**

Conservation Target Viability across SEA co-managed Protected Areas			
Conservation Target	**LBCNP**	**GSSCMR**	**SCMR**
Littoral Forest			**FAIR**
Herbaceous Beach Vegetation	**FAIR**	**GOOD**	**GOOD**
Coral Reef Communities	**FAIR**	**FAIR**	**FAIR**
Seagrass	**VERY GOOD**	**VERY GOOD**	**VERY GOOD**
Commercial / Recreational Species	**GOOD**	**FAIR**	**FAIR**
Sharks	**POOR**	**FAIR**	**POOR**
Spawning Aggregation		**FAIR**	**FAIR**
Whale Sharks		**FAIR**	**FAIR**
Sea Cucumbers / Seaweed			**POOR**

2.2 Threats to Biodiversity

Sapodilla Cayes Marine Reserve is often cited as an example of a protected area with many impacts outside the control of the site-level and national management bodies. The greatest impacts come from climate change, a major overarching threat facing most marine protected areas of the Caribbean today, as is evidenced by increased incidence of mass coral bleaching over the past 20 years. Other identified threats include transboundary fishing pressure and tourism impacts, agricultural runoff, poor boating practices and, more recently, the potential of oil exploration and extraction from near- and off-shore concession areas, with the Marine Reserve lying within one and adjacent to several off-shore oil exploration concessions.

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.

Threats impacting Sapodilla Cayes Marine Reserve

- Climate change
- Fishing Pressure / Inappropriate fishing practices:
  - Undersize / out-of-season / restricted species
  - Spear fishing / gill nets
- Inappropriate visitor use
  - Impacts on reef
  - Impacts on cayes
  - Poor practices by bareboat charters
- Poor Boating Practices
  - Anchor damage
  - Ship/boat grounding
  - Potential for oil spill
- Inappropriate caye development
  - Removal of littoral forest
  - Removal of beach vegetation
  - Reduced water quality
  - Potential for dredging
- Oil exploration and drilling
- Transboundary impacts
  - fishing,
  - tourism impacts
  - agricultural runoff
- Solid Waste
- Invasive species (particularly lionfish)

2.2.1 Identified Threats

Outputs from the threat assessment meetings identified nine primary issues. These were prioritized using three criteria to direct resources toward mitigation of the most critical threats.

- Climate Change
- Fishing Pressure
- Poor Visitor Practices
- Oil Drilling and Exploration
- Agricultural Runoff
- Caye Development

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

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		(adapted from WCS)
Criteria	**Score**	
Area	**4**	Will affect throughout >50% of the area
	3	Widespread impact, affecting 26 – 50% of the area
	2	Localized impact, affecting 11 – 25% of the area
	1	Very localized impact, affecting 1 – 10% of the area

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

Severity Ranking		(adapted from WCS)
Criteria	**Score**	
Severity	**3**	Local eradication of target possible
	2	Substantial effect but local eradication unlikely
	1	Measurable effect on density or distribution
	0	None or positive

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

Urgency Ranking		(adapted from WCS)
Criteria	**Score**	
Urgency	**3**	The threat is occurring now and requires action
	2	The threat could or will happen between 1 – 3 years
	1	The threat could happen between 3 – 10 years
	0	Won't happen in > 10 years

<table>
<tr><th colspan="5">Threats to biodiversity of Sapodilla Cayes Marine / 1</th></tr>
<tr><td rowspan="9">Climate Change</td><td>Status:</td><td colspan="3">Historical | Active | Potential</td></tr>
<tr><td colspan="4">Conservation Target(s): All</td></tr>
<tr><td colspan="4">Threats (Direct):
▪ Reduced live coral cover
▪ Erosion of beach
▪ Removal of littoral forest
▪ Ecological shifts in benthic communities
▪ Reduced biodiversity
▪ Reduced coral growth rates</td></tr>
<tr><td colspan="4">Source (Indirect Threat):
▪ Increased water temperatures
▪ Increased storm events / hurricanes
▪ Sea level rise
▪ Changes in currents
▪ Ocean acidification
▪ Removal of herbivorous species through illegal fishing practices
▪ Other local anthropogenic threats</td></tr>
<tr><td>Area</td><td>4</td><td colspan="2">Climate change is a global phenomenon, and is affecting biodiversity throughout the Marine Reserve</td></tr>
<tr><td>Severity</td><td>3</td><td colspan="2">The impacts of climate change are currently being felt at SCMR through increased bleaching and storm events, and it is expected that the severity and frequency of these events will increase over the coming years</td></tr>
<tr><td>Urgency</td><td>3</td><td colspan="2">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</td></tr>
<tr><td colspan="4">Management Goal: Continue to implement adaptive management strategies which focus on identifying and maintaining resilient ecosystems

Management Strategies:
Strategy 1: Identify resilient coral species and areas within SCMR

Strategy 2: Identify coral recruitment sources for SCMR, and identify mechanisms to ensure that these are adequately protected, if necessary

Strategy 3: Identify and understand water currents critical for coral and fish recruitment

Strategy 4: Ensure adequate protection of key herbivores to maintain live coral cover and ecological functions

Strategy 5: Reduce local anthropogenic threats through community engagement and awareness programs, and effective enforcement

Strategy 6: Work closely with national and international partners to monitor climate change effects and identify appropriate national and regional management strategies</td></tr>
</table>

Threats to biodiversity of Sapodilla Cayes Marine Reserve / 2

Unsustainable Fishing Pressure

Status:	***Historical***	***Active***	***Potential***

Conservation Target(s): Commercial Species; Spawning Aggregation Sites, Coral Reef Communities, Sea Cucumbers, Sharks

Threats (*Direct*)*:*

- Reduced commercial / recreational fish populations
- Reduced coral reef health (reduced herbivorous fish populations)
- Regime shifts and disruption of the trophic structure

Source (Indirect Threat)***:***

- Proximity to Honduras and Guatemala
- Political interference and lack of political support to address transboundary issues
- Low income in fishing communities of Belize and neighbouring countries
- Increase in the number of Belize and transboundary fishermen
- Traditional occupation
- Poor fishing practices (fishing out of season, harvesting of undersized product, use of gill nets, SCUBA)
- Market for illegal product (out of season / undersized) in Belize and transboundary
- Limited implementation of zones / enforcement
- Increasing fishing pressure and market demand from Jamaica and other CARICOM nations

Area	***4***	20% no-take established however enforcement activities need to be enhanced to ensure compliance
Severity	***3***	Severity is considered substantial, some species such as Nassau grouper and sharks have declined and remain at critical levels while others such as conch and lobster are declining but show greater resilience. Local eradication of seaweed has occurred, and sea cucumber, and large parrotfish are under severe threat, with a decrease in average size
Urgency	***3***	It is an ongoing, active threat

Management Goal: Reduce fishing pressure to maintain sustainability of the fish species (populations)

Management Strategies:

Strategy 1: Investigate and implement managed access and other mechanisms for increasing gain for traditional users, and, where feasible, quotas

Strategy 2: Collaborative enforcement (fishermen, SEA, Fisheries Dept., TIDE Coastguard, BDF, Police Dept. etc.) against transboundary incursions both within and outside the MPA – and strengthen Special Enforcement Team

Strategy 3: Improve collaboration between SEA and Fisheries Department and strengthen effective enforcement – application of laws and regulations

Strategy 4: Strengthen partnership with Immigration Department, with effective integration into patrols

Strategy 5: Ensure other Government agencies using Hunting Caye are aware of and follow the MPA regulations, and are engaged for effective management

Threats to biodiversity of Sapodilla Cayes Marine Reserve / 2	
Unsustainable Fishing Pressure	**Strategy 6:** Ensure SCMR has the human resources, equipment and training for effective surveillance and enforcement **Strategy 7:** 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 (modeled on those of LBCNP) and better management of data to be able to identify and penalize repeat offenders, with ticketing system (3 tickets revokes site level license) **Strategy 8:** Strengthen the collective voice of MPA stakeholders...investigate feasibility of coordination and collaboration with other MPA NGOs to reduce competition and increase potential success in lobbying against common threats, and to attract larger scale funding opportunities **Strategy 9:** Increase awareness of best fishing and tourism practices among immediate resource users **Strategy 10:** Assist traditional users to move towards alternative livelihoods

<table>
<tr><th colspan="5">Threats to biodiversity of Sapodilla Cayes Marine Reserve / 3</th></tr>
<tr><td rowspan="8">Visitor Impacts</td><td>Status:</td><td colspan="3">Historical Active Potential</td></tr>
<tr><td colspan="4">Conservation Target(s): Littoral Forest, Sandy Beaches, Coral Reef Communities</td></tr>
<tr><td colspan="4">Threats (Direct):
▪ Erosion of beach
▪ Reduced viability of turtle nesting sites
▪ Reduced extent of littoral forest
▪ Reduced extent of herbaceous beach community
▪ Coral mortality from mechanical damage
▪ Coral mortality from sedimentation
▪ Increased algal growth
▪ Altered behavior of terrestrial and marine life
▪ Reduction / pollution of freshwater lens</td></tr>
<tr><td colspan="4">Source (Indirect Threat):
▪ Increasing tourism
▪ Clearance of vegetation on caye for aesthetic purposes and development
▪ Need for financial sustainability
▪ Pollution from sun blocks and insecticides
▪ Poor tour guiding practices/ unguided tours
▪ Limited enforcement of visitor regulations
▪ No carrying capacity guidelines in place
▪ Insufficient moorings for visiting boats
▪ Inadequate infrastructure (sewage & garbage disposal)
▪ Poor / inadequate water management</td></tr>
<tr><td>Area</td><td>3</td><td colspan="2">There are distinct areas of visitor activity – popular dive sites, and areas adjacent to the cayes</td></tr>
<tr><td>Severity</td><td>3</td><td colspan="2">Visitor levels are high, and the increasing number of bareboat charters not carrying local boat captains and tour guides is resulting in increasing impacts, particularly from Honduras and Guatemala</td></tr>
<tr><td>Urgency</td><td>3</td><td colspan="2">Visitation is occurring now</td></tr>
<tr><td colspan="4">Management Goal: To develop and implement policies, strategies and regulations for reducing visitor impacts
Management Strategies:
Strategy 1: Implement policies and regulations for all tour boats – requirement for local guides, boat captains, use of mooring buoys, removal of garbage
Strategy 2: Increase awareness and promote best fishing and tourism practices among immediate resource users (eg. guide / tourist ratios, catch-and-release) - including Honduran and Guatemalan users
Strategy 3: Develop carrying capacities, and implement monitoring, surveillance and enforcement
Strategy 4: Put in place adequate infrastructure - moorings buoys – at cayes and dive sites (Seal Caye wall, North East wall, Lime Caye wall)
Strategy 5: Enforce policies and regulations of zones for all visitors
Strategy 6: Effectively collect visitor data – number, origin, nationality, activities, duration of stay, gender</td></tr>
</table>

<table>
<tr><th colspan="5">Threats to biodiversity of Sapodilla Cayes Marine Reserve / 4</th></tr>
<tr><td rowspan="6">Caye Development</td><td>Status:</td><td colspan="3">Historical | Active | Potential</td></tr>
<tr><td colspan="4">Conservation Target(s): All targets</td></tr>
<tr><td colspan="4">Threats (Direct):
▪ Reduced extent of littoral forest, mangroves and herbaceous beach vegetation
▪ Erosion of sandy beaches
▪ Reduced viability of nesting turtles populations
▪ Reduced viability of nesting bird populations
▪ Reduced viability of coral reef
▪ Reduced populations of commercial and non-commercial marine species
▪ Increased nutrients, sediment and pollutants in marine environment
▪ Potential destruction of seagrass beds
▪ Reduction / pollution of freshwater lens</td></tr>
<tr><td colspan="4">Source (Indirect Threat):
▪ Increased tourism
▪ Demand for visitor attractions (Belize, Guatemala and Honduras)
▪ Infrastructure development (tourism, research, enforcement, etc.)
▪ Increased resource use and demand
▪ Inadequate / unplanned water management practices
▪ Increased pollutants (insecticides, sewage, other contaminants)
▪ Water contamination from inadequate fuel storage / management
▪ Dredging
▪ Financial incentives
▪ Lack of direct management control over cayes</td></tr>
<tr><td>Area</td><td>4
2</td><td colspan="2">Cayes = 4: The most significant impacts from caye development occur directly on the cayes themselves, with major impacts on terrestrial ecosystems and directly adjacent marine areas.
MPA = 2: Impacts over the entire MPA are generally either very localized or diffuse</td></tr>
<tr><td>Severity</td><td>4
2</td><td colspan="2">Cayes = 4: Littoral forest and beach communities have already been degraded, with the loss of natural vegetation over historical (pre-cocal) levels, raising the potential for significant impacts on ecosystem integrity.
MPA = 2: The severity of impacts is generally low, with a small number of localized high severity areas associated with specific developments</td></tr>
<tr><td>Urgency</td><td>3</td><td colspan="2">Generally, development is minimal, and is likely to stay so over the next few years due to the global economic recession. The exception is the Tom Owens Caye area, which is within the MPA, where development impacts are occurring</td></tr>
</table>

Threats to biodiversity of Sapodilla Cayes Marine Reserve / 4	
Caye Development	***Management Goal:*** To promote sustainable development of the cayes within the marine reserve, with restoration of littoral forest, mangroves and herbaceous beach vegetation and minimized impacts on the terrestrial and marine environment. ***Management Strategies:*** **Strategy 1:** Engage all land owners / caye developers / residents within the marine reserve and increase awareness of caye development impacts on the MPA values **Strategy 2:** Institute rapid ecological assessment of status of cayes and develop recommendations per caye for dissemination to land owners / caye developers / residents **Strategy 3:** Develop / adopt Development Guidelines and Best Practices for development activities, and encourage the use of these guidelines by caye owners / developers, through incentives system **Strategy 4:** Ensure safe storage of fuels, oils and chemicals on the cayes during storm events **Strategy 5:** Engage landowners in littoral forest, mangrove and beach vegetation restoration, management and protection **Strategy 6:** Work closely with DOE, Forest Department, etc. to ensure enforcement of all relevant policies and regulations for development activities within the Marine Reserve (dredging of sand/coral, clearance of mangroves, water quality and sedimentation), **Strategy 7:** Work with developers and government agencies to ensure effective monitoring of environmental impacts from developments and compliance with guidelines and ECPs **Strategy 8:** Ensure effective surveillance and reporting of illegal development activities within the Marine Reserve **Strategy 9:** Lobby for conservation easements for cayes within the MPA, particularly for identified critical areas (eg. mangrove area of Frank's Caye and primary turtle nesting sites)

Human activities within the Marine Reserve are impacting the long term viability of the biodiversity of the terrestrial environment, with habitat loss through caye development, with removal of mangroves, littoral forest and coastal strand communities throughout the Marine Reserve. 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 22).

Caye Development in the Sapodilla Cayes Marine Reserve	
Clearance of Mangrove	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
Destruction of Coral	Live and dead coral used as land fill in poorly planned caye development (eg. Tom Owen's Caye)
	Destruction of coral to provide boat access, and impacts of boat access on corals within seagrass beds
Human Impacts on Sandy Beaches	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
General Human Impacts	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 caye
	Introduction of exotics – *Casuarina,* coconuts, green iguanas

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.

As all cayes are privately owned or leased, there is a limit to the management activities that can be used, other than lobbying with land owners / developers for best practices, surveillance and enforcement of development regulations and monitoring of impacts (including water quality impacts on reef).

Recommendations:

- Lobby with caye owners / leaseholders / developers for adoption of 'Best Practices' guidelines (eg. Glover's Reef / WCS guidelines)
- Increase surveillance and monitoring of identified turtle nesting beaches inside the SCMR, and address human impacts, following WIDECAST guidelines
- Ensure surveillance and enforcement of development activities is ongoing and effective, in collaboration with the Department of the Environment

Dredging	
Dredging and Associated Sedimentation	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 both the SCMR and the wider SBRC. When inappropriately managed, dredging activities have and will impact areas of conservation importance within the Sapodilla Cayes Marine Reserve.

Recommendations

- Ensure adequate surveillance of caye developments
- 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 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

<table>
<tr><th colspan="4">Threats to biodiversity of Sapodilla Cayes Marine Reserve / 5</th></tr>
<tr><td rowspan="8">Oil Drilling and Exploration</td><td>Status:</td><td>Historical</td><td>Active</td><td>Potential</td></tr>
<tr><td colspan="4">Conservation Target(s): All Targets</td></tr>
<tr><td colspan="4">Threats (Direct):
▪ Reduced viability of all conservation targets
▪ Potential for contamination and loss of ecosystem function for all ecosystems</td></tr>
<tr><td colspan="4">Source (Indirect Threat):
▪ Water contamination from drilling and transportation activities
▪ Water contamination from inadequate fuel storage / management
▪ Seismic testing impacts on biodiversity
▪ Noise pollution impacts on biodiversity
▪ Increased human and boat presence and activity within the Marine Reserve
▪ Revenue potential and the increasing global demand for oil
▪ Political interference and current national economic situation</td></tr>
<tr><td>Area</td><td>4</td><td colspan="2">Any seismic testing or oil spill within or near SCMR would affect the whole MPA, its biodiversity, and its tourism values</td></tr>
<tr><td>Severity</td><td>3</td><td colspan="2">Given the fragile nature of the ecosystems involved the potential impacts of oil exploration could be severe.</td></tr>
<tr><td>Urgency</td><td>2</td><td colspan="2">Concessions for oil exploration have already been awarded to Island Oil Belize Ltd within the MPA and to BHC International Inc for an area just outside the MPA boundary.</td></tr>
<tr><td colspan="4">Management Goal:
Lobby for a complete ban on offshore drilling/exploration within the MPA

Management Strategies:
Strategy 1: Collaborate with all key stakeholders in addressing this issue at a national level
Strategy 2: Lobby for exclusion of Sapodilla Cayes Marine Reserve from oil exploration concession areas (as per WHS recommendations)
Strategy 3: Maintain close communication with Department of Geology and Petroleum and concession holders to provide accurate information to inform management
Strategy 4: Develop a proactive strategy to address imminent implementation of oil exploration activities within or adjacent to the Marine Reserve
Strategy 5: Work with local and national partners to develop an oil spill response plan and ensure necessary equipment is in place in case of oil spill</td></tr>
</table>

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 Sapodilla Cayes Marine Reserve lying within one of the exploration blocks, with past and future oil exploration planned. The impact of oil spills and drilling muds is a potential threat if there is any future active exploration. Additionally, any oil spills from passing ships due to accidental spillage or bilge clearing is a concern.

Threats to biodiversity of Sapodilla Cayes Marine Reserve / 6

Poor Boat Practices

Status:	***Historical***	***Active***	***Potential***

Conservation Target(s): All conservation targets

Threats (*Direct*)*:*

- Reduced live coral cover
- Increased algal growth (in response to coral mortality)
- Reduced extent of seagrass
- Reduced viability of marine biodiversity

Source (Indirect Threat)***:***

- Mechanical damage to coral reef communities and nursery sites (seagrass beds) from anchor damage, sedimentation and propeller damage from shallow water boat traffic, ship and boat groundings
- Potential for fuel and oil spills from poor outboard maintenance and / or boat groundings
- Inexperienced boat captains / poor practices and / or a lack of local knowledge
- Contamination by bilge water
- Contamination by solid waste / sewage from liveaboards / larger ships
- Subsistence fishing within Marine Reserve by liveaboards moored in the area overnight, and by day trips out of Guatemala and Honduras

Area	***3***	Boats use specific areas of the MPA for a variety of purposes. In addition, a major shipping lane lies directly adjacent to the reserve boundary, and is cause for ongoing concern
Severity	***1***	Impacts from smaller vessels are measurable and more likely to occur, however it should be noted that due to the MPA's location along a shipping lane, and use of the area by smaller cruise ships, much larger and more substantial impacts are possible
Urgency	***3***	Whilst not considered a major impact at the moment, there is a current concern about boat traffic. It is anticipated that the threat will grow over the next 3 to 10 years

Management Goal:

Maintain integrity of marine environment and ecosystem functions through effective prevention and mitigation of boat impacts

Management Strategies:

Strategy 1: Install /maintain appropriate demarcation and mooring buoys (including buoys for small cruise vessels)

Strategy 2: Implement policies within the MPA to ensure that all charters have a qualified, licensed and experienced local captain and tour guide / dive guide

Strategy 3: Develop best practices and guidelines for boats entering Sapodilla Cayes Marine Reserve, with participation of liveaboard companies (including small cruise ships), local fishermen, boat captains, tour guides (including tour operators from Guatemala and Honduras), park rangers and other organizations based within the MPA

Threats to biodiversity of Sapodilla Cayes Marine Reserve / 6	
Poor Boat Practices	**Strategy 4:** Develop outreach program specifically for the liveboard companies, employees and clients with literature on rules, guidelines and maps relevant to all SEA protected areas **Strategy 5:** Train and engage rangers for increased effectiveness in enforcement of boating best practices and guidelines **Strategy 6:** Develop and implement a 'Limits of Change' programme for effective tourism management at Sapodilla Cayes Marine Reserve **Strategy 7:** Develop strategies to regulate the management of waste generated by visiting boats in collaboration with Port Authority and DoE **Strategy 8:** Continue liaising with Port Authority to ensure that all shipping vessels are appropriately equipped and that the lighthouse is in proper working order **Strategy 9:** Develop contingency plan for boat groundings, and source equipment identified for dealing with this

Threats from adjacent shipping lanes cannot be ignored. The shipping lanes between Belize and Honduras, and from Honduras and Guatemala into international waters pass close to Sapodilla Cayes Marine Reserve, 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 has started to receive far more attention in terms of the threats they pose to the environment. Any vessel travelling in the shipping lanes, whether cruise ship or not, is a potential threat to the marine life of the SBRC, 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.

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.

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 poplulations 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 the event a major incident should occur
- Work closely with Port Authority, Coast Guard and DoE towards mitigation of potential groundings

Threats to biodiversity of Sapodilla Cayes Marine Reserve / 5

Invasive Species
Lionfish

Status:	***Historical***	***Active***	***Potential***

Conservation Target(s): Commercial / Recreational Fish; Coral Reef Communities; Spawning aggregations; Sharks

Threats (*Direct*)*:*

- Reduced viability of fish populations
- Reduced coral reef health
- Reduced abundance of herbivores
- Increased algal growth

Source (Indirect Threat)***:***

- Invasive species (lionfish)

Area	***4***	Lionfish have increased exponentially since being reported from SCMR in late 2009
Severity	***1***	Whilst it is not completely known the extent of impact that could be caused by lionfish it is thought that they could have a significant impact on local fish populations
Urgency	***3***	Lionfish have increased from a single report in early 2009 to a current density of (unknown) in 2010. This trend is expected to continue, at least over the next year

Management Goal: To reduce and manage the impacts of invasive lionfish within SCMR

Management Strategies:

Strategy 1: Work with national partners in the development and implementation of a comprehensive action plan for lionfish management

Strategy 2: Strengthen stakeholder awareness, support and involvement in lionfish removal and management especially at key target areas such as sites with high juvenile fish abundance

Strategy 3: Research lionfish impacts on coral reef ecosystems and fish populations

Strategy 4: Investigate potential for regular lionfish removal by eradication teams comprised of local stakeholders

Strategy 5: Invest in training of fishermen for preparation of lionfish fillets

Strategy 6: Develop a market for lionfish, in collaboration with local stakeholders

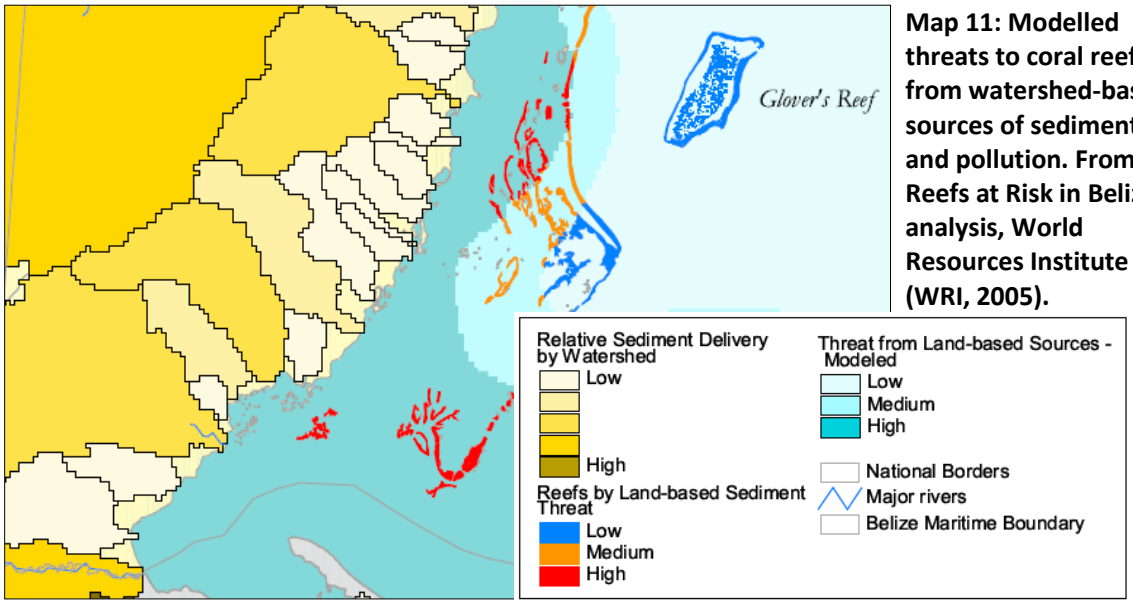
Other Impacts: Agricultural and Industrial Runoff from Watersheds

Also identified as a major threat during the conservation planning for the Marine Reserve was 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.

A more recent assessment of risks from land based sources of pollution highlighted the reefs of Sapodilla Cayes Marine Reserve as at high risk from runoff from mainland agricultural areas (Map 11). This is manifested in the form of sediment-laden river plumes rich in nutrients (effluents) that at times extend to the Marine Reserve, with the potential to cause algal blooms and coral death (WRI, 2005). Definitive research to characterize the effects of pesticides and nitrate and phosphate nutrients from agriculture and aquaculture areas underway through WWF, focusing on identifying and mitigating agrochemical impacts Belize,



Map 11: Modelled threats to coral reefs from watershed-based sources of sediment and pollution. From: Reefs at Risk in Belize analysis, World Resources Institute (WRI, 2005).

ecosystems, with concerns associated with the use of agrochemicals on the banana and citrus plantations and shrimp farms in the Toledo area, due west of Sapodilla 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.

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

Other Impacts: General Pollution

General Pollution	
Pollution	Contamination of waters near developed cayes throughout SCMR and 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 mainland
	Garbage from the mainland sources

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 of solid waste accumulating on the reef crest and caye beaches within the Sapodilla Cayes Marine Reserve, originating from the mainland (Belize / Guatemala / Honduras) and 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 Sapodilla Cayes Marine Reserve, 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 on the Sapodilla Cayes 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.

Recommendations

- Develop baseline and monitor environmental impacts of use of Sapodilla Cayes Marine Reserve on the adjacent ecosystems
- Develop an Environmental Sustainability Plan for Sapodilla Cayes Marine Reserve to mitigate current impacts, and look at synergies for reducing ecological footprint
- Encourage caye based operations within the Sapodilla Cayes Marine Reserve and SBRC to adopt best practices guidelines
- Strengthen 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 in or adjacent to Sapodilla Cayes Marine Reserve
- Monitor development activities on cayes

2.2.2 Prioritizing Threats

The assessment results for the priority threats are then compared and ranked in terms of their impact (Table 22).

Threat	Area	Severity	Urgency	Total AxSxU	Rank
Climate Change	4	3	3	**36**	**1**
Caye Development - Terrestrial	4	3	3	**36**	**1**
Unsustainable Fishing Pressure	4	3	3	**36**	**1**
Visitor Impacts	3	3	3	**27**	**2**
Poor Boating Practices	3	3	3	**27**	**2**
Oil exploration and drilling	4	3	2	**24**	**3**
Invasive Species	4	1	3	**16**	**4**
Caye Development - Marine	2	2	3	**12**	**5**

Table 22: Results of Threat Assessment

The threat with the highest total threat score is ranked as the highest threat. This places three of the threats - ***Climate Change, Caye Development*** (on the terrestrial environment) and ***Unsustainable Fishing Pressure*** as the highest priorities, as active threats, with the potential to reduce the viability of all conservation targets of Sapodilla Cayes Marine Reserve. The threat of ***Caye Development*** on the terrestrial environments is important in the national context, though as the cayes are under private lease or ownership, this limits the ability of SEA to implement conservation strategies.

Visitor Impacts and ***Poor Boating Practices*** are highlighted as the second highest active threats, followed by the threat of ***Oil Exploration***, the impacts from the ***Invasive lionfish,*** and impacts on the marine environment by ***Caye Development***.

Impacts from watershed runoff and other forms of pollution were identified, but not assessed during the conservation planning exercise, though the importance of watershed impacts was flagged.

2.2.3 Cross cutting Strategies to Reduce Threats

The primary cross cutting mitigation strategies were identified during the threat assessment, and the targets each strategy addressed was identified (Table 23).

Strategies	Seagrass	Commercial Species	Littoral Forest	Sandy Beach	Coral Reef Communities	Spawning Aggregations	Sea Cucumbers	
Reduce local anthropogenic threats through community engagement and awareness programs, and effective enforcement								7
Work closely with national and international partners to monitor climate change effects and identify appropriate national and regional management strategies								7
Ensure SCMR has the human resources, equipment and training for effective surveillance and enforcement								7
Engage caye owners developers / residents within SCMR and increase awareness of caye development impacts on the MPA values								7
Develop / adopt Development Guidelines and Best Practices and encourage the use of these guidelines by caye owners / developers / residents, through incentives system								7
Lobby for exclusion of Sapodilla Cayes Marine Reserve from oil exploration concession areas								7
Work with local and national partners to develop an oil spill response plan and ensure necessary equipment is in place in case of oil spill								7
Collaborative enforcement against transboundary incursions both within and outside the MPA – and strengthen Special Enforcement Team								6
Continue liaising with Port Authority to ensure that all shipping vessels are appropriately equipped and that the lighthouse is in proper working order								6
Develop contingency plan for boat groundings, and source equipment for dealing with an event								6
Implement policies and regulations for all tour boats – including requirement for local guides, boat captains, tourism regulations, use of mooring buoys, removal of garbage, zone regulations, Fisheries regulations, Mangrove regulations								5

Table 23: Sapodilla cayes Marine Reserve: Cross-cutting Strategies

2.3 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).

2.4 Planning for Climate Change

2.4.1 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:

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

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
- 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.

2.4.2 Identified Resources of SBRC

Identified Resources of SBRC	
The Fisheries Sector (including aquaculture) ranks 4th 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.	
▪ Conch, Lobster	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
▪ Snapper / Grouper	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
▪ Sea Cucumber	Newly exploited marine product - Laughing Bird faro – no take area known for good populations of sea cucumbers
▪ Starfish (dried, for tourism – Guatemala)	New marine product marketed as a tourism curio in Guatemalan coastal communities
The Tourism Sector ranks 3rd 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.	
▪ Healthy reef	Sapodilla Cayes Marine Reserve – highest live coral cover and coral diversity Laughing Bird Caye National Park – highest recruitment
▪ Whale sharks	Gladden Spit and Silk Cayes Marine Reserve
▪ Sandy beaches	All three MPAs
▪ Fly-fishing / sport fishing	Sapodilla Cayes Marine Reserve
▪ Sea turtles	Nesting Beaches – Sapodilla Cayes, Laughing Bird Caye, Silk Cayes
Ecosystem Service: 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.	
▪ Mangroves	Sapodilla Cayes Marine Reserve (Frank's Caye, Seal Caye)
▪ Seagrass	All MPAs
▪ Corals	Sapodilla Cayes Marine Reserve / Laughing Bird Caye National Park
▪ Littoral forest	Cayes of Sapodilla Cayes Marine Reserve

2.4.3 Climate Change Impacts	Current Status	25 – 50 yrs	100 yrs
Sea level rise	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
Sea surface temperature rise	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).
Increased frequency of storms	Increased storms from 1999 onwards, with annual fluctuations. More storms during El Nina, fewer El Nino. Stronger storms >Cat 4 / 5		
Ocean acidification (corals, lobster / conch)	Atmospheric CO_2 concentration has increased from 280 parts per million (ppm) in 1880 to nearly 380 ppm in 2005 – 30% of all atmospheric CO_2 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)
Decreased Precipitation	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
Air Temperature	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)

Climate Change Impacts	Ecosystem		
	Coral Reef	Seagrass	Mangrove
Sea level rise	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 faces 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 (i.e. Low lying cayes), mangroves may disappear.
Sea surface temperature rise	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 *T. Testudinum*). 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.
Increased frequency and intensity of storms	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

Climate Change Impacts	Ecosystem		
	Coral Reef	Seagrass	Mangrove
Ocean acidification (corals, lobster / conch)	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 CO2 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.
Decreased Precipitation			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
Air Temperature			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)

Climate Change Impacts	Resource		
	Conch	Lobster	Snappers / Groupers
Sea level rise	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
Sea surface temperature rise	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.
Increased frequency and intensity of storms	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
Ocean acidification (corals, lobster / conch)	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
Decreased Precipitation	Possible changes in salinity impacting larval dispersal	Possible changes in salinity impacting larval dispersal	Possible changes in salinity impacting larval dispersal
Air Temperature		Impacts on mangrove productivity	Impacts on mangrove productivity

Climate Change Impacts	Resource		
	Sea Turtles	**Parrotfish**	**Whale Sharks**
Sea level rise	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
Sea surface temperature rise	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.
Increased frequency and intensity of storms	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
Ocean acidification (corals, lobster / conch)	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
Decreased Precipitation			
Increased Air Temperature	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.		

2.4.4 Socio Economic Impacts		
Fisheries	**Tourism**	**Key Environmental Services**
Current Status: 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 totaled approximately Bz$20.5 million dollars in 2008, primarily from the traditional lobster and conch capture fisheries (Ministry of Agriculture and Fisheries, 2008).	**Current Status:** 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).	**Current Status:** 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.
Predicted Impacts: 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. **Limitations/Barriers:** 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.	**Predicted Impacts:** 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. **Limitations /Barriers:** No national strategies exist to address increased unemployment. Limited current market demand for inland tours. Limited capacity to conduct inland tours.	**Predicted Threat:** 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. Possible increased lagoon - open sea water exchange, with reduced sea water temperature. **Limitations / Barriers:** Limited scientific knowledge / experience of climate change impacts – few models available for successful adaptation.

2.4.5 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

2.4.6 Targeted Strategies		
Fisheries	**Tourism**	**Key Environmental Services**
▪ Increase surveillance and enforcement effort against fisheries infractions, particularly hotspots identified using SEA's enforcement data ▪ Implement managed access for traditional fishermen to address fishing impacts ▪ Collaborate with partners to develop supplemental / complimentary income generation opportunities for fishing stakeholders ▪ 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	▪ Ensure infrastructure is in place to minimize tourism impacts on the reef – signs, mooring buoys, designated dive sites ▪ Increase surveillance and enforcement effort against tourism infractions, particularly in identified hotspot threat and resilient areas ▪ Engage BTB and BTIA in climate change adaptation planning ▪ Educate visitors about the impacts of climate change ▪ Conduct market survey to determine the feasibility of promoting more inland based tourism ▪ Based on outputs of market study, diversify focus of training to include inland tourism destinations, reducing dependence on reef resources ▪ Promote and facilitate marketing for diversification of tourism focus – away from dependence solely on the reef ▪ Collaborate with partners in lobbying for passing the revised mangrove legislation.	▪ Identify resilient areas within the SEA's marine protected areas in the context of the greater Southern Belize Reef Complex ▪ Review and re-evaluate MPA boundaries and zoning in the Southern Belize Reef Complex ▪ Identify and increase protection of resilient reefs, source populations and key larval dispersal routes ▪ Establish monitoring protocols that inform management for building reef resilience ▪ Engage coastal / caye landowners in climate change adaptation strategies – including shoreline protection through conservation / re-planting of mangroves ▪ Investigate mechanisms for direct interventions – eg. coral nurseries, shading of key sites, promoting higher herbivore densities ▪ Strengthen protection of trophic structure - maintenance of top predators (eg. feasibility of declaring SBRC as a shark sanctuary)

3. Management Planning

3.1 Management Goals

Sapodilla 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 following goal was identified for the management of the Sapodilla Cayes:

> *To conserve and protect biodiversity of the Sapodilla Cayes Marine Reserve for the sustainable use of present and future generations*

This is to be achieved through the following six objectives:

1. To develop sustainable fisheries in the SCMR through effective surveillance and enforcement of zoning, and prevention of transboundary fishing incursions

2. To identify and protect resilient reefs, with effective, ongoing monitoring of biodiversity to inform management decisions

3. To ensure sustainable tourism use of the Sapodilla Cayes Marine Reserve though developing and implementing a 'limits of acceptable change' programme, with established carrying capacities

4. To address uses and activities outside Sapodilla Cayes Marine Reserve that threaten conservation and protection of biodiversity within the marine protected area, through transboundary collaboration

5. To ensure stakeholders are informed and supportive through regional education and outreach strategies

6. To ensure proper administration and implementation of the Sapodilla Cayes Marine Reserve, with full stakeholder input into decision making

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

The Sapodilla Cayes Marine Reserve was officially declared through Statutory Instrument 117 of 1996 under the Fisheries Act, as part of Belize's World Heritage Site. The Marine Reserve falls under the IUCN Category IV (a habitat management area managed mainly for conservation through management intervention), with the Fisheries Department as the Authority with the legislated responsibility for management of the protected area, a responsibility it shares with the Southern Environmental Association.

The Fisheries Department has the mandate to sustainably manage and develop Belize's fishing sector, under the Fisheries Ordinance, Chapter 133, of 1948, and subsequent amendments and subsidiary legislation, revised in the Fisheries Ordinance, 2000, and complimented by the Fisheries Regulations of 2004.

The Ecosystems Management Unit is one of four units under the Fisheries Administrator (the others being the Aquaculture and Inland Fisheries Unit, the Capture Fisheries Unit, and Administration), and includes the Protected Area Management programme. Under this mandate, the Fisheries Department is able to establish and manage the marine reserves in

Mission Statement, Fisheries Department

"To provide the country and the people of Belize with the best possible management of aquatic and fisheries resources with a view to optimize the present and future benefits through efficient and sustainable management".

Ecosystems Management Unit

The Ecosystems Management Unit (EMU) of the Fisheries Department consists of management of the marine reserves, marine environmental assessments, CITES marine related matters and regional fisheries policy formulation. Ecosystems management, a new management paradigm, has shifted from specific species and site protection to the protection of entire ecosystems and the regulation of the activities within those systems. The Marine Reserves are Fisheries Management Tools (FMT) implemented by the Department to ensure sustainable fishing.

http:/www.agriculture.gov.bz/Fisheries_Dept.html (Downloaded 2010)

Belize (including Sapodilla Cayes Marine Reserve), under the Protected Area Management (Marine Reserve) programme of the Ecosystems Management Unit, which is specifically in charge of the management of the Marine Reserves, under the Marine Protected Areas Coordinator. The Department has established a staffed Fisheries Base on Hunting Caye for site-level management of the area, and is working in a collaborative partnership with SEA.

The Marine Reserve is in a transitionary phase, and roles and responsibilities are still to be more clearly defined between the Fisheries Department and the Southern Environmental Association. Currently, on-site management is under the Reserve Manager, who is supported by two rangers and a marine biologist, paid by Fisheries Department (though this responsibility may be switching to SEA). An additional staff member is supplied by SEA. These personnel are responsible for the on-site, day-to-day management of the reserve, and will be responsible for the implementation of the management plan through effective use of funds, staff and equipment, and supported by the Ecoystem Management Unit, the SEA Protected Areas Programme Director, and SEA activities such as environmental education and outreach.

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. TASTE, established in 2001, provided the science/monitoring and educational component of management for the Sapodilla Cayes Marine Reserve (SCMR), in partnership with the Fisheries Department. Friends of Nature, established in 1991 as Friends of Laughing Bird Caye, originally had co-management responsibility for Laughing Bird Caye National Park (LBCNP) (through an agreement with Forest Department) and Gladden Spit and Silk Cayes Marine Reserve (GSSCMR), under an agreement with the Fisheries Department.

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

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.

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, Sittee 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 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 29).

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 oficio*)

Figure 29: 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.

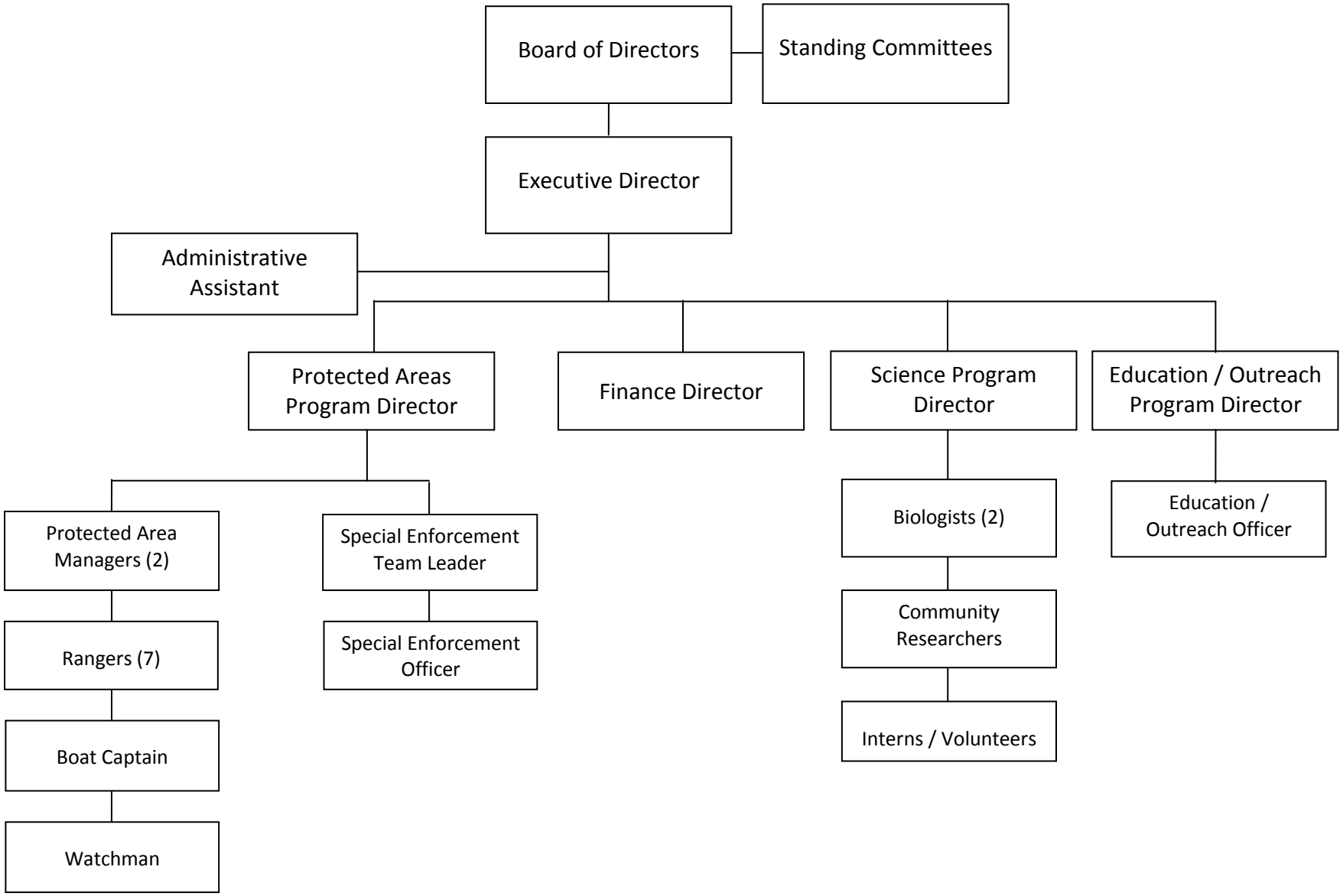


Figure 30: SEA Organizational Structure (December, 2010)

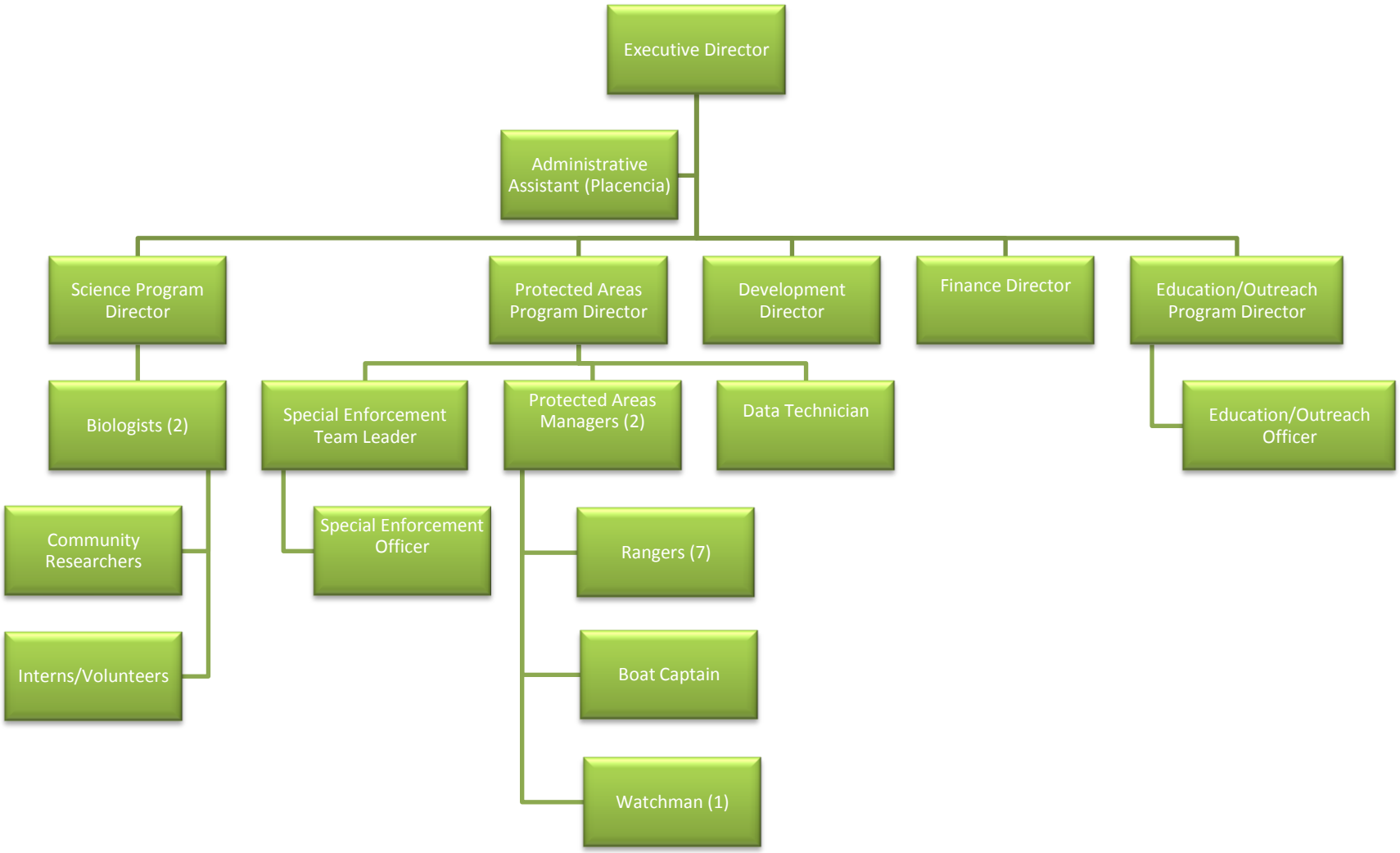


Figure 31: SEA Organizational Structure (Optimal) (SEA Strategic Plan / Salas et. al., 2008)

3.3 Review of Previous Management Effectiveness

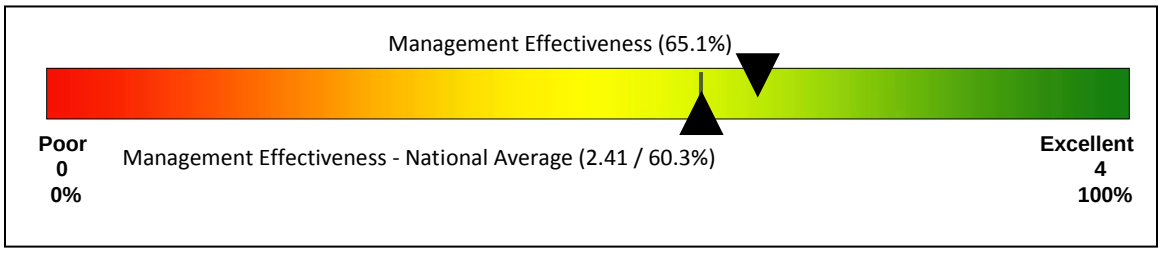
A national assessment of management effectiveness was conducted in 2009, under the Association of Protected Area Management Organizations (APAMO). This included a site-level self-assessment of Sapodilla Cayes Marine Reserve and provides a snapshot of the state of the Marine Reserve in mid-2009, with 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 management effectiveness of Sapodilla Cayes Marine Reserve as assessed in mid-2009 was rated as **MODERATE,** with an overall Management Effectiveness of score of 2.60 out of 4.00 (65.1%).



Outputs of Indicator Categories			
Indicator Category		**Average Score (as a %)**	**Rating**
1. Resource Information		72.7	Moderate
2. Resource Administration, Management and Protection		67.5	Moderate
3. Participation, Education and Socio-Economic Benefit		64.3	Moderate
4. Management Planning		66.7	Moderate
5. Governance		70.8	Moderate
6. Human Resources		43.8	Fair
7. Financial and Capital Management		68.8	Moderate
Overall		**65.1%**	**MODERATE**
Poor: 0 – 25%	**Fair:** >25% - 50%	**Moderate:** > 50% - 75%	**Very Good:** > 75%

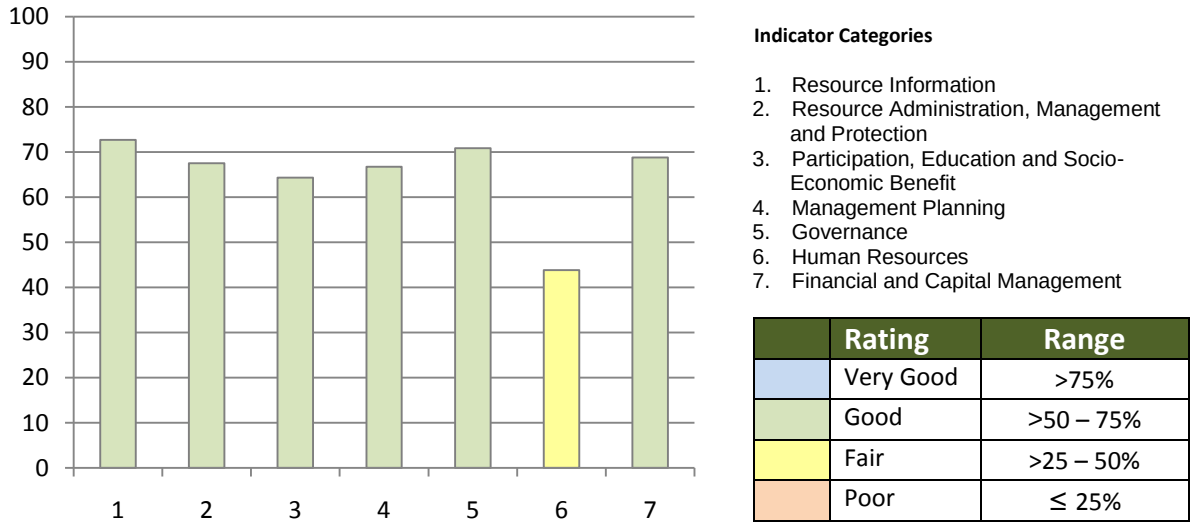


Figure 32: Results per Indicator Category

All but one of the national Indicator Categories rate as **MODERATE** (Figure 32), with the strongest area identified as Resource information, with a score of 72.7%, reflecting the strong research component that has been active in the area, through participation in the MBRS synoptic monitoring programme under the Fisheries Department, and input from groups such as Coral Caye Conservation, and more recently, Earthwatch. This will be continued and strengthened under the Southern Environmental Association.

Human Resources rates as **FAIR**, the weakest Indicator Category, with strengthening of human resource management highlighted as a critical requirement, through activities such as team building, increased leadership skills, and more active direction. This is now being strengthened under the new Executive Director.

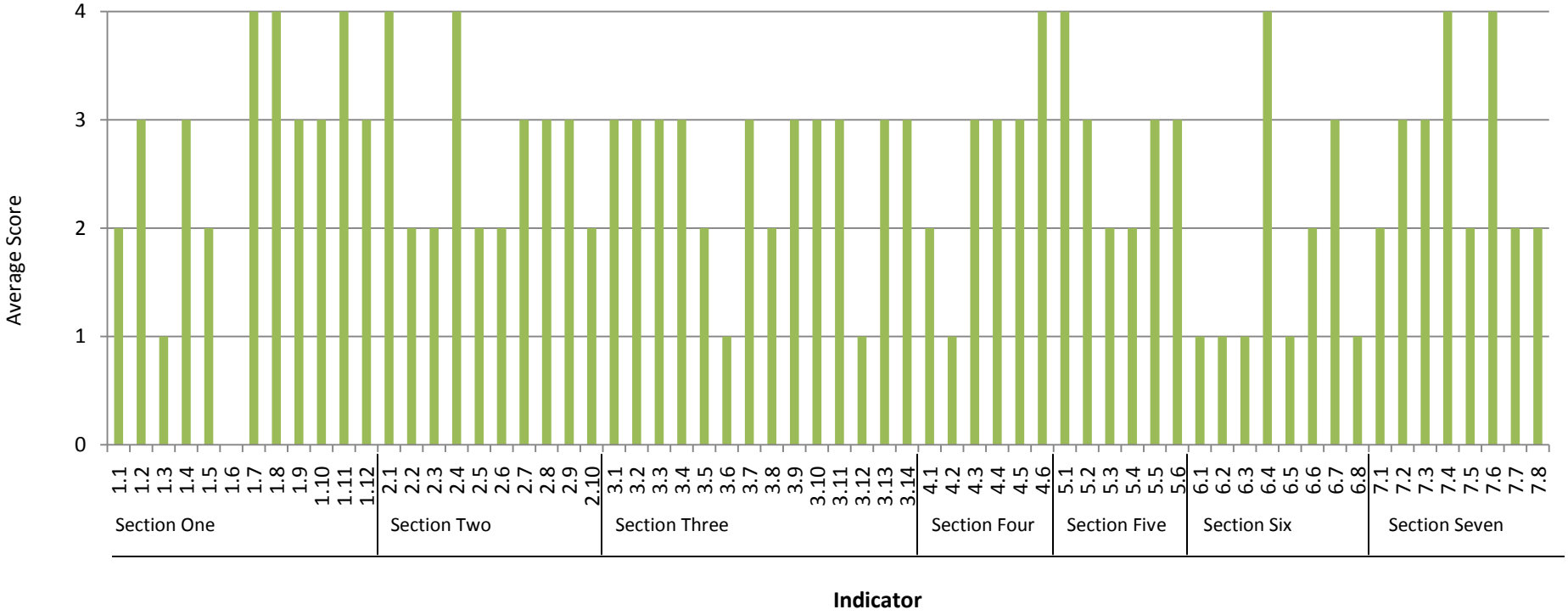


Figure 33: Mean score by indicator – sorted by Indicator Section

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

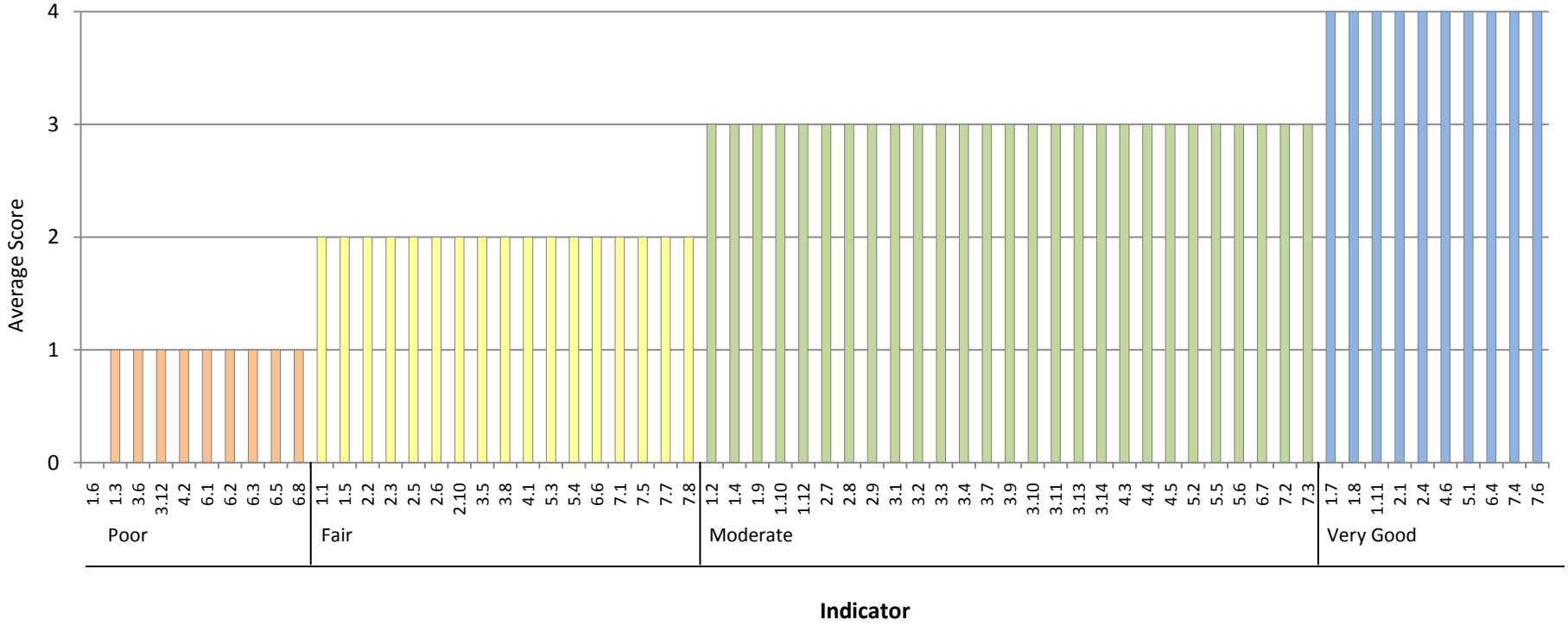


Figure 34: Mean score by indicator – sorted by Indicator Section

Of the 64 national indicators, nine showed particular strength, scoring 4, whilst nine demonstrated areas that would benefit from significant strengthening, with scores of 1 (Table 24).

Strengths
1.7 Site Assessment: Conservation Target
1.8 Site Assessment: Systematic Threat Assessment
1.11 Environmental Monitoring Activities
2.1 Legal Status
2.4 Tenure Claim Conflict Resolution
4.6 Research Planning
5.1 Protected Areas Objectives
6.4 Technical, Scientific, and Professional Staff Availability
7.6 Internal Access Adequacy
Weaknesses
1.3 Inventory: Cultural and Archaeological Resources
3.6 Participation: Local Actors Leading Management
3.12 Sustainable Use for Economic Benefit
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

Table 24: Strengths and Weaknesses of Management

A number of recommendations were developed per Indicator Category based on the outputs of the assessment.

Indicator Section One: Resource Information

Sapodilla Cayes Marine Reserve rates at the high end of **MODERATE** for Section One: Resource Information, with a mean score of 2.91 out of a possible 4.00 (72.7%), significantly higher than the average for the National Protected Areas System (2.31 (57.7%))**.** The scores per indicator 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**. **Indicator 1.6: Tenures and Claims** is considered not applicable by the assessor (being a transboundary issue outside the scope of the management organization), and is therefore not included in the assessment. 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.

- Ensure adequate baseline is available for management decisions – especially related to climate change adaptation
- Ensure information on cultural and archaeological resources within the SCMR and SBRC generally are collated and accessible, including position and condition of wrecks
- Increase knowledge of resource use and occupancy – status of land (private property / leasehold), strengthening of visitation data collection, strengthening of data collection on extractive use of the area (legal and illegal), and information on use of the spawning aggregation sites

Indicator Section 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. The Sapodilla Cayes Marine Reserve rates as **MODERATE** for Section Two, with a mean score of 2.70 out of a possible 4.00 (67.5%). Scores range from 2.00 (**FAIR**) to 4.00 (**VERY GOOD**), reflecting the strength of administration management capacity within the SEA and Fisheries Department structures. Unlike the other SEA managed protected areas, natural resource management does not rate as **VERY HIGH,** neither do enforcement activities nor visitor monitoring - areas that are highlighted as requiring strengthening.

- Ensure the Marine Reserve has adequate boundary demarcation
- Strengthening the permit process for fishermen using the Marine Reserve and the spawning aggregation sites
- Promote guidelines and best management practices among staff, resource users, visitors and caye owners / leaseholders and residents
- Ensure adequate equipment, fuel and trained staff for effective surveillance and enforcement
- Strengthen visitor management and enforcement of visitor rules and regulations

Indicator Section Three: Participation, Education and Socio-Economic Benefits

Sapodilla Cayes Marine Reserve rates as **MODERATE** for Indicator Section Three: Participation, Education and Socio-Economic Benefits, with a mean score of 2.57 out of 4.00 (64.3%) – above the overall national average of 2.13 (53.4%). Two indicators score 1.00 out of 4.00 (**POOR**) - **Indicator 3.6: Local actors leading protected area management** and **Indicator 3.12: Sustainable Use for Economic Benefit**). No indicator rates as **VERY GOOD**, the majority scoring 2.00 or 3.00.

- Identify and implement mechanisms to increase stakeholder involvement in management and participation in decision making
- Strengthen Board input from southern stakeholders
- Identify and implement mechanisms that will increase stakeholder economic benefits from the protected area – both national and transboundary

Indicator Section Four: Management Planning

Sapodilla Cayes Marine Reserve rates as **MODERATE** for Section Four, with a mean score of 2.66 out of a possible 4.00 (66.7%), higher than the national average of 2.20 (55.1%). The Marine Reserve rates as **VERY GOOD** for **Indicator 4.6 Research Programme**, based on the

strong science programme developed under TASTE, but less well on planning – with no strong management planning framework on which to base management activities. 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 Sapodilla Cayes Marine Reserve).

- Ensure staff capacity in using operational and workplans effectively, for effective project and operational management
- Ensure operational plans / workplans are based on the management plan
- Ensure monitoring and evaluation of operational plans / workplans on a quarterly basis
- Ensure monitoring and evaluation of management plan on a biennial basis

Indicator Section Five: Governance

Overall, Sapodilla Cayes Marine Reserve scores an average of 2.83 out of a possible 4.00 (70.8%), rating as **MODERATE** for Indicator Section Five: Governance, higher than the national average of 2.75 (68.8%). Under Indicator Section 5, Sapodilla Cayes Marine Reserve has one indicator rating as **VERY GOOD (Indicator 5.1 Protected Area Objectives)** and no indicator rates 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 Section Six: Human Resources

Sapodilla 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 (**MODERATE)**. One indicator scores 4.00 (**VERY GOOD**) – **Indicator 6.4: Technical, scientific and professional staff**, reflecting the strong science team SEA had in mid-2009. 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. It also reflects some of the problems Fisheries

Dept. encounters associated with managing staff at a remote location. Some of these issues have now been addressed, but others still require action.

- Ensure the on-site manager is adequately qualified, and available 100% of the time for effective leadership of management plan implementation
- Ensure that recommendations from annual staff assessments are implemented
- Identify mechanisms for increasing staff satisfaction – state of accommodation, non-financial and financial incentives etc

Indicator Section Seven: Financial and Capital Management

Sapodilla Cayes Marine Reserve scores **2.75** out of **a possible 4.00 (68.8%)** for Financial and Capital Management, rating as **MODERATE,** higher than the average protected areas system score of 2.49 (62.4%). No indicator rates as **POOR**, though a number of indicators (**Indicator 7.1: Funding Adequacy, Indicator 7.5: Equipment Adequate for Management, Indicator 7.7: Signage Adequate for Management** and **Indicator 7.8 Maintenance Adequate for Management)** rate as **FAIR**. Two indicators rate as **VERY GOOD**, reflecting the extensive past investment in infrastructure, but Sapodilla Cayes Marine Reserve is considered more limited than the other protected areas managed under SEA in terms of equipment, maintenance and signage. Implementation of the SEA Financial Plan will seek to address the issue of financial sustainability.

- Fully implement the SEA Financial Plan
- Ensure equipment and infrastructure at Sapodilla Cayes Marine Reserve is adequate and well maintained
- Ensure on-site staff are trained in basic maintenance of equipment – outboard, batteries, generator etc.

3.4 Management Strategies

3.4.1 Rules and Regulations

The following rules apply throughout the Marine Reserve:

a) No person shall have in his/her possession within the boundaries of the reserve any flora, fauna and archeological artifacts other than in accordance with the regulations.

b) No person shall deposit or extract any material in or on the waters of the reserve, except in cases allowed by special license from the Fisheries Administrator.

c) No person shall mark or tamper with any sign, buoy or notice installed in the reserve.

d) Commercial fishers, resort operators, guides, scientists, residents and visitors shall abide by the permit and entrance fee system as outlined in the regulations.

e) Scientific research will be permitted under a license granted by the Fisheries Administrator.

f) Licenses and permits issued are not transferable.

g) No nets are allowed in the reserve.

h) Any accident involving personal injury or damage to property shall be reported to the reserve personnel as soon as possible, but the Reserve Management, SEA, Fisheries Department or Government of Belize shall not be liable for such personal injury or damage to property.

i) All fisheries, wildlife, forestry, tourism and archeological laws will apply.

SCMR Management Plan (Draft) 2004
TASTE / Nightingale (2004)

3.4.2 Management Constraints and Limitations

During recent assessments of SEA 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, which provided challenges in maintaining continuity in some programme areas, and continuity in reporting.
- Communication between Programmes would benefit from strengthening, with programme managers being unaware of other Programme's activities, and with 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 is 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.
- Dissemination of results is an area requiring significant strengthening. 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 operational framework.

3.4.3 Management Zones

Boundaries

The Sapodilla Cayes Marine Reserve encompasses a total area of 38,594 acres (15,618 ha), though there is limited boundary demarcation in place at the moment (October, 2010), with the need for more marker buoys to be installed. The area is divided into four zones to allow for the management of resources for sustainability, and to provide the flexibility needed to accommodate many users:

- General Use Zone
- Conservation Zone I
- Conservation Zone II
- Preservation Zone

The zones have only recently been legislated (SI 50 of 2009; Annex One), with implementation starting in 2010

Partially overlaying the management zones in three areas are the Spawning Aggregation Sites, declared under a separate SI (SI 161 of 2003).

General Use Zone

The General Use Zone covers 32,482 acres (13,145 hectares) – 84.2% of the protected area. The area is designated for recreational use, research and fishing in accordance with the rules and regulations of the Marine Reserve. Fishing is only permitted in this Zone by licensed fishermen, with restrictions on gear used, including a ban on gillnets and spear fishing. Sport fishing is permitted, (excluding spear fishing) - best practice guidelines promote catch and release.

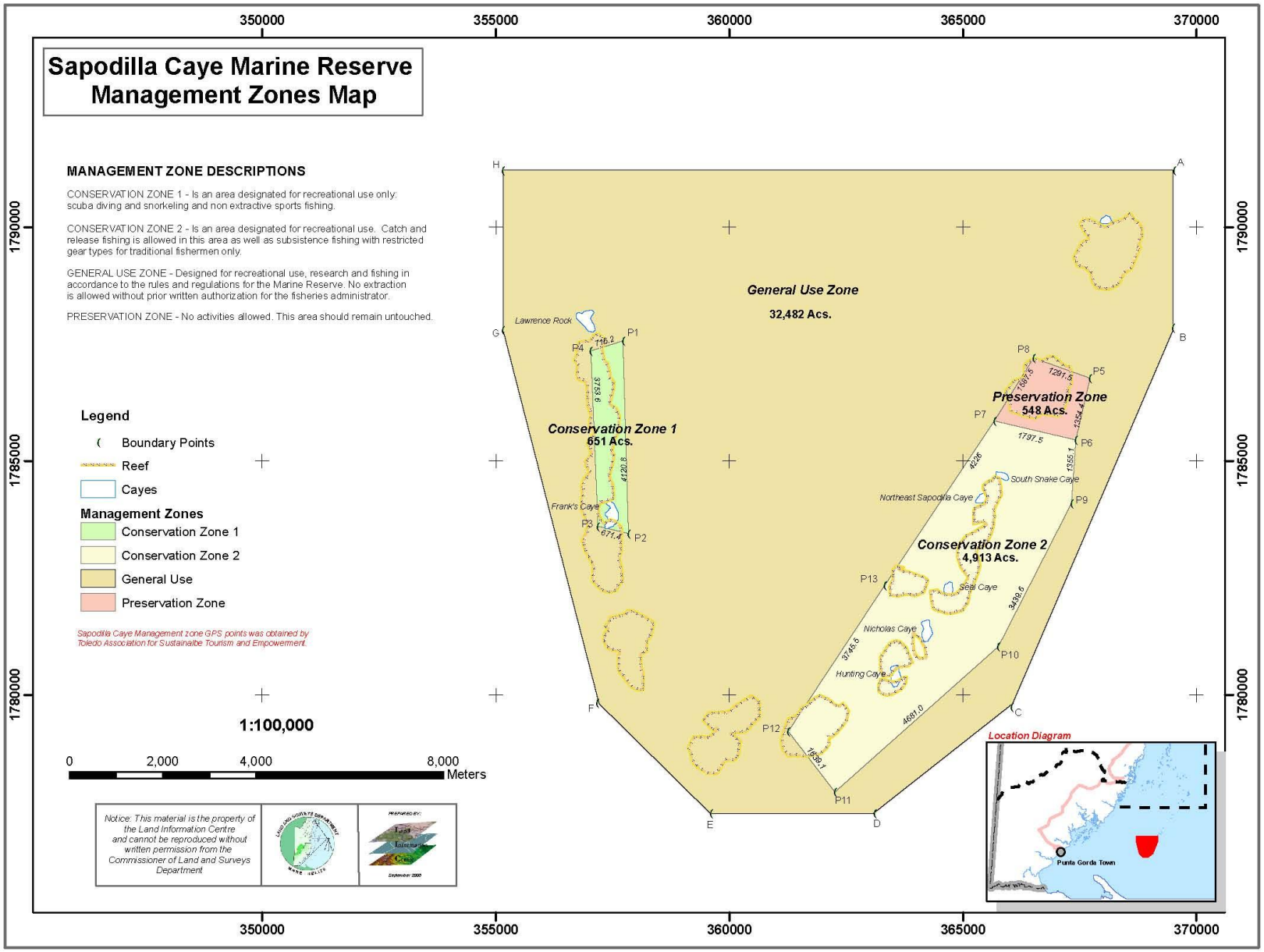
Conservation Zone I

Conservation Zone I lies on the western reef of the Marine Reserve, running northwards from Frank's Caye, and covers approximately 651 acres (264 ha, or 1.7%) of the Marine Reserve. Within this zone, marine life is fully protected, with only non-extractive recreational activities permitted and no commercial fishing allowed. Sport fishing is only allowed when 'catch and release'.

All boats using this zone should be secured using officially designated mooring buoys to prevent anchor damage to the seabed – except in emergency situations, or with prior written permission from the Protected Area Manager and Fisheries Department.

Conservation Zone II

The Conservation Zone covers approximately 4,913 acres (1,988 ha, or 12.7%) of the Marine Reserve, running along the east-facing reef, and associated cayes (excluding the Preservation Zone, and the northern most shoal around Tom Owen's Caye). Within this zone, marine life is fully protected, with only non-extractive recreational activities permitted and no commercial fishing allowed. 'Catch and release' fishing is allowed as well as subsistence, with restricted gear types for traditional fishermen only.


Sapodilla Caye Marine Reserve
Management Zones Map
MANAGEMENT ZONE DESCRIPTIONS
CONSERVATION ZONE 1 - Is an area designated for recreational use only: scuba diving and snorkeling and non extractive sports fishing.
CONSERVATION ZONE 2 - Is an area designated for recreational use. Catch and release fishing is allowed in this area as well as subsistence fishing with restricted gear types for traditional fishermen only.
GENERAL USE ZONE - Designed for recreational use, research and fishing in accordance to the rules and regulations for the Marine Reserve. No extraction is allowed without prior written authorization for the fisheries administrator.
PRESERVATION ZONE - No activities allowed. This area should remain untouched.
Legend
Boundary Points
Reef
Cayes
Management Zones
Conservation Zone 1
Conservation Zone 2
General Use
Preservation Zone
Sapodilla Caye Management zone GPS points was obtained by Toledo Association for Sustainalbe Tourism and Empowerment.
1:100,000
0 2,000 4,000 8,000 Meters
Notice: This material is the property of the Land Information Centre and cannot be reproduced without written permission from the Commissioner of Land and Surveys Department
General Use Zone
32,482 Acs.
Conservation Zone 1
651 Acs.
Preservation Zone
548 Acs.
Conservation Zone 2
4,913 Acs.
Lawrence Rock
Frank's Caye
Northeast Sapodilla Caye
South Snake Caye
Seal Caye
Nicholas Caye
Hunting Caye
Location Diagram
Punta Gorda Town
350000
355000
360000
365000
370000
1790000
1785000
1780000

Preservation Zone

The Preservation Zone covers approximately 548 acres (222 ha, or 1.4%) of the Marine Reserve, and abuts the northern end of Conservation II. No access or activities are allowed in this zone.

Spawning Aggregation Sites

Also managed under the Marine Reserve are three spawning aggregation sites defined under SI 161 of 2003 (Annex Three).

Site	Acres
Rise and Fall Bank	4,250
Nicholas Caye	1,664
Seal Caye	1,600

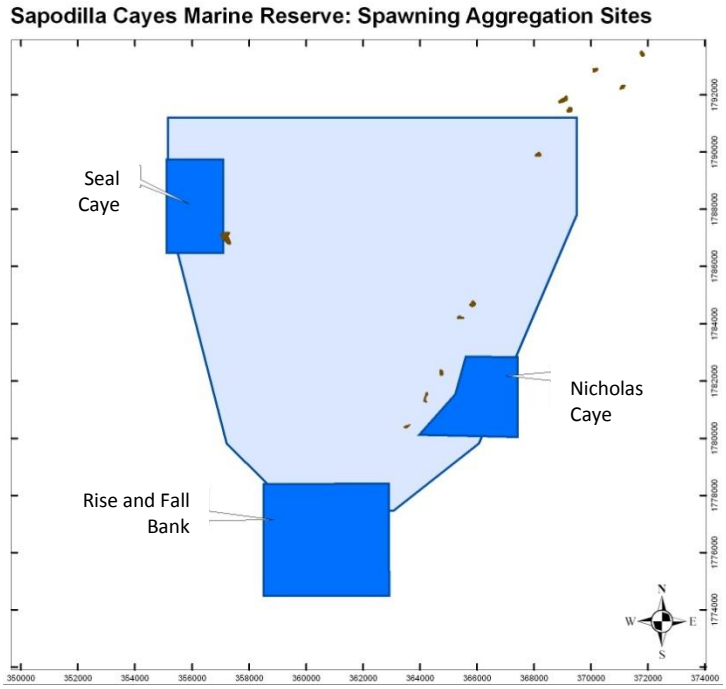


Figure 35: Spawning Aggregation Sites associated with Sapodilla Cayes Marine Reserve

These were established to protect the congregations of reproductive grouper, snapper and other commercial species. They are closed to fishing all year round, with the exception of '*limited fishing by traditional users who are designated by, and to the extent recommended by, the co-managers of the respective marine reserve'*, through special licenses. The fishing gear used, type and quantity of fish are regulated, and details of the catch are required to be submitted to the management agency.

3.4.3 Limits of Acceptable Change

At present there are no carrying capacities set for tourism activities within Sapodilla Cayes Marine Reserve. It has been recognized that this needs to be addressed, particularly in key dive sites. 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 Sapodilla 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 SCMR is a component) are also integrated, to ensure that the SCMR 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.

Also taken into consideration are the recommendations from the recent World Heritage Site assessment team, which recommend that the Belize Barrier Reef Reserve System be placed on the 'Sites in Danger' list, with serious concern as to the future viability of the Belize Barrier Reef Reserve System if certain steps aren't taken in the near future to safeguard the unique values of the seven nominated sites.

Areas of concern from the World Heritage Site assessment team

- Inclusion of Sapodilla Cayes Marine Reserve within an oil exploration concession
- Need to maintain terrestrial vegetation
- Requirement for strengthening of tourism management
- Improved coordination between Government and NGO co-management partners
- Finalization of the co-management agreements
- Need to address the problems of invasive species – *Casuarina,* lionfish

Sapodilla 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: Sapodilla 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**

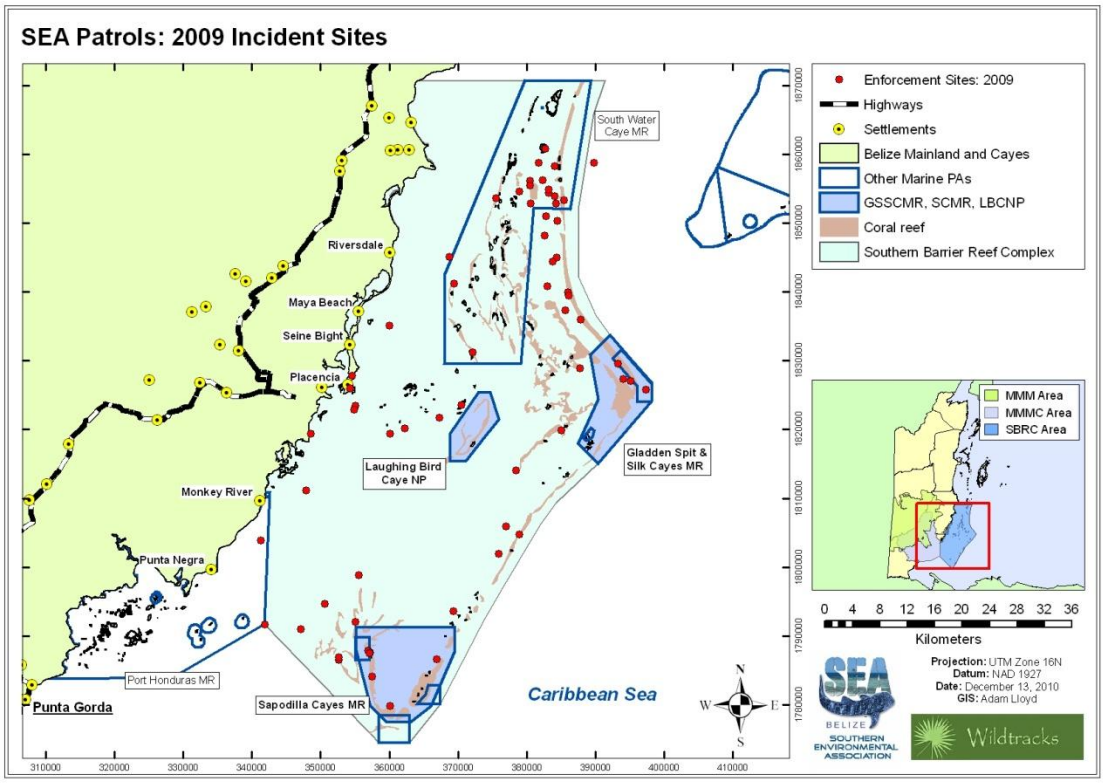
The Surveillance and Enforcement sub-programme at Sapodilla Cayes Marine Reserve is managed by the Fisheries Department, and is focused on supporting and upholding the Marine Reserve legislation, and to ensure fishing and tourism rules and regulations are enforced.

Surveillance and enforcement efforts are also supported by the SEA Special Enforcement Unit, which is guided by mapping of enforcement hotpots (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:

- Improved division of roles and responsibilities between Fisheries Department and the Southern Environmental Association
- Improved demarcation of boundaries
- Increased surveillance and enforcement presence in the adjacent SBRC through doubling the current Special Enforcement Unit (a second boat, crew and fuel allowance)
- Improve mechanisms for regulation of use of the Marine Reserve by transboundary visitors
- Implementation of more effective mechanisms for management of the invasive lionfish and other invasive species within the MPA and adjacent waters
- Impact mitigation within Sapodilla Cayes Marine Reserve
- Identification of specific management strategies for addressing climate change
- Implement management activities for specific conservation targets

The SEA Special Enforcement Team is also active in the adjacent seascape, with patrols guided by mapping of enforcement hotpots (Map 13), and focusing on enforcing the Fisheries Legislation (Figure 36).



Map 13: 2009 Patrol Incident Sites (SEA data)

Surveillance and enforcement is complicated by the constant presence of transboundary impacts. Honduran and Guatemalan fishermen, with traditionally different fishing seasons for lobster and conch, use the Sapodilla Cayes as their reference point for the international limits of their fishing areas – though this is within the 3 nautical mile Belize Economic Exclusion Zone of the south. Past Fisheries Department figures show that in 2005, 25% of fishing incursions were transboundary (13% from Honduras, and 12% from Guatemala), including undersized product, fishing in restricted areas and with restricted gear, fishing without licenses and in closed seasons (Perez, 2009).

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 of both Fisheries Department and SEA) 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 1st December and 31st 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 *Acathuridae* 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 1st to December 31st 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

Natural Resource Management Programme	
Effective Surveillance and Enforcement	

Surveillance and Enforcement	▪ Ensure SCMR has the human resources, equipment and training for effective surveillance and enforcement
	▪ Ensure effective demarcation of MPA boundaries, for visual recognition of boundaries at all points by fishermen
	▪ Lobby for the Belize border buoys to be re-installed, for recognition of Belize territory by Honduran and Guatemalan fishermen
	▪ Ensure infrastructure is in place to minimize tourism infractions - signs, mooring buoys etc.
	▪ Ensure all SCMR staff are aware of the rules and regulations of the marine protected area, and trained for effective surveillance and enforcement
	▪ Ensure continued implementation / enforcement of non-extractive regulations within no-take zones of SCMR, with particular focus on:
	  ▪ Illegal fishing in Conservation and Preservations Zones
	  ▪ Illegal fishing at spawning aggregation site
	  ▪ Illegal fishing of undersized conch by tour guides
	  ▪ Illegal transboundary fishing incursions
	  ▪ Illegal harvesting of turtle eggs
	  ▪ Dredging for coral fill (Tom Owen's)
	▪ Strengthen visitor management, maintenance of visitation data, and enforcement of visitor rules and regulations
	▪ Implement policies and regulations for all tour boats:
	  ▪ Requirement for local guides and boat captains,
	  ▪ Use of mooring points,
	  ▪ Removal of garbage
	▪ Enforce recreational policies and regulations in all zones:
	  ▪ 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 near cayes
	▪ Identify hotspot areas, times and visiting fishing boats requiring increased enforcement effort, using SEA and Fisheries Dept. enforcement data, and implement surveillance and enforcement times and locations accordingly
	▪ Identify hotspot areas, times and visiting boats / tour operators requiring increased enforcement effort, using SEA enforcement data, and implement enforcement of visitor regulations accordingly
	▪ Increase night patrols within SCMR
	▪ Support and uphold Fisheries regulations relevant to maintenance of commercial species within SCMR and the SBRC
	▪ Strengthening the permit process for fishermen using the Marine Reserve and the spawning aggregation sites, in collaboration with Fisheries Dept.

Natural Resource Management Programme	
Effective Surveillance and Enforcement	
Surveillance and Enforcement	▪ 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) ▪ Ensure other Government agencies using Hunting Caye are aware of and follow the MPA regulations, and are engaged for effective management Ensure effective surveillance and reporting of illegal development activities within the Marine Reserve ▪ Ensure enforcement of research regulations within protected area in coordination with Fisheries Department and SEA staff ▪ 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 ▪ Ensure effective surveillance and reporting of illegal development activities within the Marine Reserve
Staff	▪ Ensure adequate Fisheries Department surveillance and enforcement staff on site at SCMR at all times ▪ Ensure adequate surveillance and enforcement staff for SEA Special Enforcement Unit ▪ Engage and train local fishermen and tour guides as Fisheries Officers and Special Constables, to increase enforcement presence
Equipment and Training	▪ Ensure patrols are fully equipped and rangers fully trained for surveillance and enforcement activities (including night patrols and reliable radios installed on boats) ▪ Ensure ranger station is equipped for effective enforcement activities – adequate communications, high staff satisfaction with facilities ▪ Ensure staff are trained and equipped for enforcement of tourism regulations
Reporting	▪ Maintain patrol log books for SCMR ▪ Maintain logs of boat presence within SCMR ▪ Effective collection of visitor data and recording of entrance fees ▪ Produce quarterly reports, and submit to Fisheries Department and SEA ▪ Produce annual reports and submit to Fisheries Department and SEA Board ▪ Strengthen mechanisms to monitor and track infractions, including incorporation of GIS into patrol reports – both extraction and tourism

Natural Resource Management Programme	
Effective Surveillance and Enforcement	
Collaboration	▪ 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 ▪ Strengthen collaboration of SEA and Fisheries Department and strengthen effective enforcement – application of laws and regulations ▪ Strengthen collaborative enforcement (fishermen, SEA, Fisheries Dept., TIDE Coastguard, BDF, police dept etc.) against transboundary incursions both within and outside the MPA – with strengthening of Special Enforcement Team ▪ Strengthen partnership with Immigration Department, with more effective integration into patrols ▪ Strengthen collaboration with Belize Tourism Board for effective enforcement of Tourism Legislation within SCMR ▪ Continue liaising with Port Authority to ensure that all shipping vessels are appropriately equipped and that the lighthouse is in proper working order
Awareness of Regulations	▪ Increase staff awareness of the benefits of marine protected areas – and specifically SCMR ▪ Ensure all tour guides, caye residents and fishermen are aware of location, rules and regulations and rationale for the Marine Reserve ▪ Increase awareness of visiting live-aboard boats on the rules and regulations of Sapodilla Cayes Marine Reserve - specifically the non extractive designation ▪ Increase community awareness of the benefits of marine protected areas - particularly SCMR ▪ Engage fishing stakeholders of the SBRC, increasing stakeholder awareness and participation, and understanding of the function of no-take zones of SCMR as source areas, increasing respect for the no take regulations ▪ Engage and partner with tourism stakeholders, increasing stakeholder awareness and participation ▪ Inform all visitors of rules and regulations when visiting the Marine Reserve through installation of an information board on Hunting Caye, distribution of brochures, and handouts and other educational material ▪ 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

Natural Resource Management Programme	
Impact Mitigation	
Solid Waste and Water Contamination	▪ Ensure effective waste management through design and implementation an effective waste management plan for SCMR rangers station ▪ Ensure SCMR rangers station septic system is designed, located and maintained to minimize risk of water contamination ▪ Lobby for effective waste management in other facilities on Hunting Caye ▪ Develop 'Best Practice Guidelines' for caye developers, owners and residents in SCMR and the wider SBRC to advise on wastewater management, chemical use and storage, etc. ▪ Ensure all ships passing through SBRC are following anti-pollution regulations whilst in Belize territorial waters, in collaboration with Port Authority and DoE ▪ Strengthen links with Department of the Environment for rapid response to pollution events ▪ Develop and implement strategies to regulate the waste generated by visiting boats (solid / grey water waste) in collaboration with Port Authority and DoE ▪ Partner with organizations seeking to mitigate agrochemical contamination of water bodies from land-based sources through promotion of better practices in agrochemical use ▪ Ensure safe storage of oil and chemicals on Hunting Caye, especially during storm events, and lobby for adoption of best practices in fuel and chemical storage on the other cayes of the Sapodilla range ▪ Identify source of floating garbage, and lobby for transboundary action to reduce level ▪ Engage students and other stakeholder groups for voluntary beach cleanup efforts during times of peak garbage ▪ Establish a specific fund for employment of casual labour to assist in beach cleanup efforts during times of peak garbage
Development and Best Practices	▪ Promote guidelines and best management practices among staff, resource users, visitors and caye owners / leaseholders and residents ▪ Engage landowners in littoral forest, mangrove and beach vegetation restoration, management and protection ▪ Collaborate with Forest Dept and DoE to ensure compliance with development legislations in SCMR ▪ Work closely with DOE, Forest Department, etc. to ensure enforcement of all relevant policies and regulations for development activities on the cayes within the Marine Reserve (dredging of sand/coral, clearance of mangroves, water quality and sedimentation)

Natural Resource Management Programme	
Impact Mitigation	
Development and Best Practices	▪ Work with developers and government agencies to ensure effective monitoring of environmental impacts from developments and compliance with guidelines ▪ Develop general guidelines to assist in review of environmental assessments and EIAs for future developments proposed for SCMR, or in SBRC generally ▪ Identify and implement best means of liaising with caye developers and landowners of cayes within SCMR / in the wider SBRC - areas of conflict and mutual assistance ▪ 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 in the SCMR and wider SBRC ▪ Lobby for conservation easements for cayes within the MPA, particularly for identified critical areas (eg. mangrove area of Frank's Caye and primary turtle nesting sites)
Petrochemical Issues	▪ Lobby for exclusion of marine protected areas – including SCMR - from oil exploration concession areas ▪ Maintain close communication with Department of Geology and petroleum concession holders to provide accurate information to inform management ▪ Develop a proactive strategy to address imminent implementation of oil exploration activities within or adjacent to the Marine Reserve ▪ Lobby for creation / adoption of navigation and oil exploration / extraction standards as needed, and enforce all such regulations ▪ 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
Invasive Species	▪ Work with national partners to develop and implement a comprehensive plan for management of lionfish ▪ Increase awareness in staff, and tour guides of the potential impacts of lionfish ▪ Strengthen stakeholder and staff engagement, support and participation in lionfish removal and use ▪ Promote lionfish as a marketable species ▪ Increase staff and tourism stakeholder awareness of invasive nature of *Casuarina,* and lobby for removal from SCMR, particularly on identified turtle nesting beaches ▪ Lobby for implementation of policies of no domestic animals or introduced wildlife on turtle nesting cayes

Natural Resource Management Programme	
Conservation Target Management	
General	▪ Strengthen mechanisms to ensure consistent communication between programmatic areas to support overall adaptive management of SCMR and the SBRC ▪ Ensure clear communication, liaison and collaboration between rangers and science staff for the effective management of conservation targets ▪ Ensure staff are aware of the conservation targets and the role of enforcement and surveillance in ensuring their effective management ▪ Strengthen collaboration with partners towards implementation of coral reef and mangrove restoration programs in SCMR and the wider SBRC ▪ Identify and protect key nursery grounds (for all priority marine species) from extraction / damage
Coral Reef	▪ Identify and increase protection of high resilience reef areas, source populations and key larval dispersal routes within and associated with the SCMR, in response to climate change research outputs ▪ Designate and enforce specific mooring sites and boat access channels to reduce mechanical impacts on corals by boats ▪ Ensure adequate protection of key herbivores to maintain live coral cover and ecological functions ▪ Develop initiatives to increase awareness of the importance of parrotfish to the health of the reef among key stakeholders
Commercial Species	▪ Continue to develop and implement effective mechanisms to ensure a sustainable fishing industry in Belize with close collaboration between SEA and Fisheries Department ▪ Investigate and implement managed access, quotas and other mechanisms for increasing gain for traditional users within SCMR, where feasible ▪ Investigate feasibility of declaration of SBRC as a managed access traditional fishing area ▪ Collaborate with NGO and GoB partners to develop potential supplemental / complimentary income generation opportunities for fishing stakeholders ▪ 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

Natural Resource Management Programme	
Conservation Target Management	
Herbaceous Beach Vegetation / Mangroves	▪ Protect nesting and roosting bird populations through engagement of caye owners / developers, control of visitor access and effective surveillance and enforcement ▪ Lobby against clearance of natural vegetation on the cayes within the SCMR, with increased awareness of use of native vegetation in landscaping, and role in stabilizing cayes ▪ Investigate the status of Ragged Caye, and if not currently leased, lobby for inclusion within SCMR, to provide representation of natural caye vegetation
Sandy Beaches	▪ Identify, adopt and implement guidelines for managing marine turtle nesting on the Sapodilla Cayes, with training for rangers, visitor awareness, and demarcation of turtle nesting areas, to prevent direct impacts from tourism (WIDECAST Technical Report No. 9: Best Practices for Sea Turtle Nesting Beaches) ▪ Ensure all external lights used at SEA / Fisheries Dept. facilities on Hunting Caye are turtle-friendly - low pressure sodium lights, with a wavelength of between 560 - 620nm ▪ Engage land owners, leaseholders and developers within the SCMR and wider SBRC, and lobby for stakeholder management of turtle nesting beaches, with implementation of WIDECAST Best Practices ▪ Liaise with regional and international turtle conservation initiatives
Sharks	▪ Strengthen protection of trophic structure through maintenance of top predators, with targeted surveillance and enforcement ▪ Investigate feasibility of declaring SBRC as a shark sanctuary ▪ Ensure regulations on no feeding of sharks are fully enforced

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.

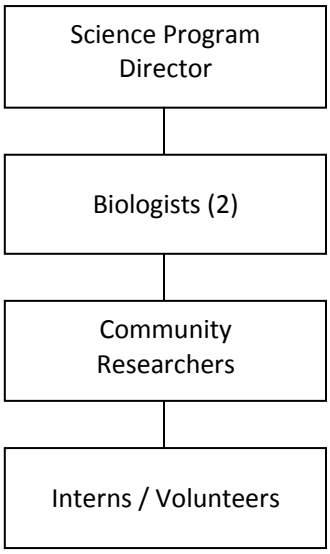


Figure 38: SEA Research and Monitoring Programme staff structure

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 engagement by the science team in the activities of the education and outreach programs to

ensure increased public awareness and involvement in management of Sapodilla 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

Sapodilla Cayes Marine Reserve has been the focus of a number of recent research initiatives, once being the base for research-based Earthwatch expeditions, with the construction of facilities on Hunting Caye (now given to the University of Belize) and more recently under the Conservation International Marine Management Area Science Programme, focused on providing a framework for long-term monitoring of the Belize reef system, with Sapodilla Cayes Marine Reserve identified as one of five survey sites. In the long term, this has the potential to provide important feedback into the adaptive management of the marine protected area, with data on the current status of the reef at all five sites (Shank et. al., 2010).

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.

Research and Monitoring Programme	
General	
	▪ Ensure the SEA Research and Monitoring Programme is equipped and staffed for effective programme management and strategy implementation ▪ Ensure integration of SEA Science team and Fisheries Dept. Marine Biologist for effective coordination of research and monitoring activities ▪ Increased communication and sharing of information through inter-programme collaboration mechanisms for strategy integration and greater adaptive management effectiveness
Research	
General Research	▪ Ensure collaboration and liaison between Fisheries Department and SEA during the process of granting research licenses ▪ 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 ▪ Ensure all research conducted within Sapodilla Cayes Marine Reserve keeps to the rules and regulation and agreed research protocols, including research conducted by SEA and its research partners, ▪ Integrate monitoring and research results into the adaptive management process ▪ Ensure information on cultural and archaeological resources within the SCMR and SBRC generally are collated and accessible, including position and condition of wrecks ▪ Increase knowledge of resource use and occupancy – status of land (private property / leasehold), strengthening of visitation data collection,
Priority Research	▪ Ensure adequate baseline is available for management decisions – especially related to climate change adaptation ▪ Update ecosystem mapping for the Marine Reserve ▪ Identify priority research activities in the SCMR from conservation planning and adaptive management requirements, and identify partners / locate funding for implementation ▪ Identify priority research activities in the SCMR from climate change assessment and planning, and identify partners / locate funding for implementation ▪ Continue to update baseline species lists for fish, corals, birds and other vertebrates and invertebrates of the protected area ▪ Disseminate list of priority research activities to research stakeholders active within the SBRC ▪ Assessment of shark species and populations within SCMR, as part of a larger SBRC initiative ▪ Support research that investigates lionfish impacts on coral reef ecosystems and fish populations

Research and Monitoring Programme	
Monitoring	
General	▪ Continue implementing an effective, standardized monitoring and data management program for the SCMR and wider SBRC area, as outlined by the SEA Monitoring Plan ▪ Engage SEA rangers in monitoring and research activities wherever possible ▪ Integrate monitoring of Conservation Planning indicators into the existing SEA monitoring framework ▪ Integrate monitoring for climate change within the SEA monitoring framework ▪ Integrate monitoring for SBRC indicators within the SEA monitoring framework ▪ Integrate monitoring of Acceptable Change parameters within the SEA monitoring framework ▪ Integrate monitoring of turtle activity within the marine environment of SCMR within the SEA monitoring framework ▪ Strengthen monitoring of birds (nesting / resident and migratory) with integrated training in species recognition for SEA biologists and rangers ▪ Ensure mechanisms are in place for easy access to monitoring data and quarterly data summaries ▪ Implement effective water quality monitoring programme in SCMR and the wider SBRC ▪ Implement effective water quality monitoring of wells on Hunting Caye
Monitoring of Impacts	▪ Develop rapid assessment mechanisms that engage staff and stakeholders, for assessing and monitoring impacts such as ship groundings, disease outbreaks, oil spills etc. ▪ Ensure post impact assessments are conducted and reports produced and disseminated for all impact events – eg. earthquakes, hurricanes, boat groundings ▪ Monitor run-off from the southern coastal plain and northern Honduras / Guatemala during extreme storm events using remote sensing information (NOAA website / SERVIR, ICRAN-MAR), and assess impacts on SCMR ▪ Prioritize monitoring of agrochemical contamination in water / tissue samples ▪ Monitor nutrient levels and relative algal growth on a regular basis to monitor anthropogenic impacts, particularly in high visitor-use areas, using methods such as stable isotope analysis - adjacent to Hunting Caye, mooring buoys and popular dive sites (also in no-impact control site) ▪ Monitor presence and density of lionfish population ▪ Develop indicators for Limits of Acceptable Change monitoring of visitor impacts

Research and Monitoring Programme	
Monitoring	
Research and Monitoring for Climate Change	▪ Continue monitoring for coral bleaching, with input into Mesoamerican Coral Reef Watch Programme (through ECOMAR) for early reporting of bleaching episodes ▪ Identify resilient areas within the SEA's marine protected areas in the context of the greater Southern Belize Reef Complex ▪ Review and re-evaluate MPA boundaries and zoning in the Southern Belize Reef Complex ▪ Identify coral recruitment sources for SCMR, and identify mechanisms to ensure that these are adequately protected, if necessary ▪ Characterize water currents critical for coral recruitment at SCMR ▪ Establish monitoring protocols that inform management for building reef resilience ▪ Investigate mechanisms for direct interventions – eg. coral nurseries, shading of key sites, promoting higher herbivore densities ▪ Work closely with national and international partners to monitor climate change effects and identify appropriate national and regional management strategies ▪ Integrate collection of coral fragments into post-impact (hurricane, boat grounding) assessment activities for incorporation into coral restoration programme
Socio Economic Monitoring	▪ Effectively access and use baseline information from Conservation International (MMAS) on the socio-economic context of the protected area (CI / Catzim et. al. 2009) ▪ Maintain and update accurate socio-economic data on SCMR stakeholder communities

Research and Monitoring Programme	
Monitoring	
Monitoring of Conservation Action Planning Indicators	▪ Area of Littoral Forest ▪ Area of unimpacted littoral forest ▪ Area of red mangrove ▪ Presence of native caye species ▪ Number of *Casuarina* trees ▪ Numbers and species of migratory birds per migration (fall and spring) ▪ % of sandy beaches in good conditions (unimpacted by human activities) ▪ Number of turtle nests ▪ Extent of seagrass ▪ Condition of seagrass ▪ Number of dredging permits issued within SCMR ▪ number of areas and total area dredged within SCMR ▪ Densities of conch ▪ Live coral cover ▪ Recent mortality ▪ Recent coral recruitment ▪ Herbivorous fish density ▪ *Diadema* density ▪ Abundance of sharks ▪ Densities of lobster ▪ Densities of target finfish species ▪ Number of fishing incursions / violations ▪ Number of species using each spawning aggregation site ▪ Number of individuals per species using each spawning aggregation site ▪ Number of shark species and individuals using SCMR ▪ Population density of sea cucumbers ▪ Extent / density of seaweed
Training	
Training	▪ Ensure all staff (particularly rangers) understand the reasons behind research and monitoring ▪ Ensure all staff are aware of, and can articulate, major research and monitoring outputs (state of reef, state of fish resources etc.) ▪ Ensure any new biologists are trained in monitoring protocols, species identification and data management ▪ Train staff and rangers in identification of key species (particularly nesting birds)

Research and Monitoring Programme	
Data Management and Dissemination	
Data management	▪ 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 ▪ Improve mechanisms to integrate surveillance and enforcement and biological monitoring information ▪ Strengthen mechanisms for accessing monitoring and research outputs
Communication	▪ Continue presenting monitoring results in annual reports, and integrate into the adaptive management cycle ▪ Use available forums for dissemination of results (eg. workshops, conferences, school visits, tour guide meetings. ▪ Develop digital library of all published work on Sapodilla Cayes Marine Reserve and make available, where feasible, for download on line ▪ Ensure results of monitoring and research outputs are available to staff at SCMR and to other SEA Program Managers
Collaboration	
Collaboration	▪ Strengthen communication and collaboration between the Science Programme and other SEA programme areas ▪ Strengthen communication and collaboration with coral restoration / reef resilience partners ▪ Strengthen communication and collaboration with other current and future research partners ▪ Develop / strengthen mechanisms for tour guides and other stakeholders to participate in monitoring activities of turtles, coral bleaching and lionfish ▪ Engage BTB and BTIA in climate change adaptation planning

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 Sapodilla Cayes Marine Reserve through the past collaboration with TASTE. 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 comes 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 Sapodilla 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.

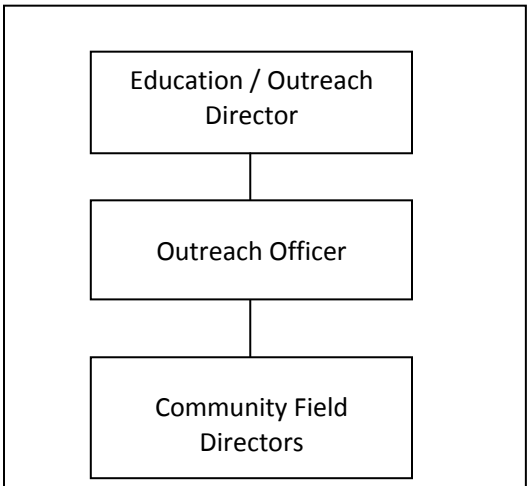


Figure 39: SEA Education and Outreach Programme staff structure

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 Sapodilla 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.

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.

Education and Outreach Programme	
Engagement and Participation	
General	▪ 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 ▪ Engage tourism and fishing stakeholders from key communities through increased awareness, participation and communication ▪ Engage schools in key stakeholder communities through increased awareness activities, participation and communication ▪ Identify and implement mechanisms that will increase stakeholder economic benefits from the protected area – both national and transboundary – added value to trips etc.
Participation	▪ Encourage active participation of Board members in management activities and events ▪ Identify and implement mechanisms to increase stakeholder involvement in management and participation in decision making ▪ Engage and train tour guides and fishermen in surveillance activities ▪ Develop and implement mechanisms for participation of tour guides in monitoring activities of turtles, coral bleaching and lionfish ▪ Engage new sectors – the hotel industry, restaurants, and other businesses, within the stakeholder footprint ▪ 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
Environmental Education	
Primary and Secondary Schools	▪ Give presentations targeting primary and secondary schools in stakeholder communities on the SEA marine protected areas and their environmental and socio economic benefits ▪ Liaise and collaborate with local NGOs and other SBRC partners (SWCMR, TIDE, Fisheries Dept) for joint educational outreach to schools in stakeholder communities ▪ Ensure continued communication and collaboration with schools, to build on past successes ▪ Provide ongoing field trips for students to the reef, to invest in the engagement of future decision-makers

Education and Outreach Programme	
Outreach and Dissemination of Information	

Public Awareness	▪ Continue raising awareness in all stakeholders of the benefits of Sapodilla Cayes Marine Reserve
	▪ Encourage greater visitation by local visitors and school groups through organized and guided day trips, school visits and other mechanisms
	▪ Ensure continued production and distribution of brochures on Sapodilla Cayes Marine Reserve, incorporating key biodiversity and ecosystem values, goals and rules and regulations
	▪ Develop and implement targeted public awareness programmes that address specific issues including, but not limited to:
	  ▪ Goals and Objectives of Sapodilla Cayes Marine Reserve
	  ▪ Goals and Objectives of the Southern Environmental Association
	  ▪ Lionfish
	  ▪ Coral Bleaching
	  ▪ Climate Change
	  ▪ Mangroves
	  ▪ Manatee Conservation
	  ▪ Marine protected areas and maintenance of sustainable fish stocks
	  ▪ Value of SCMR no-take zones
	  ▪ Managed access and no-take areas
	  ▪ Sharks
	  ▪ Sea turtles
	  ▪ Pollution
	▪ Ensure there is awareness of Sapodilla 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)
	▪ Increase awareness among stakeholders of the biodiversity value and importance of mangrove, and encourage protection – especially in areas identified as important nursery sites for SCMR
	▪ Increase awareness among fishermen on proper disposal of oil / lube containers, and effects of pollution on the marine environment
	▪ Continued education and awareness activities in stakeholder communities, focusing on the value of SCMR no-take zoning and its ability to help maintain the sustainability of commercial species
	▪ Increase general awareness of SEA and Sapodilla Cayes Marine Reserve through participation in national events - displays and exhibits at events such as the Agriculture & Trade Show, Earth Day, etc.

Education and Outreach Programme	
Outreach and Dissemination of Information	
Dissemination of Information	▪ Ensure all awareness documents relevant to Sapodilla Cayes Marine Reserve are available for download from the website (brochures, leaflets, regulations, posters etc.) ▪ 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 ▪ 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
Sustainable Livelihoods and Training	

Training	▪ 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
	▪ Training of local fishermen and tour guides for participation as Fisheries Officers / Special Constables in surveillance and enforcement activities
	▪ Provision of training opportunities to enhance stakeholder skills in areas of:
	  ▪ First Aid / CPR
	  ▪ Project Management
	  ▪ Skills for tour guide for leading in-land tours
	  ▪ Small business start-up and management
	  ▪ Capture and preparation of lionfish
	▪ Conduct a needs assessment with local community based organizations and associations, to see how SEA may best partner and / or assist them

3.5.4 Public Use Programme

Sapodilla Cayes Marine Reserve was established based on its value as a traditional fishing area, and as a recreational destination for both local residents and visitors. It continues to be important in attracting the reef-based tourism that supports tour-based operations in Punta Gorda, Monkey River and a number of coastal communities of Guatemala and Honduras.

The Public Use Programme covers a number of different responsibilities, focused on recreational use of the area, and 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.

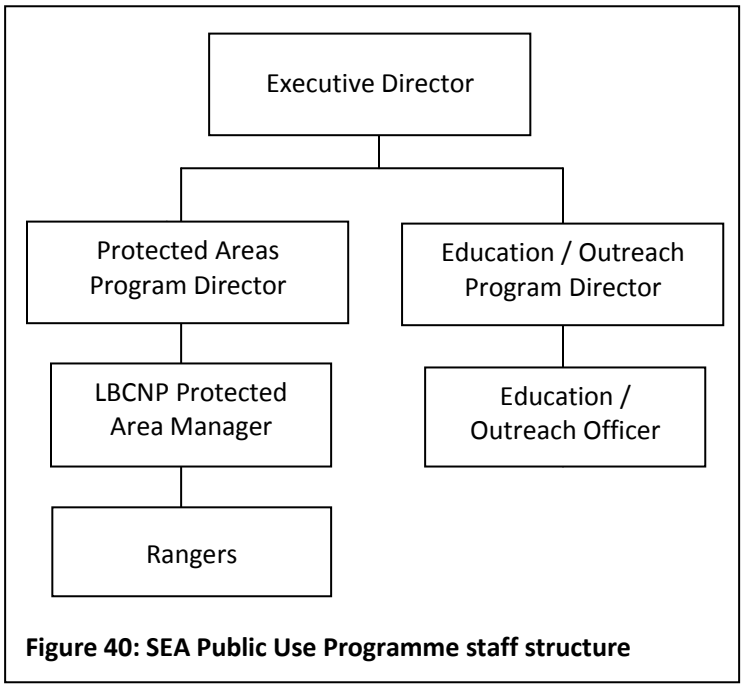


Figure 40: SEA Public Use Programme staff structure

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

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 is also the need to strengthen engagement of the transboundary users of the Marine Reserve, as these form the majority of visitors to the area and have the highest impact. Mechanisms to address this include:

- Ensuring that all boats using the Marine Reserve have a Belizean boat captain aboard
- Ensuring that all snorkelling / diving groups are led by Belizean, licensed tour guides, certified in site-level best practices
- Ensuring that all boats using the Marine Reserve are aware of the Reserve rules and regulations

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 to find out more about protecting the aquatic environment and its resources.

CORAL BP-1042002

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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 to find out more about protecting the aquatic environment and its resources.

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Public Use Programme	
Visitor Management	

General Visitor Management	▪ Encourage greater visitation by local visitors and school groups through organized and guided day trips, school visits and other mechanisms
	▪ 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
	▪ Develop and implement strategies and actions to strengthen baseline data collection on resource use of the marine protected area, and data accessibility
	▪ Ensure sufficient mooring buoys are installed at key snorkel / dive sites
	▪ 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
	▪ Enforce SCMR public use regulations:
	  ▪ Enforce 'no take' regulations for tourists and tourism operations in the Conservation and Preservation Zones
	  ▪ Ensure dive boats fly ' divers down' flag when divers are in the water
	  ▪ Ensure that dive boats follow the legislated diver:guide ratio of 8:1
	  ▪ Ensure that snorkel groups follow the recommended guide:snorkeler ratio
	  ▪ Ensure boat captains follow anchor-use / mooring regulations
	  ▪ Exclusion of jet ski and water-ski use
	  ▪ Ensure all users of Hunting Cay (UB students / supervisors / caretakers / Fisheries and Coastguard officers, lighthouse keeper etc.) follow Reserve regulations
	▪ Liaise with Belize Tourism Board for effective enforcement of tourism legislation
	▪ Develop and implement best practices and guidelines for boats entering Sapodilla Cayes Marine Reserve, with participation of live-aboard companies, boat captains, tour guides and park rangers
	▪ Work with tour guides to develop a 'code of conduct' for reef based activities
	▪ 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

Public Use Programme	
Visitor Management	
General Visitor Management	▪ 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 ▪ Develop and implement a 'Limits of Acceptable Change' programme for effective tourism management at the Sapodilla Cayes Marine Reserve, especially for primary dive and snorkel sites within the protected area ▪ Integrate tourism best practices into Best Practices planning for SCMR, including re-visiting tour guide-visitor ratios for snorkeling and diving ▪ Develop conflict resolution mechanisms and in-house skills for dealing with public use conflicts ▪ Ensure all relevant fees are collected and recorded ▪ Ensure researchers and students follow Marine Reserve regulations and Fisheries Dept. and SEA research guidelines
Awareness	▪ Ensure visitors, tour guides and tour operators using Sapodilla Cayes Marine Reserve are aware of rules and regulations – clear, on-site signs at Hunting Caye indicating rules and regulations, and through brochures, handouts and other educational material related to regulations ▪ 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 (www.coral.org)) ▪ 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 ▪ Develop outreach program specifically for the Honduran and Guatemalan tour guides and boat captains with literature on rules, guidelines and maps relevant to Sapodilla Cayes Marine Reserve ▪ Ensure visitors in independent sailboats visiting Sapodilla Cayes Marine Reserve are aware of rules and regulations, mooring buoy locations and mooring regulations ▪ Ensure all researchers and students are aware of the rules and regulations of the Marine Reserve, and under the Fisheries legislation
Visitor Education and Interpretation	
Interpretation	▪ Equip Visitors Centre / Information Centre with interpretive information designed to raise awareness of the environmental and socio-economic benefits and services of the Marine Reserve, and its World Heritage status

Public Use Programme	
Visitor Education and Interpretation	
Interpretation	▪ Provide information on sea turtles, turtle nesting and turtle conservation during nesting time, when access to nesting beaches are restricted Provide information on coral reefs and climate change implications ▪ Provide information on garbage issues, including breakdown of origin of garbage arriving at SCMR ▪ Provide information and training to tour guides on conservation targets, climate change, coral bleaching, bird use of the cayes, caye vegetation, sharks and other topical subjects to assist them in providing accurate information for their visitors ▪ Provide quarterly information to tour guides on interesting activities, research outputs, educational activities etc. that can be incorporated into their interpretation during tours
Visitor Safety	
Visitor Safety	▪ Ensure Ranger's Station is equipped with good radio communications / satphone ▪ Ensure Ranger's Station is equipped with an adequate first aid kit ▪ Ensure all rangers based on Hunting Caye are trained in first aid and CPR, and dealing with marine-based first aid (including lionfish stings) ▪ Ensure a ranger is on-site at all times when visitors are present ▪ Ensure all snorkeling / diving groups have the legislated guide / visitor ratio ▪ Ensure all tour guides and boat captains are trained and licensed ▪ Ensure enforcement of visitor regulations designed to provide visitor safety
Visitor Facilities	
Facilities	▪ Ensure visitor facilities (barbecue stands, picnic tables, bathrooms and visitor centre) are maintained in first class condition ▪ Ensure bathrooms are adequate for the number of visitors on the caye at any one time ▪ Ensure sufficient mooring buoys are installed for visitation requirements

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, for greater accessibility to local stakeholders, and for use by the SCMR staff.

A Ranger Station is located on Hunting 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 Hunting Caye.

Currently (2010), the Visitors Centre, which takes up the bottom floor of the Ranger's Station, requires greater interpretive information for visitors. Visitor facilities include mooring buoys, placed at key mooring and dive sites, which are serviced throughout the year.

Site and Infrastructure Management Programme	
Infrastructure	
Fisheries Department Office Facilities	▪ Ensure the Fisheries Department enforcement and Ecosystem Management Unit offices are adequately equipped for effective implementation of their programme areas
SEA Office Facilities	▪ Ensure all Programme Directors / Managers are fully equipped for effective implementation of their programme areas ▪ Investigate the feasibility of purchase of land and design and construction of SEA office, and locate funds for implementation ▪ Incorporate solar power and other green initiatives into the design and operation of the SEA Offices, rangers stations, and all SEA activities
On-site Staff Facilities	▪ Ensure current on-site staff facilities are maintained / improved for high staff satisfaction ▪ Maintain and improve solar power to supply the staff and visitor facilities on Hunting Caye ▪ Ensure SCMR Ranger Station sewage and grey water system is effective and not contaminating groundwater or waters adjacent to caye

On-site Visitor Facilities	▪ Fully equip the Visitor's Centre, and ensure adequate visitor interpretive information on Sapodilla Cayes Marine Reserve in the Visitor Centre, with changing displays each quarter
	▪ Ensure visitor facilities are adequate for visitation levels and for maintaining high visitor satisfaction (picnic tables, barbecue grills, bathrooms)
	▪ Ensure sufficient mooring buoys are installed for visitation requirements
	▪ Ensure sufficient signage, including:
	  ▪ Large "Welcome' / rules and regulations sign
	  ▪ WHS status sign
	  ▪ Temporary turtle nesting signs (for nesting sites) – no-entry and info

Equipment	
Fisheries Department Equipment	▪ Maintain and replace office equipment as necessary for ensuring effective operations ▪ Identify equipment gaps and locate funds for equipment purchase ▪ Ensure Fisheries Department has sufficient vehicles and boats for effective operations
SEA Equipment	▪ Maintain and replace office equipment as necessary for ensuring effective operations ▪ Identify equipment gaps and locate funds for equipment ▪ Ensure SEA has sufficient vehicles, boats and motors for effective operations

Site and Infrastructure Management Programme	
Equipment	
On-site Equipment-General	▪ Ensure SCMR Ranger Station is adequately equipped for surveillance and enforcement activities and good radio communications ▪ Install satellite internet for improved communication between SEA and Sapodilla Cayes staff ▪ Ensure SCMR has an operational and fully equipped boat and engine for surveillance and enforcement activities ▪ Purchase second 4 stroke engine ▪ Acquire second, larger boat for more effective enforcement in rough seas ▪ Ensure surveillance and enforcement team are fully equipped for day and night patrols – spotlights, raincoats ▪ 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
Maintenance	
Facilities	▪ Ensure staff facilities are maintained in first class condition ▪ Ensure visitor facilities (barbecue stands, picnic tables, bathrooms and palapa) are maintained in first class condition ▪ Ensure bathrooms are adequately maintained ▪ Ensure mooring buoys are adequately maintained

3.5.6 Administrative Programme

The Fisheries Department Administrative Headquarters is in Belize City, and is responsible for all Fisheries Department operations.

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 Sapodilla 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.

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**

With the dual co-management roles of the Fisheries Department and SEA, it is a priority that clear reporting procedures and chains of command are established, to ensure that on-site activities and goals are achieved, and that reports are submitted to both the Fisheries Department and SEA.

Administration Programme	
Administration Procedures	▪ Finalize co-management agreement between Fisheries Depart. and SEA ▪ Develop systems to ensure consistent communication between Fisheries Department and SEA programme areas to support overall adaptive management of SCMR and the SBRC ▪ Develop mechanisms to ensure consistent and effective communication between SCMR on-site staff, Fisheries Department and SEA (including installation of internet) ▪ Identify and implement specific activities that integrate SCMR staff into the SEA staff structure ▪ Ensure staff capacity in using operational and workplans effectively, for effective project and operational management ▪ Preparation of annual workplan and budget by each programme manager in November each year ▪ Ensure operational plans / workplans are based on the management plan ▪ Ensure monitoring and evaluation of operational plans / workplans on a quarterly basis ▪ Ensure monitoring and evaluation of management plan on a biennial basis ▪ Prepare annual State of the Park / SBRC reports including monitoring / research output for SBRC area ▪ Produce quarterly reports for Fisheries Department reporting, and submit to Fisheries Department and the SEA Board of Directors ▪ Develop conflict resolution mechanisms and in-house skills for dealing with public use conflicts
Staff	▪ Ensure there are sufficient on-site staff for effective management of SCMR ▪ Ensure all Fisheries Department employees are familiar with organizational policies and procedures ▪ Ensure all SEA employees are familiar with organizational policies and procedures ▪ 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 ▪ Ensure on-site staff have adequate support from Fisheries Dept and SEA ▪ Ensure equality in pay and benefits in all operational staff in all three SEA co-managed protected areas ▪ Ensure SCMR staff are equipped with uniforms

Administration Programme	
Staff	▪ Ensure the on-site manager is adequately qualified, and available 100% of the time for effective leadership of management plan implementation ▪ Conduct an annual evaluation of staff performance and ensure that recommendations are implemented ▪ Identify human resource skills gaps and implement training programme to build capacity where required ▪ Conduct an annual review of staff capacity and training requirements ▪ Continue encouraging participation of local stakeholders through volunteer rangers programme – local fishermen and tour guides ▪ Seek funds to employ casual labour to assist staff in beach clean ups during times of peak garbage ▪ Engage local students and community groups in assisting staff in beach clean ups during times of peak garbage
Training	▪ Ensure operational staff are trained in CPR, First Aid and use of the oxygen kit ▪ Ensure staff have sufficient administrative training for effective general management, fundamental accounting, budget and proposal / workplan preparation and implementation ▪ Ensure surveillance and enforcement staff have sufficient surveillance and enforcement training to be effective ▪ Ensure all on-site and operational staff members are trained in operation and maintenance of reserve equipment (boat handling, outboard engine repair etc.) ▪ Ensure staff have sufficient training in biodiversity monitoring protocols for effective monitoring ▪ Ensure staff are trained in conflict resolution, consensus building, public relations and communications skills ▪ Ensure the Board members have the skills and capacity to perform effectively
Health and Safety	▪ Ensure an effective Emergency Plan is in place (to include natural and anthropogenic disasters), and staff are trained in implementation ▪ Ensure all staff working in SCMR have adequate insurance for their roles
Communication and Collaboration	▪ Strengthen communication and collaboration between Fisheries Department and SEA ▪ Strengthen communication and collaboration between SEA Programmes ▪ Identify and implement mechanisms to increase stakeholder involvement in management and participation in decision making ▪ Maintain and update SEA website on an ongoing basis ▪ Strengthen links with other organizations and Government agencies involved in marine protected areas management

Administration Programme	

Communication and Collaboration	▪ Ensure a flow of information to on-site staff re. science and monitoring outputs. Ongoing communication and dissemination of information to all stakeholder sectors
	  ▪ Fisheries Department
	  ▪ Board of Directors
	  ▪ Staff
	  ▪ Surveillance and enforcement and research partners,
	  ▪ Funding partners
	  ▪ Stakeholder partners – tour guides, fishermen, schools
	  ▪ Government agencies (especially Coast Guard, Port Authority, Department of the Environment, and Department of Geology and Petroleum)
	  ▪ Local decision makers
	▪ Ensure tour guides operating in the Sapodilla Cayes Marine Reserve are kept informed of reserve activities and management decisions affecting them

Financial Sustainability	▪ Improve the internal financial system, and link expenditures to programme areas ▪ Assess 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 ▪ Re-evaluate partnership with Seabourne based on financial income, impact on socio-economic benefits to stakeholders and impacts on reef health ▪ Seek funding to fully implement SEA's Financial Plan ▪ Increased promotion and marketing of Sapodilla Cayes Marine Reserve through media such as video, posters etc. ▪ Establish an 'honorary Board' to assist with fundraising ▪ Investigate mechanisms to diversify funding base ▪ Seek funding for establishing an endowment fund for long term sustainability ▪ Market SEA, with increased brand name recognition locally, nationally and internationally ▪ Seek to reduce variable costs through strategic partnerships in all programme areas ▪ Assess and plan for potential liability issues

3.5.7 Management Policies

On-site staff at SCMR 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.

A Hurricane Preparedness Plan is in place (Fisheries Dept., 2002) to ensure protection of life and property during hurricane events, particularly with the distance of Sapodilla Cayes Marine Reserve to the mainland.

SEA has 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 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.

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 SCMR has the human resources, equipment and training for effective surveillance and enforcement	SCMR is fully staffed	SCMR continues to be fully staffed						Ecosystem Management Unit SEA	
Effective demarcation of park boundaries to ensure visual recognition of boundaries at all points	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						Ecosystem Management Unit SEA PA Program Director PA Manager	
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 SCMR 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 SCMR	Effective implementation / enforcement of regulations within non-extractive zones of SCMR	Continued effective implementation / enforcement of regulations within non-extractive zones of SCMR						PA Program Director PA Manager	Ensure that patrols scheduled and implemented on a regular basis (daily if possible)
Implement policies and regulations for all tour boats – requirement for local guides, boat captains, use of mooring points, removal of garbage	Guatemalan and Honduran tour boats seldom 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

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		
Enforce BTB recreational policies 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
Identify hotspot areas, times and visiting fishing boats requiring increased enforcement effort, using SEA and Fisheries Dept. enforcement data, and implement surveillance and enforcement times and locations accordingly	Surveillance and enforcement activities are guided by experience of rangers, but when rangers leave, their knowledge of activity hotspots is lost	Annual maps of enforcement activities are used to guide patrol schedules and locations						PA Program Director PA Manager	
Identify hotspot areas, times and visiting boats / tour operators requiring increased enforcement effort, using SEA enforcement data, and implement enforcement of visitor regulations accordingly	There is little surveillance and enforcement of tourism activities within the SCMR	Increased surveillance and enforcement of tourism activities within the SCMR guided by past hotspots / times for tourism infractions						PA Program Director PA Manager	
Increase night patrols within and outside SCMR	Limited night patrols in the SCMR and adjacent SBRC.	Increased						PA Program Director PA Manager Special Enforcement Unit	Assess limitations for night patrols, equipment / training
Support and uphold Fisheries regulations relevant to maintenance of commercial species	Ongoing	Ongoing						PA Program Director PA Manager Special Enforcement Unit	

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).

Tracking of Management Action Implementation							
Management Actions	**Present Status**	**1st Year**	**2nd Year**	**3rd Year**	**4th Year**	**5th Year**	**Desired Status**
Ensure SCMR has the human resources, equipment and training for effective surveillance and enforcement	SCMR is fully staffed						SCMR continues to be fully staffed
Effective demarcation of park boundaries to ensure visual recognition of boundaries at all points	Boundary marker buoys are far apart, and can be hard for fishermen to see from dories						SCMR continues to be fully staffed
Ensure infrastructure is in place to minimize tourism infractions	Some mooring buoys in place						Boundaries clearly defined by sufficient, highly visible marker buoys
Ensure all SCMR 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.						Information on rules and regulations posted on caye, sufficient mooring buoys in place, dissemination of information on tourism rules and regulations
Ratings: 1: Not started 2: Started, but some limitations to implementation				3. Ongoing but behind schedule 4. On schedule			

Table 28: Criteria for tracking implementation

3.7 Financing

Financing for management of Sapodilla Cayes Marine Reserve is a joint commitment between the Fisheries Department (which currently covers the majority of the costs of on-site surveillance and enforcement) and SEA. Under the co-management agreement, SEA will be taking on more of the financial responsibility for the protected area, though Fisheries Department will continue to retain the entrance fees.

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			
Variable Expenses	102,176	119,060	173,890	138,834	167,518	701,477
Fixed Expenses						
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
Total Fixed Expenses	96,237	50,779	262,740	139,696	279,173	828,625
TOTAL EXPENSES	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 ..), 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.

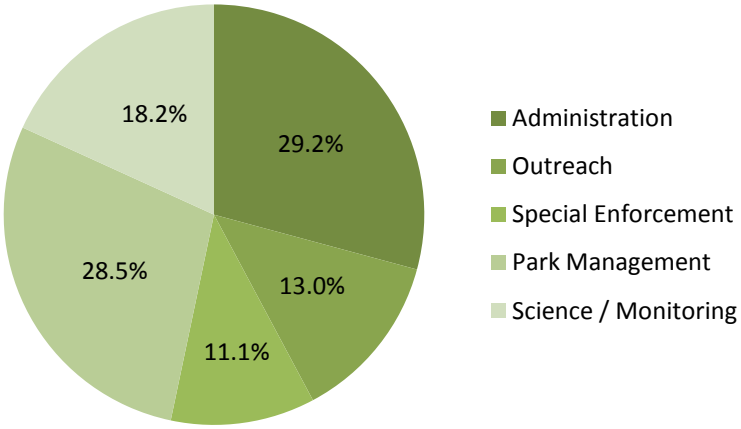


Figure 41: Breakdown of Total Current Expenses per Programme (SEA Financial Plan (Draft) / P. Bravo, 2010)

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 Sapodilla Cayes Marine Reserve through ticket, however, is retained by Fisheries Department, providing them with the funds for maintaining effective ecosystem management and surveillance and enforcement programmes.

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.

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

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

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).

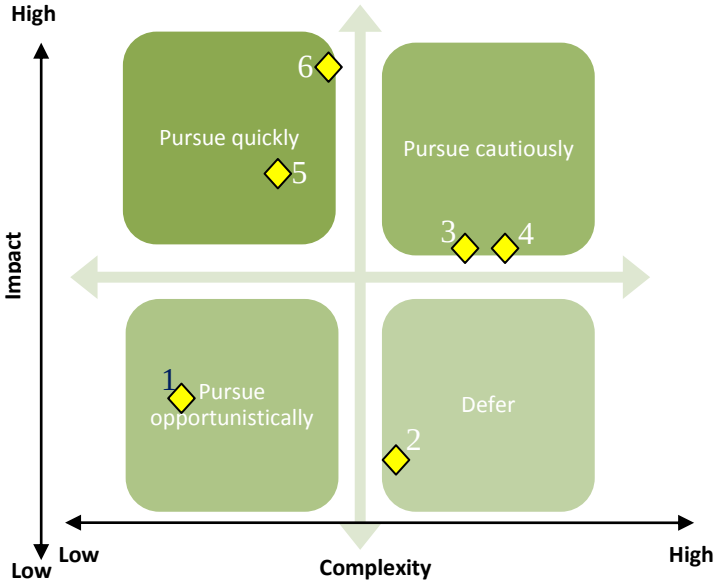
Reducing core costs per programme area through strategic partnerships with national and international organizations is also recommended as a mechanism for increasing financial sustainability, through sharing of costs.

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 42).



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 42: Results of Cost / Benefit analysis based on complexity and impacts

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Annexes

Annex One: SI50 of 2009

BELIZE:

STATUTORY INSTRUMENT

No. 50 of 2009

ORDER made by the Minister responsible for Fisheries in exercise of the power conferred upon him by section 14 of the Fisheries Act, Chapter 210 of the Substantive Laws of Belize, Revised Edition 2000-2003, and all other powers thereunto him enabling.

(Gazetted 11th April, 2009.)

1. The Order may be cited as the

FISHERIES (SAPODILLA CAYES MARINE RESERVE) (AMENDMENT) ORDER, 2009 and shall be read and construed as one with the Fisheries (Sapodilla Cayes Marine Reserve) Order, 1996.

Short title

2. The principal Order is amended by repealing the Schedule and substituting the following

SI 117 of 1996 Amendment of Schedule

SCHEDULE

SAPODILLA CAYES MARINE RESERVE
[Para. 2]

"ALL THAT PORTION of the Caribbean Sea, land and reef known as the Sapodilla Cayes consisting of approximately 38,594 acres and comprising the General Use Zone, Conservation Zone 1, Preservation Zone and Conservation Zone 2 and more fully described as follows:

GENERAL USE ZONE

ALL THAT AREA of the Caribbean Sea and reef except for the areas designated and described below as Conservation Zone 1, Preservation Zone and Conservation Zone 2 comprising

approximately 32,482 acres and commencing at a point A having scaled UTM coordinate of 369498 East and 1791221 North; thence in a Southerly direction to a point B having scaled UTM coordinate of 369498 East and 1787804 North; thence in a Southwesterly direction to a point C having scaled UTM coordinate of 366061 East and 1779812 North; thence in a Southwesterly direction to a point D having scaled UTM coordinate of 363074 East and 1777459 North; thence in a Westerly direction to a point E having scaled UTM coordinate of 359601 East and 1777459 North; thence in a Northwesterly direction to a point F having scaled UTM coordinate of 357210 East and 1779812 North; thence in a Northwesterly direction to a point G having scaled UTM coordinate of 355156 East and 1787804 North; thence in a Northerly direction to a point H having scaled UTM coordinate of 355156 East and 1791221 North; thence in a Easterly direction to the point of commencement.

CONSERVATION ZONE I

ALL THAT AREA comprising sea and reef containing approximately 651 acres commencing at a point P1 having scaled UTM coordinate of 357717 East and 1787569 North; thence in a Southeasterly direction for a distance of approximately 4,121 meters to a point P2 having scaled UTM coordinate of 357839 East and 1783450 North; thence in a Northwesterly direction for a distance of approximately 671 meters to a point P3 having scaled UTM coordinate of 357186 East and 1783608 North; thence in a Northwesterly direction for a distance of\ approximately 3,754 meters to a point P4 having scaled UTM coordinate of 357031 East and 1787358 North; thence in a Northeasterly direction for a distance of approximately 716 meters to the point of commencement.

PRESERVATION ZONE ALL THAT AREA comprising sea and reef containing approximately 548 acres commencing at a point P5 having scaled UTM coordinate of 367722 East and 1786769 North; thence in a Southwesterly direction for a distance of approximately 1,354 meters to a point P6 having scaled UTM coordinate of 367417 East and 1785449 North; thence in a Northwesterly direction for a distance of approximately 1,798 meters to a point P7 having scaled UTM coordinate of 365667 East and 1785859 North; thence in a Northeasterly direction for a distance of approximately 1,588 meters to a point P8 having scaled UTM coordinate of 366507 East and 1787206 North; thence in a Southeasterly direction for a distance of approximately 1,292 meters to the point of commencement.

CONSERVATION ZONE II

ALL THAT AREA comprising sea and reef containing approximately 4,913 acres commencing at a point P6 on the Southeastern boundary of the Preservation Zone having scaled UTM coordinate of 367417 East and 1785449 North; thence in a Southwesterly direction for a distance of approximately 1,355 meters to a point P9 having scaled UTM coordinate of 367320 East and 1784097 North; thence in a Southwesterly direction for a distance of approximately 3,440 meters to a point P10 having scaled UTM coordinate of 365756 East and 1781034 North; thence in a Southwesterly direction for a distance of approximately 4,681 meters to a point P11 having scaled UTM coordinate of 362261 East and 1777920 North; thence in a Northwesterly direction for a distance of approximately 1,639 meters to a point P12 having scaled UTM coordinate of 361258 East and 1779218 North; thence in a Northeasterly direction for a distance of approximately 3,746 meters to a point P13 having scaled UTM coordinate of 363328 East and 1782339 North; thence in a Northeasterly direction to a distance of approximately 4,226 meters to a point P7 being the Southwesterly boundary of the Preservation Zone and having scaled UTM coordinate of 365667 East and 1785859 North; thence in a Southeasterly direction for a distance of approximately 1,798 meters to the point of commencement.

3. This Order comes into force on signature. **Commencement**

MADE by the Minister of Agriculture and Fisheries this
1st day of April 2009.

Minister of Agriculture and Fisheries

Annex 2: SI 117 of 1996

FISHERIES (SAPODILLA CAYES MARINE RESERVE) ORDER
(Section 14)

[31st August, 1996.]

1. This Order may be cited as the

FISHERIES (SAPODILLA CAYES MARINE RESERVE) ORDER. **Short title**

2. The area known as the "Sapodilla Cayes", as more fully described in the Schedule hereto, is hereby declared to be a marine reserve for the purposes of the Fisheries Act. **Declaration of the Marine Reserve. Schedule**

MADE by the Minister of Agriculture and Fisheries this 28th day of August, 1996.

(RUSSELL GARCIA)
Minister of Agriculture and Fisheries

SCHEDULE (Paragraph 2)

SAPODILLA CAYES MARINE RESERVE

ALL THAT portion of the Caribbean Sea being part thereof and being described as follows:

On the North bounded by an East-West line approximately 1,000 m. north of Tom Owen's Caye, on the East, South and West by the Gulf of Honduras therein enclosed, more particularly described as follows:

Commencing at a Point A Northeast of Tom Owen's Caye having scaled UTM coordinates 3 69 498 East 1791 221 North; thence in a general westerly direction to a Point B Northwest of Seal Caye having scaled UTM coordinates 355 156 East 1791 221 North; thence in a general southerly direction to a Point C Southwest of Seal Caye having scaled UTM coordinates 355 156 East 1787 804 North; thence in a general Southeasterly direction to a Point D West of Ragged Caye having scaled UTM coordinates 357 21 0 East 1779 812 North; thence in a general Southeasterly direction to a Point E Southwest of Ragged Caye having scaled UTM coordinates 359 601 East 1777 459 North; thence in a general easterly direction to a Point F Southeast of Ragged Caye having scaled UTM coordinates 363 074 East 1777 459 North; thence in a general northeasterly direction to a point G Southeast of Lime having scaled UTM coordinates 366 061 East 1779 812 North; thence in a general northeasterly direction to a point H having scaled UTM coordinates 369 498 East 1787 804 North; thence in a general northerly direction to the point of commencement.

Annex 3: SI 161 of 2003

FISHERIES (SPAWNING AGGREGATION SITE RESERVES)

ORDER, 2003

ARRANGEMENT OF PARAGRAPHS

_____

SCHEDULE 1

_____

SCHEDULE 2

STATUTORY INSTRUMENT

No. 161 of 2003

ORDER made by the Minister of Agriculture and Fisheries in exercise of the powers conferred upon him by section 14 (1) of the Fisheries Act, Chapter 210 of the Substantive Laws of Belize, Revised Edition 2000, and all other powers thereunto him enabling.

(Gazetted 1st November, 2003)

1. This Order may be cited as the

FISHERIES (SPAWNING AGGREGATION SITE RESERVES) ORDER, 2002

2. The areas specified below, and fully described in Schedule 1 to this Order are hereby declared to be Marine Reserves for the purposes of the Fisheries Act-

Rocky Point, Ambergris Caye
Dog Flea Caye, Turneffe Islands Atoll
Caye Bokel, Turneffe Islands Atoll
Sandbore, Lighthouse Reef Atoll
South Point, Lighthouse Reef Atoll
Emily or Caye Glory
Northern Glover's, Glover's Reef Atoll
Gladden Spit
Rise and Fall Bank, Sapodilla Cayes
Nicholas Caye, Sapodilla Cayes
Seal Caye, Sapodilla Cayes

3. Maps of the Reserves listed in Paragraph 2 above, are set out in Schedule 2 to this Order, and may be seen at the Office of the Fisheries Administrator, Fisheries Department, Belize City.

4. (1) The relevant areas referred to in paragraph 2 shall be closed to all fishing year round in order to protect important fish spawning grounds. (2) The areas referred to in paragraph (1) shall be zoned as Conservation 1 (No Extraction) Zones. Areas listed above in paragraph (2) that are wholly or partially in marine reserves, but not included within any seasonal closure or conservation zone, may be used for limited fishing by traditional users who are designated by, and to the extent recommended by, the co-managers of the respective marine reserve. Fishermen and the type and quantity of fishing so designated shall be approved by the Fisheries Administrator, who shall grant Special Licenses accordingly. (3) Details of the catches made in these areas shall be submitted to the Fisheries Administrator as prescribed by the terms of the license issued.

(4) Licenses will be reviewed on an annual basis, and shall be cancelled for non–compliance or if monitoring results determine that no fishing should be allowed.

5. This Order shall come into force on the 21st day of October, 2003.

MADE by the Minister of Agriculture, Fisheries and Cooperatives this 21 day of October , 2002.

(SERVULO BAEZA)

Minister of Agriculture,
and Fisheries

SCHEDULE 1

SPAWNING AGGREGATION SITE RESERVES

ALL THAT PORTION of the Caribbean Sea, reefs and cayes zoned as Conservation Zone 1 and more fully described (using WGS 84 datum) for each site as follows:

(the following are those relevant to Sapodilla Cayes Marine Reserve)

Rise and Fall Bank, Sapodilla Cayes – Commencing at a point 1, having scaled UTM coordinates 358517 East 1 778 594 North; thence proceeding east for a distance of 2.75 miles to a point 2, having scaled UTM coordinates 362 914 East 1 778 600 North; thence proceeding south for a distance of 2.45 miles to a point 3, having scaled UTM coordinates 362 920 East 1 774 686 North; thence proceeding west for 2.75 miles to a point 4, having scaled UTM coordinates 358 517 East 1 774 686 North; thence proceeding north for 2.44 miles to the point of origin, and encompassing 6.64 square miles.

Nicholas Caye, Sapodilla Cayes – Commencing at a point 1, on the fore reef, and having scaled UTM coordinates 365 615 East 1 783 053 North; thence proceeding east for a distance of 1.13 miles to a point 2, having scaled UTM coordinates 367 425 East 1 783 038 North; thence proceeding south for a distance of 1.75 miles to a point 3, having scaled UTM coordinates 367 430 East 1 780 245 North; thence proceeding on a bearing of 2710 (true bearing) for a distance of 2.15 miles to a point 4, on the east side of Lime Caye, having scaled UTM coordinates 363 984 East 1 780 313 North; thence proceeding on a bearing of 420 (true bearing) for a distance of 1.18 miles to a point 5, having scaled UTM coordinates 365 245 East 1 781 729 North; thence proceeding on a bearing of 160 (true bearing) for a distance of 0.86 miles to the point of origin, and encompassing 2.60 square miles.

Seal Caye, Sapodilla Cayes – Commencing at a point 355 111 East 1 789 940 North; thence proceeding 1.24 miles east to a point 2, having scaled UTM coordinates 357 100 East 1 789 940 North; thence proceeding south for a distance of 2.04 miles to a point 3, having scaled UTM coordinates 357 100 East 1 786 683 North; thence proceeding west for a distance of 1.24 miles to a point 4, having scaled UTM coordinates 355 111 East 1 786 683 North; thence proceeding north for 2.04 miles to the point of origin, and encompassing 2.50 square miles.

Annex 4: Terrestrial Plants of the Sapodilla Cayes (Site visit, P. Walker, 2010)

Common name	Scientific name
Mangrove fern	*Acrostichum aureum*
Lady of the night orchid	*Brassavola nodosa*
Sea rocket	*Cakile lanceolata*
Beach bean	*Canavalea rosea*
Spreading spurge	*Chamaesyce blodgettii*
Upright spurge	*Chamaesyce mesembrianthemifolia*
Cocoplum	*Chrysobalanus icaco*
Seagrape	*Coccoloba uvifera*
Buttonwood	*Conocarpus erecta*
Zericote	*Cordia sebestena*
Flat-spiked sedge	*Cyperus polystachyos*
Trefoil	*Desmodium sp.*
Spike rush	*Eleocharis*
Fig	*Ficus crassinervia (?)*
Moho	*Hibiscus pernambucensis*
Spider lily	*Hymenocallis littoralis*
Beach morning glory	*Ipomea pes-caprae*
White mangrove	*Laguncularia racemosa*
Lantana	*Lantana involucrata*
Provision tree	*Pachira aquatica*
Passionflower	*Passiflora suberosa*
Verbena	*Phyla nodiflora*
Sea purslane	*Portulaca oleracea*
Cough bush	*Pulchea carolinensis*
Mangrove rubber vine	*Rhabdadenia biflora*
Red mangrove	*Rhizophora mangle*
Seaside purslane	*Sesuvium portulacastrum*
Silver bush	*Sophora tomentosa*
Wedelia	*Sphagneticola trilobata*
Bay cedar	*Suriana maritima*
Palmetto	*Thrinax radiata*
Sea lavender	*Tournefortia gnaphalodes*
Wild cow pea	*Vigna luteola*

Plant Species of Sapodilla Cayes (cont.)

Exotics	
Neem	*Azadirachta indica*
Australian pine	*Casuarina equisetifolia*
Coconut	*Cocos nucifer*
Lupin-type yellow pea	*Crotalaria sp.?*
Morning glory	*Ipomea indica*
Noni	*Morinda citrifolia*
Fan flower	*Scaevola plumieri*
Indian almond	*Terminalia catappa*

Annex 5: Marine Plants (SCMR Draft Management Plan)

Seagrasses

Thalassia testudinum
Syringodium filiforme

Marine Algae

Rhodophyta

Calfified encrusting
Sheetlike
Coarse branched
Encrusting
Wrangelia argus
Halymenia floresia
Filamentous
Fine branched
Calcified
Amphiroa spp.
Liagora spp.
Kallymenia limminghei

Phaeophyta

Dictyota spp
Sargassum spp
Turbinaria turbinara
Padina stypopodium
Lobophora variegata
Sargassum hystrix
Padina gymnospora

Chlorophyta

Uva spp
Caulerpa spp
Caulerpa cupressoides
Rhipocephalus phoenix
Penicillus dumetosus
Penicillus pyriformis
Cladocephalus luteofuscus
Udotea occidentalis
Halimeda incrassata
Halimeda opuntia
Halimeda copiosa
Halimeda discoidea
Ventricaria ventricosa
Acetabularia spp
Caulerpa paspaloides
Caulerpa prolifera
Penicillus capitatus
Avrainvillae spp
Udotea flabellum
Udotea wilsonii
Udotea cyathiformia
Halimeda monile
Halimeda goreaui
Halimeda tuna
Cladophora prolifera
Enteromorpha flexuosa

Fish Species of Sapodilla Cayes Marine Reserve (Preliminary List, SEA, 2010)			
Family	**Species**	**Common name**	**IUCN**
Acanthuridae	*Acanthurus bahianus*	Ocean surgeonfish	
	Acanthurus chirurgicus	Doctorfish	
	Acanthurus coerulus	Blue tang	
Albulidae	*Albula vlupes*	Bonefish	
Apogonidae	*Apogon bintatus*	Barred Cardinalfish	
	Apogon lachneri	Whitestar cardinalfish	
	Apogon maculatus	Flamefish	
	Apogon townsendi	Twospot cardinalfish	
	Apogon robinsi	Roughlip Cardinalfish	
	Apogon stellatus	Conchfish	
Aulostomidae	*Aulostomus maculatus*	Trumpetfish	
Balistidae	*Aluterus schoepfi*	Orange filefish	
	Balistes capriscus	Gray triggerfish	
	Balistes vetula	Queen triggerfish	VU
	Cantherdermis sufflamen	Ocean triggerfish	
	Cantherhines macrocerus	Whitespotted filefish	
	Cantherhines pullus	Orangespotted filefish	
	Melichthys niger	Black durgon	
	Monocanthus tuckeri	Slender filefish	
	Xanthichthys ringens	Sargassum triggerfish	
Batrachoides	*Batrachoides gilberti*	Large eye toadfish	
	Sanopus barbatus	Bearded toadfish	
	Sanopus greenfieldorum	Whitelined toadfish	VU
	Sanopus splendidus	Splendid toadfish	VU
Belonidae	*Ablennes hiannes*	Flat needlefish	
	Strongylura notata	Redfin needlefish	
	Tylosurus crocodilus	Houndfish	
Bothidae	*Bothus lunatus*	Peacock flounder	
Carangidae	*Caranx batholomaei*	Yellow jack	
	Caranx crysos	Blue runner	
	Caranx hippos	Crevalle jack	
	Caranx latus	Horse-eye jack	
	Caranx lugubris	Black jack	
	Caranx ruber	Bar jack	
	Decapterus macarellus	Mackerel scad	
	Elagatis bipinnulata	Rainbow runner	
	Trachinotus falcatus	Permit	
	Trachinotus goodei	Palometa	
Carcharhinidae	*Carcharhinus leucas*	Bull shark	
	Carcharhinus limbatus	Blacktip shark	

Fish Species of Sapodilla Cayes Marine Reserve (Preliminary List, SEA, 2010)			
Family	**Species**	**Common name**	**IUCN**
Carcharhinidae	*Carcharhinus perezi*	Caribbean Reef Shark	
	Carcharhinus falciformis	Silky shark	
	Carcharhinus acronotus	Blacknose shark	
	Galeocerdo cuvier	Tiger Shark	
	Negaprion brevirostris	Lemon shark	
	Rhizoprionodon porosus	Caribbean Sharpnosed shark	
	Carcharhinus brevipinna	Spinner Shark	
	Carcharhinus galapagensis	Galapagos shark	
Centropomidae	*Centropomus undecimalis*	Common snook	
Chaenopsidae	*Emblemariopsis dianae*	Orangeflag blenny	
Chaetodontidae	*Chaetodon aculeatus*	Longsnout	
	Chaetodon capistratus	Foureye butterflyfish	
	Chaetodon ocellatus	Spotfin butterflyfish	
	Chaetodon sedentarius	Reef butterflyfish	
	Chaetodon striatus	Banded butterflyfish	
Cirrhitidae	*Amblycirrhitus pinos*	Red-spotted hawkfish	
Clinidae	*Acanthemblemaria spinosa*	Spinyhead blenny	
	Chaenopsis ocellata	Bluethroat pike blenny	
	Emblemaria pandionts	Sailfin blenny	
	Lucayablennius zingaro	Arrow blenny	
	Malacoctenus boehlkei	Diamond blenny	
	Malacoctenus macropus	Rosy blenny	
	Malacoctenus triangulatus	Saddled blenny	
	Ophioblennius atlanticus	Redlip blenny	
Congridae	*Heteroconger halis*	Garden eel	
Dasyatidae	*Dasyatis americana*	Southern stingray	
	Dasyatis gutatta	Longnose stingray	
	Himantura schmardae	Chupare stingray	
Diodontidae	*Diodon holocanthus*	Balloonfish	
	Diodon hystrix	Porcupinefish	
Echeneidae	*Echeneis neucratoides**	Whitefin sharksucker	
Elopidae	*Megalops atlanticus*	Tarpon	
Ephippidae	*Chaetodipterus faber*	Atlantic spadefish	
Exocoetidae	*Hirundichthys speculiger*	Mirrorwing flyingfish	
Gerreidae	*Eucinostomus lefroyi*	Mottled mojarra	
	Gerres cinereus	Yellowfin mojarra	
Ginglymostomidae	*Ginglymostoma cirratum*	Nurse shark	
Gobiesocidae	*Tomicodon briggsi*		
	Tomicodon clarkei		
	Tomicodon lavettsmithi		

Fish Species of Sapodilla Cayes Marine Reserve (Preliminary List, SEA, 2010)			
Family	**Species**	**Common name**	**IUCN**
Gobiidae	*Ctenogobius saepapellans*	Dash goby	
	Coryphopterus dicrus	Colon goby	
	Coryphopterus eidolon	Pallid goby	
	Coryphopterus galucofraenum	Bridled goby	
	Coryphopterus lipernes	Peppermint goby	
	Coryphopterus personatus	Masked goby	
	Gnatholepsis thompsoni	Goldspot goby	
	Gobionellus saepepallens	Dash goby	
	Gobiosoma dilepsis	Orangesided goby	
	Gobiosom evelynae	Sharknose goby	
	Gobiosoma genie	Cleaning goby	
	Gobiosoma horsti	Yellowline goby	
	Gobiosoma illecebrosum	Barsnout goby	
	Gobiasoma prochilos	Broadstripe goby	
	Elacatinus colini		
	Elacatinus lobeli		
	Elacatinus lori		
	Lophogobius cyprinoides	Crested goby	
Gramistinidae	*Gramma loreto*	Fairy basslet	
	Gramma melacara	Blackcap basslet	
	Liopropoma rubre	Peppermint basslet	
Haemulidae	*Anisotremus surinamensis*	Black margate	
	Anisotremus virginicus	Porkfish	
	Haemulon album	White margate	
	Haemulon aurolineatum	Tomtate	
	Haemulon carbonarium	Caesar grunt	
	Haemulon chrysargyreum	Smallmouth grunt	
	Haemulon flavolineatum	French grunt	
	Haemulon macrostomum	Spanish grunt	
	Haemulon melanurum	Cottonwick	
	Haemulon parra	Sailor's choice	
	Haemulon plumieri	White grunt	
	Haemulon sciurus	Bluestriped grunt	
	Haemulon striatum	Striped grunt	
Hemiramphidae	*Hemiramphus brasiliensis*	Ballyhoo	
Holocentridae	*Holocentrus adscensionis*	Squirrelfish	
	Holocentrus rufus	Longspine squirrelfish	
	Sargocentron coruscum	Reef squirrelfish	
	Sargocentron vexillarium	Dusky squirrelfish	
	Myripristis jacobus	Blackbar soldierfish	

Fish Species of Sapodilla Cayes Marine Reserve (Preliminary List, SEA, 2010)			
Family	**Species**	**Common name**	**IUCN**
Holocentridae	*Neoniphon marianus*	Longjaw squirrelfish	
	Priacanthus arenatus	Bigeye	
Inermiidae	*Emmelichthyops atlanticus*	Bonnetmouth	
	Inermia vittata	Boga	
Kyphosidae	*Kyphosus sectatrix*	Bermuda chub	
Labridae	*Bodianus pulchellus*	Spotfin hogfish	
	Bodianus rufus	Spanish hogfish	
	Clepticus parrae	Creole wrasse	
	Doratonatus megalepis	Dwarf wrasse	
	Halichoeres bivittatus	Slippery dick	
	Halichoeres cyanocephalus	Yellowcheek wrasse	
	Halichoeres garnoti	Yellowhead wrasse	
	Halichoeres maculipinna	Clown wrasse	
	Halichoeres radiatus	Puddingwife	
	Hemipteronotus novacula	Pearly razorfish	
	Lachnolaimus maximus	Hogfish	VU
	Thalassoma bifasciatum	Bluehead wrasse	
	Xyrichtys martinicensis	Rosy razorfish	
	Xyrichtys spendens	Green razorfish	
Labridomidae	*Malacoctenus triangulatus*	Saddled blenny	
Lutjanidae	*Lutjanus analis*	Mutton snapper	VU
	Lutjanus apodus	Schoolmaster	
	Lutjanus cyanopterus	Cubera snapper	VU
	Lutjanus griseus	Grey Snapper	
	Lutjanus jocu	Dog snapper	
	Lutjanus mahogani	Mahogany snapper	
	Lutjanus synagris	Lane Snapper	
	Ocyurus chrysurus	Yellowtail snapper	
Malacanthidae	*Malacanthus plumieri*	Sand tilefish	
Mobulidae	*Manta birostris*	Atlantic manta	
	Mobula hypostoma	Devil ray	
Monacanthidae	*Cantherhines pullus*		
	Cantherhines macrocerus	Whitespotted filefish	
	Aluterus scriptus	Scrawled Filefish	
Muglidae	*Mugil curema*	White mullet	
Mullidae	*Mulloidiochthys martinicus*	Yellow goatfish	
	Pseudopeneus maculatus	Spotted goatfish	
Muraenidae	*Enchelycore carychroa*	Chestnut moray	
	Gymnothorax funebris	Green moray	
	Gymnothorax miliaris	Goldentail moray	

Fish Species of Sapodilla Cayes Marine Reserve (Preliminary List, SEA, 2010)			
Family	**Species**	**Common name**	**IUCN**
Muraenidae	*Gymnothorax moringa*	Spotted moray	
	Gymnothorax vicinus	Purplemouth moray	
Myliobatidae	*Aetobatus narinari*	Spotted eagle ray	
Ogcocephalidae	*Ogcocephalus nasutus*	Shortnose batfish	
Ophicthidae	*Myrichthys breviceps*	Sharptail eel	
Opisthognatidae	*Opistognathus aurifrons*	Yellowhead jawfish	
	Opistognathus macrognathus	Banded jawfish	
	Opistognathus whitehurstii	Dusky jawfish	
Ostraciidae	*Acanthostracion polygonia*	Honeycomb cowfish	
	Acanthostracion quadricornis	Scrawled cowfish	
	Lactophrys bicaudalis	Spotted trunkfish	
	Lactophrys trigonus	Buffalo trunkfish	
	Lactophrys triqueter	Smooth trunkfish	
Pempheridae	*Pempheris schomburgki*	Glassy sweeper	
Pomacanthidae	*Holacanthus ciliaris*	Queen angelfish	
	Holacanthus tricolor	Rock beauty	
	Pomacanthus arcuatus	Grey angelfish	
	Pomacanthus paru	French angelfish	
	Holacanthus ciliaris	Queen angelfish	
Pomacentridae	*Abudefduf saxatilis*	Sergeant major	
	Abudefduf taurus	Night sergeant	
	Chromis cyanea	Blue chromis	
	Chromis insolata	Sunshinefish	
	Chromis multilineata	Brown chromis	
	Microspathodon chrysurus	Yellowtail damselfish	
	Stegastes diencaeus	Longfin damselfish	
	Stegastes adustus[9]	Dusky damselfish	
	Stegastes leucostictus	Beaugregory	
	Stegastes partitus	Bicolor damselfish	
	Stegastes planifrons	Threespot damselfish	
	Stegastes variabilis	Cocoa damselfish	
Priacanthidae	*Priacanthus arenatus*	Bigeye	
	Priacanthus cruentatus	Glasseye snapper	
Rhincodontidae	*Rhincodon typus*	Whale shark	
Scaridae	*Scarus coelestinus*	Midnight parrotfish	
	Scarus coeruleus	Blue parrotfish	
	Scarus guacamaia	Rainbow parrotfish	VU
	Scarus iserti	Striped parrotfish	

[9] Formerly classified as *S. fuscus*, but now considered to be a separate species

Fish Species of Sapodilla Cayes Marine Reserve (Preliminary List, SEA, 2010)			
Family	**Species**	**Common name**	**IUCN**
Scaridae	*Scarus taeniopterus*	Princess parrotfish	
	Scarus vetula	Queen parrotfish	
	Sparisoma atomarium	Greenblotch parrotfish	
	Sparisoma aurofrenatum	Redband parrotfish	
	Sparisoma chrysopterum	Redtail parrotfish	
	Sparisoma radians	Bucktooth parrotfish	
	Sparisoma rubripinne	Yellowtail parrotfish	
	Sparisoma viride	Stoplight parrotfish	
	Cryptotomus roseus	Bluelip parrotfish	
Sciaenidae	*Equetus acuminatus*	Highhat	
	Equetus punctatus	Spotted drum	
	Equetus umbrosus	Cubbyu	
	Odontoscion dentex	Reef croaker	
Scombridae	*Scomberomorus regala*	Cero	
Scorpaenidae	*Scorpaena plumieri*	Spotted scorpionfish	
Serranidae	*Alphestes afer*	Mutton hamlet	
	Cephalopholis fulvus	Coney	
	Cephalopholis s cruentatus	Graysby	
	Epinephelus adscensionis	Rock hind	
	Epinephelus guttatus	Red hind	
	Epinephelus inermis	Marbled grouper	
	Epinephelus itajara	Goliath grouper	CR
	Epinephelus morio	Red grouper	
	Epinephelus striatus	Nassau grouper	EN
	Hypoplectrus aberrans	Yellowbelly hamlet	
	Hypoplectrus chlorurus	Yellowtail hamlet	
	Hypoplectrus gemma	Blue hamlet	
	Hypoplectrus gummingatta	Golden hamlet	
	Hypoplectrus guttavarius	Shy hamlet	
	Hypoplectrus indigo	Indigo hamlet	
	Hypoplectrus nigricans	Black hamlet	
	Hypoplectrus puella	Barred hamlet	
	Hypoplectrus unicolor	Butter hamlet	
	Mycteroperca bonaci	Black grouper	
	Mycteroperca interstitialis	Yellowmouth grouper	
	Mycteroperca rubra	Comb grouper	
	Mycteroperca tigris	Tiger grouper	
	Mycteroperca venenosa	Yellowfin grouper	
	Paranthias furcifer	Creole-fish	
	Rypticus saponaceus	Greater soapfish	

Fish Species of Sapodilla Cayes Marine Reserve (Preliminary List, SEA, 2010)			
Family	**Species**	**Common name**	**IUCN**
	Serranus baldwini	Lantern bass	
	Serranus flaviventris	Two-spot bass	
	Serranus tabacarius	Tobaccofish	
	Serranus tigrinus	Harlequin bass	
	Serranus tortugarium	Chalk bass	
Sparidae	*Calamus bajonado*	Jolthead progy	
	Calamus calamus	Saucereye porgy	
Sphyraenidae	*Sphyraena barracuda*	Barracuda	
	Sphyraena picudilla	Southern sennet	
Sphyrnidae	*Sphyrna mokarran*	Great Hammerhead	
	Sphyrna lewini	Scalloped hammerhead	
	Sphyrna tiburo	Bonnethead	
Sygnathidae	*Cosmocampus elucens*	Shorthorn pipefish	
	Hippocampus erectus	Northern seahorse	VU
Synbranchidae	*Ophisternon aenigmaticum*	Obscure swamp eel	
Synodontidae	*Synodus intermedius*	Sand diver	
	Synodus saurus	Bluestriped lizardfish	
Tetraodontidae	*Canthigaster rostrata*	Sharpnose puffer	
	Chilomycterius antennatus	Bridled burrfish	
	Chilomycterius antillarum	Web burrfish	
	Diodon holocanthus	Ballonfish	
	Diodon hystrix	Porcupinefish	
	Sphoeroides spengleri	Bandtail puffer	
	Sphoeroides testudineus	Checkered pufferfish	
Triakidae	*Mustelus canis*	Dusky smooth hound	
Triglidae	*Prionotus ophryas*	Bandtail searobin	
Tripterygiidae	*Enneanectes altivelis*	Lofty tripletail	
	Enneanectes atrorus	Blackedge triplefin	
Urolophidae	*Urolophus jamaicensis*	Yellow stingray	