

Corozal Bay Wildlife Sanctuary

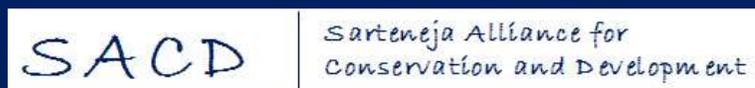
Management Plan – Final Draft

2013 - 2018



Prepared for:

Sarteneja Alliance for Conservation and Development



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SACD

Corozal Bay Wildlife Sanctuary Management Plan

2013 - 2018

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Introduction

Background and Context

Situated in the north east of Belize, Corozal Bay Wildlife Sanctuary was established in 1998 as part of Belize's National Protected Areas System, principally to provide protection for the large population of West Indian manatee (*Trichechus manatus*) utilizing the waters. This national protected area encompasses approximately 178,000 acres (72,000 hectares) of the Belize portion of the Mesoamerican Reef's largest estuarine system, and much of the northern shelf lagoon behind Ambergris Caye. The Wildlife Sanctuary status is equivalent to **IUCN Category IV**, designated for management mainly for conservation through management intervention.

The Wildlife Sanctuary has been identified as an important transboundary drainage system, shared by Mexico and Belize, and one of the principle areas with transboundary issues (GEF, 2001¹). SACD is working to strengthen the transboundary collaboration with Santuario de Manati. Fishing pressure within the bay is high, both for commercial fishing and sport fishing, being a premier destination for targeting tarpon, bonefish, and other sportfish. Tourism is low, but growing.

The boundaries of Corozal Bay Wildlife Sanctuary are defined by Statutory Instrument 48 of 1998, with its northern border following the Belize Mexico border. The protected area is defined by the high water mark rather than the 66' used in a number of other protected areas in Belize, and therefore does not include cayes within the Wildlife Sanctuary, which has implication on the ability to protect coastal and caye mangroves, important as bird nesting sites, storm barriers and as protective nurseries for many fish species.

Although Corozal Bay Wildlife Sanctuary was declared as a protected area in 1998, it was a classic example of a 'paper park' until 2008, when the first steps were taken towards increasing the management effectiveness of the protected area. This was through the establishment of the Sarteneja Alliance for Conservation and Development (SACD) - a community-based, organization, with its office in Sarteneja.

Since 2008, SACD has developed its Natural Resource Management and Education Programmes, and is now working on the framework for its Research and Monitoring Programme. The organization has identified and prioritised a series of conservation targets and threats to guide its management decisions, working closely with its primary stakeholders, and engaging them in management decisions and activities.

¹ **GEF (2001)**. Regional Project for the Conservation and Sustainable Use of the Mesoamerican Barrier Reef System (MBRS). Project document, May 2001

This Management Plan provides the background information for informed management decisions, and a structured framework of activities to assist the co-management organization, the Sarteneja Alliance for Conservation and Development, in working with the Forest Department, the legislated management body, and other partners to implement effective conservation management.

Purpose and Scope of Plan

The management of Corozal Bay is guided by its categorization as a Wildlife Sanctuary - the Corozal Bay Wildlife Sanctuary, designated under the National Park Systems Act of 1981 (Chapter 215, Laws of Belize, Revised Edition 2000), being set aside:

“for the protection of nationally significant species, biotic communities or physical features.”.

This is the first management plan to be developed for the protected area, and has been prepared to fit within the framework required by the National Protected Area Policy and System Plan (NPAPSP, 2006). Originally drafted in 2009, it has more recently been updated for submission to Forest Department as a requirement of the organization’s commitment to co-management. It includes general information on the physical and biological attributes of the Wildlife Sanctuary, documents the current uses and management problems, defines the goals and objectives of management for the protected area, summarises conservation planning, outlines specific management programmes, sets in place the means for measuring management effectiveness, and recommends an implementation schedule.

In line with NPAPSP recommendations, this Management Plan has been prepared with the input of the various stakeholders through community meetings, meetings with the Sarteneja Alliance for Conservation and Development (who are currently finalizing an interim co-management agreement (2012)), and interviews with a wide variety of individuals, including fishermen, the tourism sector, and visitors, and seeks to protect the resources of the area while establishing a mechanism for continued, more sustainable harvesting of local fish stocks by traditional fishermen, and economic benefit for the communities through environmentally sustainable tourism. The management programmes are based on the best available data and scientific knowledge, with the integration of conservation planning strategies.

The management plan, submitted to Forest Department, is designed to guide the management of the Wildlife Sanctuary through the next five years (2013 to 2018), providing a framework for both broad management activities as well as more specific research and monitoring activities. Detailed operational plans will be developed on an annual basis by Forest Department and the Sarteneja Alliance for Conservation and Development, based on the framework provided by this management plan. In addition an annual review of implementation success will allow for adaptive management over the five year period.

1. Current Status

1.1 Location

Situated in the north east of Belize, Corozal Bay Wildlife Sanctuary was established in 1998 under the National Park Systems Act of 1981, as part of Belize's National Protected Areas System, and as part of a transboundary protected area, twinned with the Santuario del Manati of Mexico, following Belize /Mexico bilateral agreements. This national protected area encompasses approximately 178,000 acres (72,000 hectares) of the Belize portion of the estuary system, and much of the northern shelf lagoon behind Ambergris Caye.

The boundaries of Corozal Bay Wildlife Sanctuary are defined by Statutory Instrument 48 of 1998 (Map 1). The protected area is defined by the high water mark rather than the 66' used in a number of other protected areas in Belize, and does not include cayes within the Wildlife Sanctuary, which has implication on the ability to protect coastal and caye mangroves, important as bird nesting sites, storm barriers and as protective nurseries for many fish species. The boundaries of Corozal Bay Wildlife Sanctuary are contiguous with those of Bacalar Chico Marine Reserve to the east, and the Santuario del Manati of Mexico to the north.

The Wildlife Sanctuary, part of the largest estuary in the region, has a very shallow water depth of 1 to 7m with an average depth of 3 m (Kramer & Kramer, 2002). The bottom is predominantly covered with fine mud and algae and localized seagrass beds of seagrass - *Thalassia testudinum* and *Halodule wrightii*. Numerous coastal lagoons with inlets, mangrove forests, and salt marshes are connected to the bay and a number of fresh water rivers, including Río Hondo and New River, discharge into it (Morales et al., 2000). Several communities are situated around the Wildlife Sanctuary. The largest is Chetumal, in the state of Quintana Roo, in Mexico, with a population of more than 150,000. A number of smaller towns and villages also lie on the Belize coast - Corozal (pop: 9,100²), Copper Bank (approx. pop: 525³), Chunox (approx. pop: 1,400⁴), and Sarteneja (approx. pop: 2,000⁵).

The protected area can be accessed from within Belize by road, sea and air – the main departure points are Corozal, Sarteneja, and San Pedro. All three are accessible by road and air, with boat access from all coastal communities, and from the adjacent Mexican waters near Chetumal.

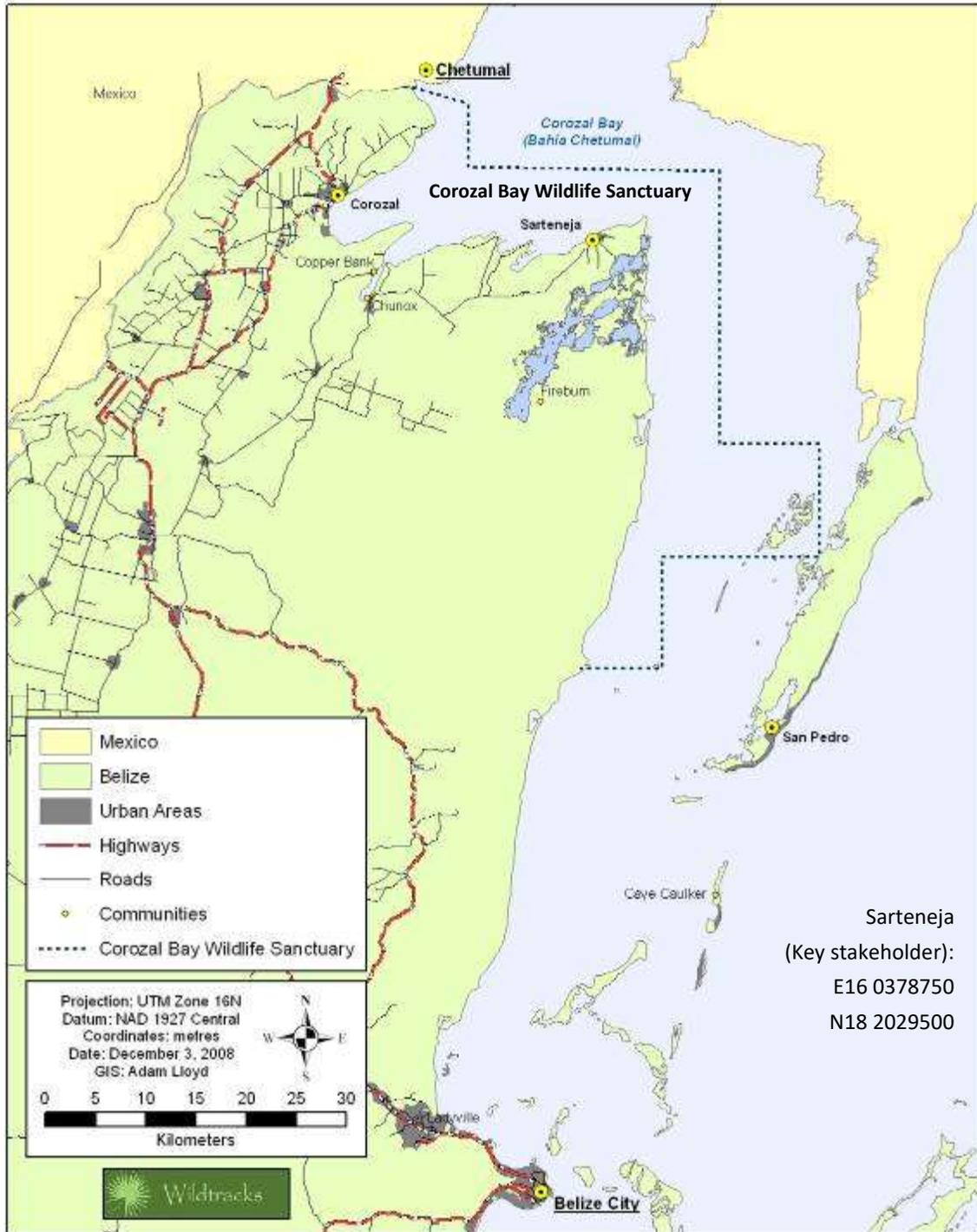
The Sarteneja Alliance for Conservation and Development (SACD), as the provisional co-management agency, has an office on the Sarteneja seafont. There is no Forest Department infrastructure associated with Corozal Bay Wildlife Sanctuary.

² Abstract of Statistics, 2007. Statistical Institute of Belize

³ Chairman, Copper Bank

⁴ Chairman, Chunox

⁵ Health Centre, Sarteneja



Map 1: Location of Corozal Bay Wildlife Sanctuary

1.2 Regional Context

Corozal Bay Wildlife Sanctuary lies within Mesoamerica, a region highlighted as a world ‘hotspot for species diversity’ (Conservation International, 2003), and considered critical for the preservation of the biodiversity of the Western Hemisphere. Here, the Nearctic bioregions of North America converge with the Neotropical bioregions of South America, and, in Belize, in particular, also with the Greater Antillean bioregion of the Caribbean. Each of these three bring a unique assemblage of fauna and flora which has resulted in a particularly rich biodiversity, with components of all three regions being represented within the Central American land bridge and adjacent waters.

Corozal Bay Wildlife Sanctuary is the largest estuary in the Mesoamerican reef system, the longest barrier reef in the Western Hemisphere, with an assemblage of ecosystems of great socio-economic and scientific value, and important for many species of conservation concern - among them the threatened Antillean manatee (*Trichechus manatus manatus*). The coastal zone of Belize is home to the largest recorded number of West Indian manatee within the species' Caribbean range, with Corozal Bay supporting a relatively high population density within the region, estimated at 800 to 1,000 (Auil 1998; Morales-Vela et al. 2000).

Ecoregional Prioritization: The Wildlife Sanctuary has been categorised as a High Priority area with “a moderate capacity to adjust and recover from future disturbances” (Kramer & Kramer, 2002⁶), though it is recognized that some intervention is necessary to maintain ecosystem integrity and functionality. The area has also been identified as an important transboundary drainage system, shared by Mexico and Belize, and one of the principle areas with transboundary issues (GEF, 2001⁷). Corozal Bay was also highlighted as a priority site under the recent Ecoregional Assessment of the Mesoamerican Reef (Arrivillaga et. al., 2008⁸), based on the importance of the estuarine system, manatee habitat, and extensive mangrove systems (particularly on the East Coast).

The coastal zone of Belize is home to the largest recorded number of West Indian manatee within the species' Caribbean range, with the sheltered waters of Corozal Bay being highlighted within the region as particularly important for mating and calving (Auil 1998; Morales-Vela et al. 2000). The area also supports numerous wading birds, providing outstanding nesting and foraging habitat (Kramer & Kramer, 2002). Adjacent to the Sanctuary, just south of Deer Caye, Little Guana Caye was established as a bird sanctuary under the National Lands Act, in 1977, for the presence of the largest nesting colony of reddish egrets in the Caribbean and is also known to have nesting white ibis, tri-colored herons, and roseate spoonbills (Kramer & Kramer, 2002). Los Salones, a second of the seven

⁶ **Kramer P.A. and P.R. Kramer**, (2002). Ecoregional Conservation Planning for the Mesoamerican Caribbean Reef, WWF, Edited by McField M.

⁷ **GEF (2001)**. Regional Project for the Conservation and Sustainable Use of the Mesoamerican Barrier Reef System (MBRS). Project document, May 2001

⁸ **Arrivillaga A. and N. Windevoxhel (2008)**. Mesoamerican Reef Ecoregional Assessment: Marine Conservation Plan. The Nature Conservancy.

bird sanctuaries established under the same Act, lies just south of the southern boundary, and is a major nesting site for Roseate Spoonbills. Immediately adjacent to the Sanctuary, protected islands in Shipstern Lagoon support two nesting colonies of woodstorks, and a third lies in Bennett's Lagoon in the Bulkhead area adjacent to the eastern coastline of Belize.

The shallow bay also provides a protected nursery habitat for a variety of fish and invertebrates species. Juvenile bull shark use the area when young. Similarly, Bonnethead sharks, which once congregated in the Bay, have also suffered from high fishing pressure. Although the critically endangered sawfish once also aggregated in this area, it was presumed to have been fished to local extinction (Gall, 2006, pers.com.), though recently, several reports suggest that a remnant population may exist in the shallow coastal lagoons that flow into the southern end of the Wildlife Sanctuary.

The area has been identified by the World Bank MBRS GEF Report (2001) as being one of the principal areas with transboundary issues. Corozal Bay has an important transboundary drainage system, shared by Mexico and Belize. Degrading water quality and pollution associated with urbanization have been identified by the WWF Mesoamerican Reef Biodiversity Report as potentially the greatest threats to the area. In the past, Chetumal has discharged 200 cubic meters of untreated sewage into the bay each day (FAO, 2000), and still has an overloaded sewage system that only copes with a third of the sewage discharged (Ecosur, pers. com. 2010), and approximately 2,500 gallons of liquid wastes were reported as being discharged annually from sugar refining and rum distilling operations on the New River in Belize (UNEP, 1994) – though since that time, efforts have been made to mitigate many of these impacts. Because of the lack of flushing or strong currents, the bay acts as a catchment for accumulating contaminants.

Conservation of the Corozal Bay Wildlife Sanctuary contributes towards fulfilling Belize's international commitments under the **Convention on Biological Diversity**, signed in 1992, and a number of other conventions to which Belize is a signatory (Table 1).

Table 1: International Conventions and Agreements of Relevance to Corozal Bay Wildlife Sanctuary	
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 <i>CBWS provides an important and integral part in the national protected areas system, protecting biodiversity and threatened species, as per Belize’s commitment under the CBD.</i>
Alliance for the Sustainable Development of Central America (ALIDES) (1994)	Regional alliance supporting sustainable development initiatives. <i>Initiatives by SACD, a community NGO working in Sarteneja, one of the stakeholder communities of CBWS are targeted at stimulating sustainable economic and environmental development</i>
Central American Commission for Environment and Development (CCAD) (1989)	Regional organisation of Heads of State formed under ALIDES, responsible for the environment of Central America. Initiated Mesoamerican Biological Corridors and Mesoamerican Barrier Reef Systems Programmes.
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. <i>CBWS provides an important and integral part in the national protected areas system, protecting biodiversity and threatened species, as per Belize’s commitment under this Convention.</i>

There is a need to coordinate conservation efforts with those of regional and global initiatives such as the ALIDES Meso-American Biological Corridors Programme, and the Climate Change Programme, with an emphasis on international collaboration and a strong commitment to technological transfer between nations.

1.3 National Context

1.3.1 Legal and Policy Framework

Corozal Bay was designated in 1998 as the Corozal Bay Wildlife Sanctuary (SI 48 of 1998) under the National Parks System Act (1981) following recognition of its importance for the Antillean, or West Indian, manatee (*Trichechus manatus*).

The Wildlife Sanctuary is one of five distinct categories of protected areas under the National Parks System Act of 1981, each of which is protected by restrictions strictly defined by law. The Wildlife Sanctuary designation is for the protection of nationally significant species, biotic communities or physical features, and allows for research, tourism and education but no extractive activities.

Wildlife Sanctuaries in Belize

Agua Caliente Luha Wildlife Sanctuary
Cockscomb Basin Wildlife Sanctuary
Corozal Bay Manatee Sanctuary
Crooked Tree Wildlife Sanctuary
Gales Point Manatee Sanctuary
Spanish Creek Wildlife Sanctuary
Swallow Caye Wildlife Sanctuary

At present, Belize has over 2.6 million acres (46% of the country) of its area under some form of protection (CSO, 2000) – either as national or private protected areas. Corozal Bay Wildlife Sanctuary is one of seven Wildlife Sanctuaries created within Belize under the National Parks System Act of 1981.

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

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

Whilst being managed under the Forest Department, Corozal Bay Wildlife Sanctuary is considered to be one of the 13 marine protected areas totaling 608,742 acres within the national protected areas system. Five of these are designated under the Forest Department (Table 2), the remaining eight are Marine Reserves, administered under Fisheries Department.

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

Table 2: Marine Protected Areas of Belize

Also contributing to the conservation framework of Belize are a number of laws designed to protect wildlife and national heritage. The Fisheries Act, 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. Marine turtles have been given protection since the original Fisheries Ordinance in 1940. The Environmental Protection Act (1992) was developed under the Department of the Environment, a department of the Ministry of Natural Resources, with the aim of ensuring that development initiatives within Belize are planned for minimum environmental impact – in the context of Corozal Bay Wildlife Sanctuary, this is particularly important when ensuring that the impacts from development taking place on the coast – particularly mangrove clearance and dredging - within the Wildlife Sanctuary are minimized. Any major coastal development requires an Environmental Impact Assessment, resulting in the production of an Environmental Compliance Plan, approved and theoretically monitored by the Department of Environment.

Also under the Ministry of Natural Resources is the Forest (Protection of Mangrove) Regulations (SI 52 of 1989, currently being revised, 2009), provides for the protection of mangroves, with restrictions on mangrove alteration and / or clearance without permission. There is currently a moratorium on the clearance of mangroves, though to date there is considered to be a lack of awareness among property developers, and until recently, there has been no monitoring or enforcement of land use change in coastal mangrove. Before granting a permit for mangrove alteration, Belize law requires the Forest Department 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 (a) that the proposed alteration will not significantly lower or change water quality or (b) that the degradation of water quality is in the "larger and long-term interest of the people of Belize." (Chapter 213, Section 5.5, of Belize's Forest Act).

The Wildlife Protection Act (Chapter 220, SI 12 of 1982, revised 2000) also falls under the Forest Department, and provides protection for a number of marine species (including West Indian Manatee and dolphins), with the regulation of hunting and commercial extraction.

Whilst the above are the legislative Acts most relevant to the Corozal Bay Wildlife Sanctuary, there are others - such as the Mines and Minerals Act (1989) and the Petroleum Act (1991), which regulate the exploration and extraction of non-renewable resources. These Acts control activities including dredging, prospecting and drilling. A number of small dredging operations have taken place in the past for the creation of marinas, and Corozal Bay has also been the site of previous oil exploration activities in the early 1970's, with reports of massive associated fish, dolphin and manatee kills as a result of seismic testing. It lies within a current oil exploration concession area.

The Port Authority is mandated to ensure the safety of navigational channels, through the installation of navigational aids (Belize Port Authority Act, revised, 2000) – particularly relevant for the sugar barge. It also has a role in the monitoring of vessels using navigational channels and the removal of boats from the reef, when groundings occur

One financial sustainability mechanism at Government level has been established, through the development of a funding mechanism to assist in management and development activities within protected areas – the Protected Areas Conservation Trust (PACT), through a 'conservation tax' of Bz\$7.50 levied on non-residents as they leave the country. Corozal Bay Wildlife Sanctuary is eligible for funding from the Trust, and has received funding in 2009 towards surveillance and enforcement activities.

Key National Legislation Protecting Fauna, Flora, and National Heritage

The Fisheries Act (1980)

Enables the Minister responsible for fisheries to declare an area as a marine reserve, within the fishing limits of Belize

The Wildlife Protection Act (1981)

“to provide for the conservation, restoration and development of wildlife, for the regulation of its use and for all other matters connected therewith”

Environmental Protection Act (1992)

“to promote the preservation and improvement of the environment, the rational use of natural resources, the control of pollution, and matters connected therein”

The Forest Act (1990)

Promotes the forestry industry, with the implementation of conservation techniques

The National Parks Systems Act (1981)

Empowers government to create or maintain a “national system” of protected areas.

National Lands Act (1992)

Provides legislation for protecting the 66’ reserve along river edges, and allows GoB permission to access minerals etc.

1.3.2 Land and Sea Tenure

Corozal Bay Wildlife Sanctuary is included in Belize’s territorial waters. The seabed is national land, and thus any construction in this region, such as piers, marinas, and seawalls, needs to be licensed by the Lands Department. Any mining, including beach sand mining or dredging activities, requires a license from the Geology & Petroleum Department. Belizean fishermen have fished the area for many years, and therefore are considered to have traditional rights to the fishing grounds in the area, though are encouraged to develop sustainable fishing practices or alternative livelihoods.

1.3.3 Evaluation of the Importance of the Protected Area

Species of Concern

Corozal Bay Wildlife Sanctuary is considered part of the Mesoamerican Barrier Reef System, the World’s second largest barrier reef. It is an assemblage of importance for many species of conservation concern, among them the critically endangered goliath grouper (*Epinephelus itajara*), smalltooth sawfish (*Pristis pectinata*), and hawksbill turtle (*Eretmochelys imbricata*), as well as the vulnerable West Indian manatee (*Trichechus manatus manatus*) (IUCN, 2008⁹; Table 3).

It is also important for many wetland bird species highlighted as species of national conservation concern (NPAPSP, 2005), with several mangrove cayes supporting key nesting colonies for the country, and identified as an integral part of the north east Important Bird Area (IBA) for these, and for Yucatan endemics, Neotropical migrants and overwintering habitats for congregatory waterbird species.

Critically Endangered	
Goliath Grouper	<i>Epinephelus itajara</i>
Hawksbill Turtle	<i>Eretmochelys imbricata</i>
Small tooth Sawfish*	<i>Pristis pectinata</i>
Endangered	
Green Turtle	<i>Chelonia midas</i>
Vulnerable	
Mutton Snapper	<i>Lutjanus analis</i>
Cubera Snapper	<i>Lutjanus cyanopterus</i>
Hogfish	<i>Lachnolaimus maximus</i>
West Indian Manatee	<i>Trichechus manatus</i>

*confirmation required...may be locally extinct

Table 3: Species of Concern of Corozal Bay Wildlife Sanctuary (IUCN, Redlist, 2010)

⁹ IUCN (2008). 2008 IUCN Red List of Threatened Species. <www.iucnredlist.org>. Downloaded on 21 March 2009

Biophysical Features

The Wildlife Sanctuary, part of the largest estuarine system in the region, is very shallow, with a maximum water depth of approximately 7m, and an average of 3m (Kramer & Kramer, 2002). The sediment is predominantly fine mud with algae and localized beds of seagrass - *Thalassia testudinum* and *Halodule wrightii*. Just south of the mouth of the Rio Hondo lies one of the few internationally identified sites with living stromatolite reef, an increasingly rare example of these cyanobacterial formations.



Figure 1: Corozal Bay Wildlife Sanctuary (NASA)

Numerous coastal lagoons with inlets, inundated dwarf and coastal mangroves, and salt marshes are connected to the Bay and a number of fresh water rivers, including Río Hondo and New River, discharge into it. The decreased salinity at the river mouths, and increased nutrient load from upstream, result in impressive examples of basin mangrove where the rivers enter the Bay.

With the presence of the shallow Bulkhead Shoals area to the south limiting flow in and out of the system, and the lack of flushing or strong currents, the Bay acts as an important catchment for accumulating contaminants and sediment before they reach the reef.

Biodiversity Importance

The coastal zone of Belize is home to the largest population of West Indian manatee within the Caribbean range, with the sheltered waters of Corozal Bay and the adjacent Chetumal Bay being highlighted within the region as particularly important for mating and calving (Auil, 2004¹⁰; Morales-Vela et al. 2000¹¹), verified by relatively frequent reports of mating congregations from local fishermen, and sightings along the entire coastline.

¹⁰ Auil, N. (2004). Abundance and Distribution Trends of the West Indian Manatee in the Coastal Zone of Belize:

Implications for Conservation. Masters Thesis.

¹¹ Morales-Vela, B., D. Olivera-Gómez, J. E. Reynolds, III, and G. B. Rathbun. (2000). Distribution and habitat use by manatees (*Trichechus manatus manatus*) in Belize and Chetumal Bay, Mexico. Biological Conservation 95:67-75.

The area also supports numerous wetland birds, with small mangrove cayes providing important nesting and foraging habitat (Kramer & Kramer, 2002). Cayo Falso, to the west of Sarteneja, supports a large breeding colony of magnificent frigatebirds (*Fregata magnificens*) and brown pelicans (*Pelecanus occidentalis*), with great egrets (*Ardea alba*), reddish egrets (*Egretta rufescens*), roseate spoonbills (*Ajaia ajaja*), great egrets (*Ardea alba*) and cormorants. Adjacent to the Sanctuary, just south of Deer Caye, Little Guana Caye was established as a bird sanctuary under the National Lands Act, in 1977, for the presence of the largest nesting colony of reddish egrets in the Caribbean and is also known to have nesting white ibis (*Eudocimus albus*), tricolored herons (*Egretta tricolor*), and roseate spoonbills (Kramer & Kramer, 2002). Los Salones, a second of the seven bird sanctuaries established under the same Act, lies just south of the southern boundary, and is a major nesting site for Roseate Spoonbills. Immediately adjacent to the Sanctuary, protected islands in Shipstern Lagoon, the largest of Belize's coastal lagoons, support two nesting colonies of American woodstorks (*Mycteria americana*). A third lies in Bennett's Lagoon in the Bulkhead area adjacent to the eastern coastline of Belize.



The mangroves and littoral forest that line the shores provide an important habitat for migratory bird species, with an estimated 14 to 20 million individuals passing through in the 2007 southward migration (Bayly et. al. 2008¹²), including the near-threatened olive-sided flycatcher (*Contopus cooperi*), golden-winged warbler (*Vermivora chrysoptera*) and painted bunting (*Passerina ciris*). The shallow waters provide foraging areas for large rafts of migrating American coots (*Fulica americana*), and inlets shelter large flocks of blue-winged teal (*Anas discors*). The coastal mangrove, mangrove cayes and littoral forest areas are also important for Yucatan endemic bird species such as the near threatened black catbird (*Melanoptila glabirostris*), Yucatan jay (*Cyanocorax yucatanensis*) and Yucatan flycatcher (*Myiarchus yucatanensis*). The large expanses of dwarf mangrove and mud flats provided feeding areas for many waders, both migrants and residents, and the low mangroves support large numbers of nesting white-winged doves (*Zenaida asiatica*).

The shallow bay provides a protected nursery habitat for a variety of fish and invertebrate species – including the goliath grouper and at least five shark species (Bonfil, 1997¹³), with bull sharks (*Carcharhinus leucas*) and bonnethead sharks (*Sphyrna tiburo*) reported from the Bulkhead Shoals area to the southern end of the Wildlife Sanctuary. It is rumoured that a snapper spawning site exists within the Bay (though to be the lane snapper (*Lutjanus synagris*), but this is still to be confirmed.

¹² Bayly, N.J. & Gomez, C. (2008). Evaluating a stepping stone for Neotropical migratory birds – the Belizean north-east biological corridor. Final Report to Belize Forestry Department, Belmopan, Belize (Nov 2008).

¹³ Bonfil R. (1997). Status of shark resources in the Southern Gulf of Mexico and Caribbean: implications for Management. Fisheries research, vol. 29, No.2, pp. 101-117

In terms of connectivity, Corozal Bay Wildlife Sanctuary is a crucial transboundary link, connecting Corozal Bay to the protected areas system in Mexico through the Santuario de Manati. This large transboundary protected area is considered essential for the survival of species such as the Antillean manatee.

Environmental Services of the Protected Areas

Other than the specific values of the protected area itself, the mangrove and seagrass ecosystems provide various ecosystem services (Table 4).

Ecosystem Services of Corozal Bay Wildlife Sanctuary	
Regulation	Protection of the coastline from storm surges and waves through the presence of coastal mangrove
	A reduction of coastal beach erosion within the protected area , through presence of mangroves
	Seagrass plays an important role in stabilizing the substrate and settling turbidity in the water
Recruitment	Mangrove and seagrass provide important nursery areas for both commercial and non-commercial species
Cultural	The protected area has the potential to be an important resource for tourism and recreation
	Aesthetic appreciation
Support	Seagrass and mangroves play an important role in the cycling of nutrients
	Seagrass beds and mangroves within the protected area provide ecosystems necessary for different life stages of commercial and non-commercial species
	Mangroves provide nesting structure for several bird nesting colonies, including for the nesting colony of magnificent frigatebirds and woodstorks
Adapted from UNEP-WCMC, 2006	

Table 4: Ecosystem Services of Corozal Bay Wildlife Sanctuary

Corozal Bay Wildlife Sanctuary - a High Priority Transboundary Biodiversity Area

Location: Chetumal Bay, Corozal Bay, and surrounding wetlands

Approximate size: 3,209 km²

Ownership: Mexico/Belize

Biological Importance: High

Biological Features: Large area including Chetumal Bay, Corozal, Bacalar Chico, and north Ambergris. Large manatee populations (~ 250 manatees) and one of most important calving areas in Caribbean. About 90% of Chetumal Bay population uses Guerro Lagoon and Río Hondo. Habitat for crocodiles, dolphins, and sea turtles. Two small bird nesting islands with wood storks (one of only two wood stork nesting sites in Yucatán). Over 250 bird species are found in Bacalar Chico.

Description of area: Chetumal Bay is a large (2,450 km²) brackish estuary straddling the Belize-Mexico border with a very shallow water depth of 1 to 7 m (average of 3 m). The bottom is covered with fine mud and algae and localized seagrass beds of *Thalassia testudinum* and *Halodule wrightii*. Several fresh water rivers, including Río Hondo and New River, empty into the bay (Morales et al., 2000). Many coastal lagoons with inlets, salt marshes, and mangrove forests are connected to the bay.

Outstanding biological features

Chetumal Bay is the largest estuary in the ecoregion and supports one of the largest populations of manatees in the Caribbean (Aul, 1998 Thesis). Outstanding nesting and foraging habitat is available for numerous wading birds. The area around Little Guana Caye has the largest nesting colony of reddish egrets in the Caribbean and is also known to have nesting white ibis, tri-colored herons, and roseate spoonbills. Protected islands in Shipstern Lagoon support support two nesting colonies of woodstorks. The shallow estuary also provides excellent nursery habitat for a variety of fishes and invertebrates. Current conservation status Corozal Bay Wildlife Sanctuary encompasses the Belize portion of the bay and much of the Northern shelf lagoon behind Ambergris Caye. The area is declared protected but currently is not being managed. The Shipstern Nature Reserve includes 22,000 acres of wetlands, mangroves, lagoon, cayes, and unique dry hardwood forest. Manatee Sanctuary includes most of Chetumal Bay and San Jose Bay

Moderate Persistence

These priority areas have a moderate capacity to adjust and recover from future disturbances and some intervention would be needed to maintain ecosystem integrity and functioning. For example, Chetumal and Corozal Bays Priority Area has moderately degraded habitat quality due to low fish populations, lack of vegetation, and poor water quality, although the area remains a stronghold for manatee populations. This priority area would require a reduction in pollution from these sources to prevent further habitat degradation.

Adapted from Kramer and Kramer (WWF, 2002)

1.3.4 Socio Economic Context

Belize has a low population currently estimated at approximately 307,900 (Figure 2; CIA, 2010), of which 51.2% are urban dwellers (UN data, 2007). Population densities are low, with just over 13.1 persons per sq. km., concentrated primarily within the northern plain, southern coastal plain, Belize Valley and Stann Creek Valley, with much of the remaining country being less suited to habitation, with swampy lowlands and steep terrain in the Maya Mountains. It is a country of many ethnic cultures, with Mestizo, Creole, Maya and Garifuna being the major population groups (Figure 3). The Maya occupants of Belize, descendants of the original Central American civilization, at its height approximately 2,000 years ago, form three distinct ethnic groups – the Yucatec Maya of the north, the Mopan Maya of the west and south, and the Ketchi of the southern regions. In general, the northern coastal fishing communities are based on the Mestizo culture, being settled in the 1850s by refugees from the Mexican Caste War.

In the last 25 years, there has been a shift in the cultural demographic, with a significant influx of Central American refugees – primarily from Guatemala and Honduras – an estimated 20% of heads of households are born outside of Belize (2010 Poverty Assessment data). There is also an ongoing emigration of Belizeans to the United States – generally those from urban areas who have completed secondary school or have professional training.

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 A number of communities have been highlighted as being major stakeholders in the protected area, through fishing or tourism (Table 5), and a stakeholder analysis identifies other stakeholder interests and impacts (Table 6).

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 2: Belize Demographic Statistics

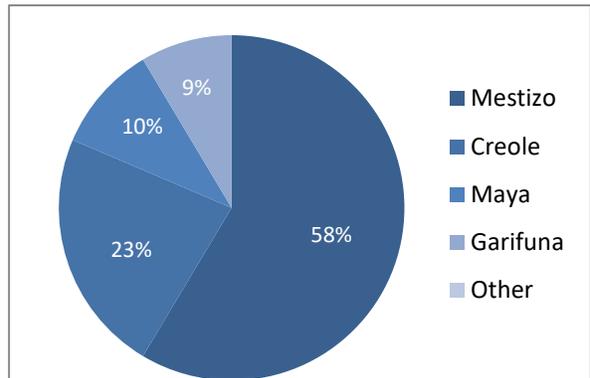


Figure 3: Belize Population Structure

Sarteneja, Copper Bank and Chunox are considered the major northern fishing communities - each have two fishing sectors – the lobster and conch fishermen who harvest marine resources (lobster, conch and finfish) from the reef, and the local artisanal fishermen who fish within Corozal Bay for home consumption and low-scale commercial purposes. The reef sector is part of traditional industry that provides employment for over 3,000 people nationally (McConney et. al., 2003). The primary commercially exploited species, lobster, conch, and to a lesser extent, finfish, have declined since the early 1980's, when the industry was at its peak. 80% of the lobster and conch is thought to be exported through the four fishing cooperatives, the remaining 20% is sold for local consumption (Cooper et. al. 2008). Alternative job opportunities in the northern coastal communities - Sarteneja and Chunox in particular, are limited, though there is the potential for a shift towards a greater dependence on tourism.

Value of Belize's Fishing Industry

Approximately 1.2 million pounds of fish were sold to Belize's Fishermen's Co-ops in 2007. Over 80% of that total was exported, earning US\$11.2 million in gross revenue. In addition, Co-ops earned an estimated US\$1 million in local sales. Fishermen also sell their catch to local markets and restaurants, and distribute it to family and friends, contributing an additional US\$1.9 to \$3.5 million per year to the economy. In total, reef- and mangrove-associated fisheries have an estimated direct economic impact of US\$14 to \$16 million per year.

From: Cooper, E., L. Burke and N. Bood. 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. Very few of these access Corozal Bay Wildlife Sanctuary, and there is currently no established tourism base in the majority of the stakeholder communities for exploring the Bay. The one exception is San Pedro, where the sport fishing industry that utilizes the flats of Bulkhead Shoals and Deer Caye area.

Stakeholder Communities of Corozal Bay Wildlife Sanctuary				
Community	Location (UTM)	Population (approx.)	Population components	Comments
Sarteneja	E16 378750 N20 29500	2,300*	Mestizo	Largest fishing community, concentrating on lobster, conch and finfish throughout Belize waters. A limited number of local fishermen (12 – 15) dependent on fishing in Corozal Bay
Chunox	E16 356500 N20 23500	1,400	Mestizo	Located on Laguna Seca, part of the Progreso Lagoon system. Increasing number of reef fishermen, focused primarily on Lighthouse Reef Atoll. A limited number of local fishermen (4 – 5 in both communities) using Corozal Bay
Copper Bank	E16 356700 N20 26020	525	Mestizo	
Corozal	E16 353643 N 20 33873	9,100 ¹⁴	Mestizo	District town with major services (banks, post office, Government offices etc.). A limited number (2 to 3) of fishermen dependent on Corozal Bay. Recreational fishing by youths in the mornings
Consejo	E16 362344 N20 40688	<1,000	Mixed	Border community, with some (7) fishermen dependent on Corozal Bay. Large expat component
San Pedro	E16 0398200 N18 1981250	4,499**	Mestizo	Tourism destination, embarkation point for many visitors to reef. Fly fishing industry utilizes Corozal Bay Wildlife Sanctuary
Chetumal	E16 363347 N20 46291	238,520	Mestizo	Mexican coastal town with significant impacts on the estuarine system

Table 5: Stakeholder Communities of Corozal Bay Wildlife Sanctuary

¹⁴ Abstract of Statistics, 2007. Statistical Institute of Belize

Table 6: Stakeholder Analysis for Corozal Bay Wildlife Sanctuary					
Stakeholder	Influence or Impact of Corozal Bay Wildlife Sanctuary on Stakeholder			Influence or Impact of Stakeholder on Corozal Bay Wildlife Sanctuary	
Community Stakeholder Sarteneja	<ul style="list-style-type: none"> Management of fish resources ensuring continued viability of fishery Protection of important mangrove nursery sites, ensuring continued viability of fishery Recreational opportunities Protection of an important tourism resource 	+	+	<ul style="list-style-type: none"> Active participation in surveillance and enforcement activities Low level of cooperation towards protected areas from reef fishermen Non-sustainable fishing activities Poor tourism practices Pollution from shore based activities (boat painting etc) 	+ - - - -
Community Stakeholder Chunox and Copper Bank	<ul style="list-style-type: none"> Management of fish resources ensuring continued viability of fishery Protection of important mangrove nursery sites, ensuring continued viability of fishery Recreational opportunities Protection of an important tourism resource 	+	+	<ul style="list-style-type: none"> Low level of interest towards protected areas from community stakeholders Non-sustainable fishing activities 	- -
Community Stakeholder Corozal and Consejo	<ul style="list-style-type: none"> Recreational opportunities Protection of an important tourism resource Management of fish resources ensuring continued viability of fishery Protection of important mangrove nursery sites, ensuring continued viability of fishery 	+	+	<ul style="list-style-type: none"> High level of interest from community stakeholders Pollution from poor septic systems Clearance of coastal mangroves 	+ - -
Community Stakeholder San Pedro	<ul style="list-style-type: none"> Recreational opportunities Protection of an important tourism resource – particularly for sport fishing Management of fish resources ensuring continued viability of fishery Protection of important mangrove nursery sites, ensuring continued viability of fishery 	+	+	<ul style="list-style-type: none"> High level of interest from sport fishing guides Interest and understanding of concept of conservation Pollution from poor septic waste and solid waste disposal on San Pedro Poor sport fishing practices Poor development practices 	+ + - - -
Transboundary Stakeholder Chetumal / Mexico	<ul style="list-style-type: none"> Provides additional importance to Sanctuario de Manati as a transboundary protected area Provides a mechanism for transboundary cooperation on conservation activities 	+	+	<ul style="list-style-type: none"> Interest in transboundary cooperation on conservation activities Illegal fishing within CBWS Poaching of manatees within CBWS 	+ - -
Tour Guides (including tour boat captains)	<ul style="list-style-type: none"> Benefit from having Corozal Bay Wildlife Sanctuary as a major venue for snorkeling, dive- and kayak-associated tourism Employment in tourism initiatives Income from using Corozal Bay Wildlife Sanctuary for tourism 	+	+	<ul style="list-style-type: none"> Support the conservation goals of Corozal Bay Wildlife Sanctuary Provide interpretation for visitors, facilitating overall visitor appreciation If well trained, assist with visitor management within the protected areas through in-depth briefings If poorly trained, can result in poor visitor management and increased impact on corals and associated fauna, anchor damage etc. Poor tourism practices may impact wildlife behavior (eg. manatee, birds at nesting colonies) 	+ + + - -

Table 6: Stakeholder Analysis for Corozal Bay Wildlife Sanctuary (cont.)				
Stakeholder	Influence or Impact of Corozal Bay Wildlife Sanctuary on Stakeholder		Influence or Impact of Stakeholder on Corozal Bay Wildlife Sanctuary	
Local / National Tour Operators	<ul style="list-style-type: none"> Benefit from having Corozal Bay Wildlife Sanctuary as a tourism venue based on its biodiversity and scenic values Income from using Corozal Bay Wildlife Sanctuary as a tourism destination 	+	<ul style="list-style-type: none"> Provide marketing at a national level, and send visitors to Corozal Bay Wildlife Sanctuary, increasing sustainability Support the conservation goals of Corozal Bay Wildlife Sanctuary 	+
International Tour Operators	<ul style="list-style-type: none"> Benefit from having Corozal Bay Wildlife Sanctuary as a tourism venue based on its biodiversity and scenic values Income from using the Wildlife Sanctuary for tours 	+	<ul style="list-style-type: none"> Provide marketing at an international level, and send visitors to the protected area, increasing sustainability Support the conservation goals of Corozal Bay Wildlife Sanctuary 	+
BTIA	<ul style="list-style-type: none"> Benefit from having Corozal Bay Wildlife Sanctuary as a tourism venue, 	+	<ul style="list-style-type: none"> Providing national and international marketing of Corozal Bay Wildlife Sanctuary Support the conservation goals of Corozal Bay Wildlife Sanctuary 	+
General Belize Public (excluding primary stakeholder communities)	<ul style="list-style-type: none"> Maintenance of local native fish stocks Environmental services Cultural and aesthetic appreciation Increased awareness through education 	+	<ul style="list-style-type: none"> Support of the general public will strengthen the position of protected area Lack of support may increase chances of dereservation 	+
Visitors: Tourists	<ul style="list-style-type: none"> Enjoy Corozal Bay Wildlife Sanctuary as a tourism destination Benefit from education and awareness opportunities 	+	<ul style="list-style-type: none"> 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 fishing (and other illegal activities) within protected area Negatively impact marine and terrestrial environments 	+
Government of Belize	<ul style="list-style-type: none"> Provides management framework Provides environmental services Corozal Bay Wildlife Sanctuary is included within the National Protected Areas System Plan - Assists in fulfilling Belize Government's commitment to the conservation of natural resources, CCAD, CBD, and MBRS Income generation of foreign revenue Provides employment opportunities in stakeholder communities 	+	<ul style="list-style-type: none"> Political support (currently being strengthened through the NPAPSP) Uncertainty of long term future commitment 	+

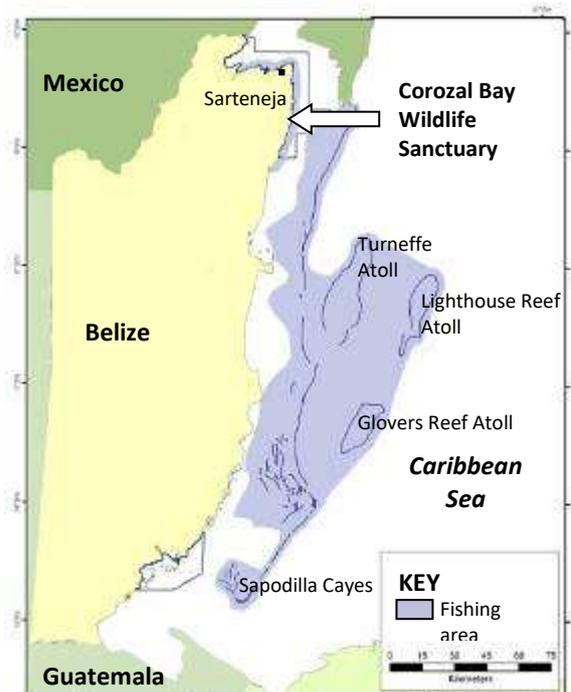
Table 6: Stakeholder Analysis for Corozal Bay Wildlife Sanctuary

Socio-economic Context – Sarteneja

Sarteneja is considered one of the key stakeholders of both the Corozal Bay Wildlife Sanctuary and the Belize Reef, and community members have based their lives around the traditional harvesting of marine products, notably lobster, conch and finfish, along the entire Belize Barrier reef (Commonwealth Foundation; Map 2). 80% of households within the community are dependent on fisheries resources – principally through traditional lobster, conch and finfish fishing, and more recently also through fly-fishing and reef tourism (SACD Socio-economic survey data, 2008).

This reliance on the marine resources creates a strong relationship between the state of the resource and the needs of the community. With the rapidly expanding national (and international) population of fishermen active on the reef, it is recognized that these resources are not being managed for sustainability nor optimal utilization (Gillet, 2003¹⁵), and are in decline, with the harvest spread too thinly amongst too many people (COMPACT Planning report, 2005). It is also acknowledged that the lobster fishery is fully exploited (Carcamo, 2005¹⁶), the conch fishery has been in serious decline (McConney et. al., 2003¹⁷), that there has been a collapse of some of the spawning aggregation sites, and that there are too many fishermen seeking a declining fisheries resource.

Against a background of limited education (86% of interviewees in Sarteneja had not progressed beyond primary level education), limited communication skills (95% of respondents are Spanish speaking as their first language, and many have limited English skills), limited financial capital to start new initiatives and lack of training in alternative skills, it is going to be a challenge for this stakeholder community to move from fishing into other livelihoods, especially with the poor quality of agricultural soils, few employment opportunities and lack of alternative industries in the area.



Map 2: Sarteneja – Current Fishing Effort (After CHEC, 2008)



¹⁵ Gillet V. (2003) The Fisheries of Belize. Fisheries Centre Research Report (2003), Vol. 11(6)

¹⁶ Carcamo. (2005). Report on the Spiny Lobster Fisheries on Belize. WECAFC - Report of the second Workshop on the Management of Caribbean

¹⁷ McConney P., R. Mahon and R. Pomeroy (2003). Belize Case Study: Fisheries Advisory Board in the Context of Integrated Coastal Management. Caribbean Conservation Association (CCA)

The Sarteneja area has been identified several times over the years for its conservation importance and its potential as a site for national tourism development, with an increasing number of tourists visiting the area each year for its tranquillity, its wildlife and its fly-fishing.

1.4 Physical Characteristics

1.4.1 Climate

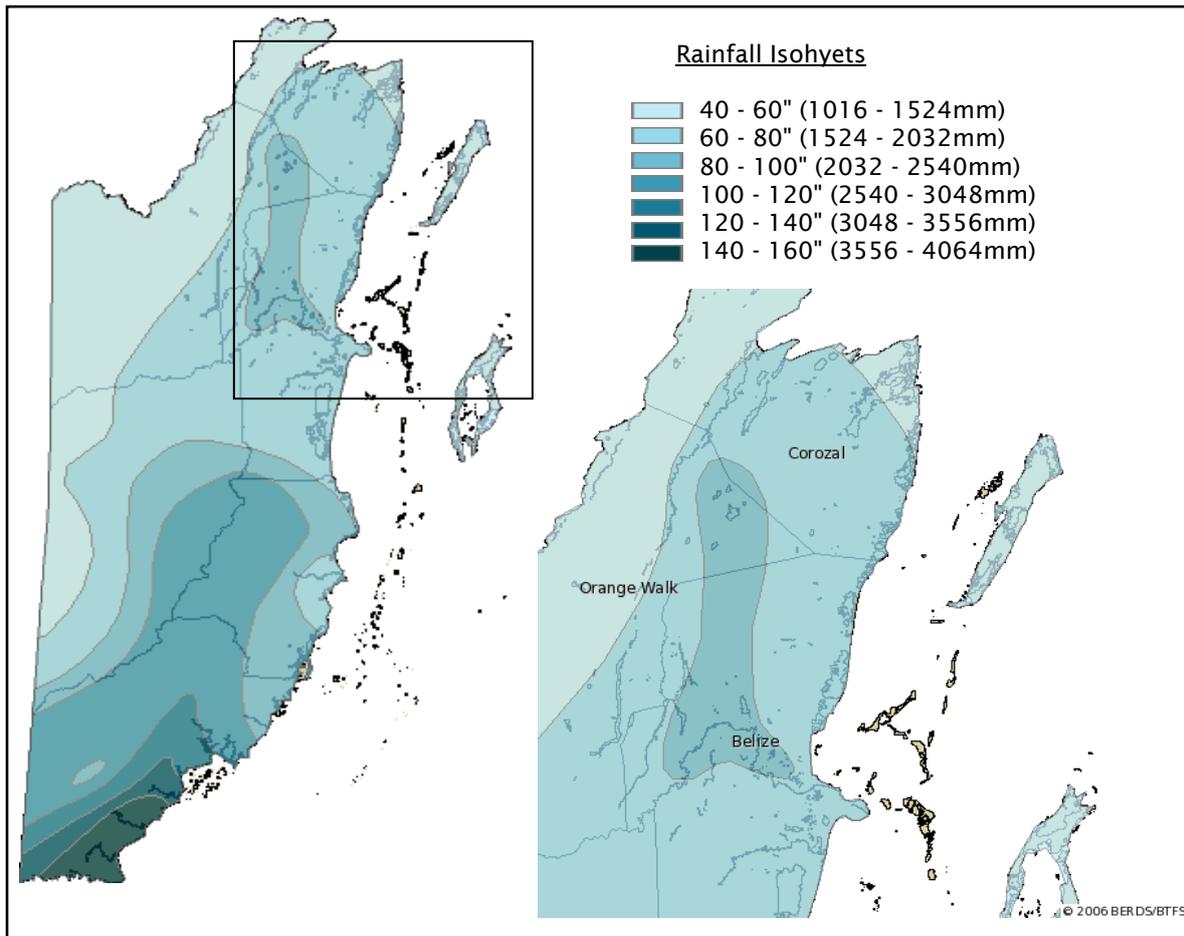
Belize lies within the outer tropical geographical belt - the relatively high temperature and rainfall patterns associated with the tropics being one of the factors that promote and sustain the high levels of biodiversity within the region.

Rainfall: Corozal Bay Wildlife Sanctuary is situated in northern Belize, an area defined climatically as sub-tropical, with distinct wet and dry seasons. It lies within the two driest rainfall belts for the country, with an annual rainfall averaging approximately 1524mm a year, with a minimum of 1016mm (Map 3).

A pronounced dry season stretches from February through to the end of May (Figure 4), covering a twenty-two year period of data for Consejo, 1978 to 2000 and a ten-year period for San Pedro, 1971 to 1981 (Belize National Meteorological Office, 2006). During this period, the minimum monthly rainfall can be as low as 23mm (as recorded in March, the driest month). This is followed by a wetter season (June to December / January), punctuated by a mini dry season in the month of August. The majority of rain falls within the hurricane season, associated with passing tropical storms, particularly in September.

Table 7: Rainfall in the Corozal Bay Wildlife Sanctuary area			
Month	Mean Rainfall (mm)		
	Consejo*	San Pedro**	CBWS Area (Average)
January	94.2	81.5	87.9
February	33.6	56.6	45.1
March	22.8	22.9	22.8
April	44.3	40.6	42.5
May	80.6	77.0	78.8
June	190.9	138.4	164.7
July	162.3	65.5	113.9
August	136.7	99.3	118.0
September	221.7	154.7	188.2
October	174.5	289.1	231.8
November	104.7	228.6	166.7
December	93.8	193.0	143.4
Annual Mean	1360.1	1447.3	1403.7
* Source of data: Belize National Meteorological Office, Consejo Shores (1978 - 2000)			
** Source of data: Belize National Meteorological Office, San Pedro (1971 - 1981)			

Table 7. Mean Rainfall by Month in Consejo and San Pedro, Belize.



Map 3: Rainfall regimes of Belize

Data Source: Base Map from BERDS (Biodiversity and Environmental Resource Data System)

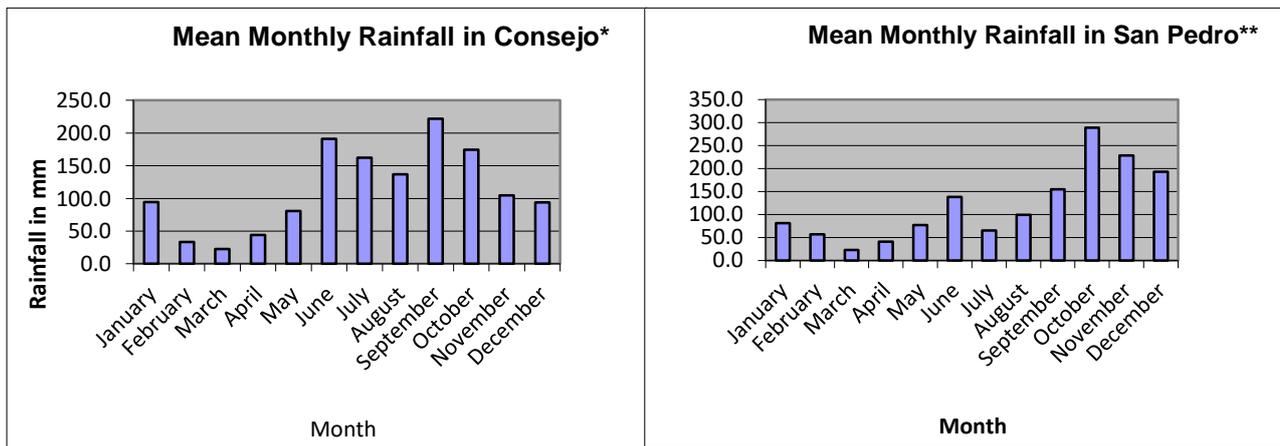


Figure 4: Mean Rainfall by Month in Consejo and San Pedro, Belize

*Source of data: Belize National Meteorological Office, Consejo Shores (1978 - 2000)

** Source of data: Belize National Meteorological Office, San Pedro (1971 - 1981)

Temperature: Temperature records from Chetumal (Mexico), and Libertad (Corozal District, Belize) demonstrate that temperatures in the Corozal Bay Wildlife Sanctuary area can be expected to vary from 18°C to 34°C, with minimum temperatures around 18°C (Libertad) - 21°C (Chetumal) in March, in the dry season, when the north wind systems sweep over northern Belize (Table 8; Figure 5). Maximum temperatures were recorded in July in Libertad (33.1°C) and September in Chetumal

(34.8°C). These regional variations may be attributed to position on the coast and the level of urban development.

Table 8: Temperature in the Corozal Bay Wildlife Sanctuary area							
	Chetumal*			Libertad, Corozal**			CBWS Area
Month	Mean Temp °C	Max Temp °C	Min Temp °C	Mean Temp °C	Max Temp °C	Min Temp °C	Mean Temp °C
January	24.7	30.1	18.4	23.0	29.0	16.9	23.8
February	25.1	30.5	18.8	24.5	30.4	18.6	24.8
March	26.5	32.4	21.8	25.0	31.5	18.4	25.7
April	27.8	33.6	22.7	26.7	33.1	20.3	27.3
May	28.8	33.2	24.6	27.8	33.0	22.6	28.3
June	28.9	33.4	25.2	28.2	32.6	23.7	28.5
July	29.1	34.3	24.7	28.1	33.1	23.1	28.6
August	29.4	34.7	24.9	28.0	32.9	23.1	28.7
September	28.8	34.8	23.6	27.7	32.9	22.4	28.2
October	27.8	33.3	22.9	26.5	31.6	21.4	27.2
November	26.7	31.5	20.4	24.4	29.7	19.0	25.5
December	25.5	31.0	19.2	23.7	29.0	18.3	24.6

* Source of data: <http://www.tutiempo.net/en/> Chetumal (2004 - 2006)

** Source of data: Belize National Meteorological Office, Libertad, Corozal (1992 - 2002)

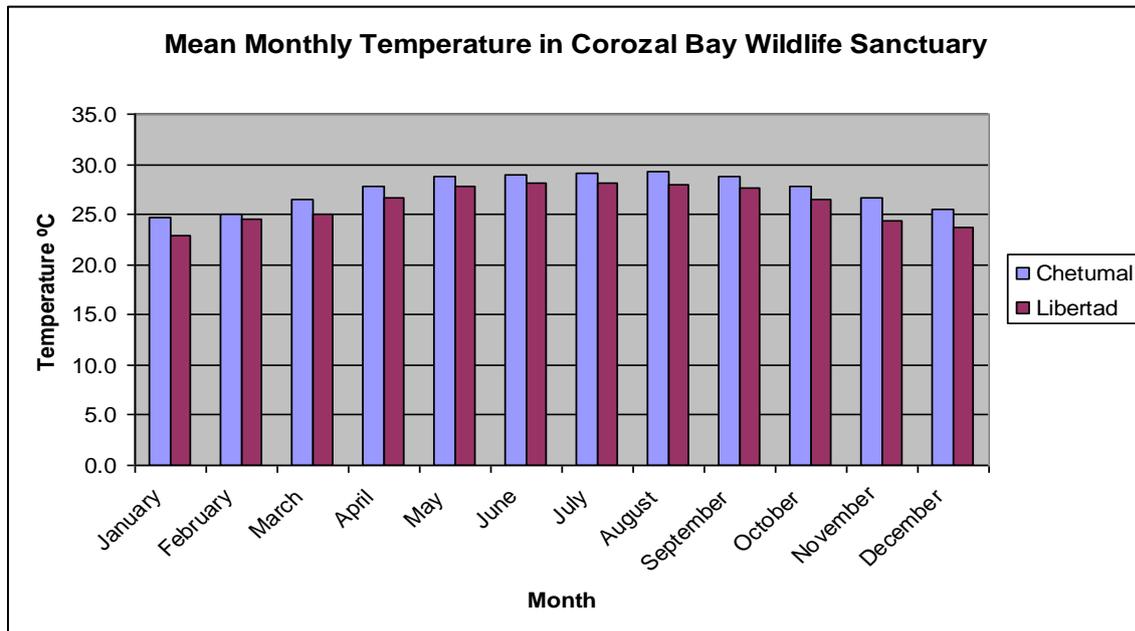


Figure 5: Mean Monthly Temperatures – Corozal Bay Wildlife Sanctuary

Weather Systems: Belize is affected by three very distinct seasonal weather systems:

- **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

All three have an influence on the rainfall and temperature patterns, on the sea level, and on the currents within Corozal Bay Wildlife Sanctuary itself.

Tropical Storms: Tropical storms affect Belize every year, 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). The storms move westward towards the Caribbean, gathering strength until they hit land.

Whilst many hurricanes have a very focused path of destruction, their effects are wide ranging, particularly at sea. Corozal Bay Wildlife Sanctuary has been affected on numerous occasions by tropical storms, some of these reaching hurricane strength. All tropical storms, even tropical depressions such as Katrina of 1999 can bring increased rainfall, causing extensive flooding of the coastal savannas, and water flow from the rivers, decreasing the salinity of the Corozal Bay system. Some of the stronger storms of most note in the region are Hurricane Janet, Hurricane Keith (2000), and most recently, the Category Five Hurricane Dean (2007).



Figure 4; Path of Hurricane Janet, September 1955 (www.hurricane.terrapin.com)

On the 27th September 1955 Hurricane Janet struck northern Belize with winds mainly from the northwest reaching 175mph (Figure 6). Corozal Town was hit by the eye bringing torrential downpours, destroying the town and flooding many northern districts. Sarteneja, too, was badly hit, with the majority of the building destroyed, and water reported to have risen by 8 feet, causing widespread forest damage (Hurricanes and the Forests Of Belize, Forest Department, 1993 (Jon Friesner)).



Figure 6; Path of Hurricane Dean, August 2007, www.nhc.noaa.gov

The next major hurricane to impact in this way was Hurricane Dean, in 2007 (Figure 5). This storm passed a few miles north of Corozal Bay, with wind speeds of 150mph – a Category Four hurricane

(winds ranging from 131 – 155mph). The strong winds caused significant damage to forest and mangrove ecosystems in the area, with torrential rain causing extensive run-off of sediments into the Bay.

1.4.2 Geology and Substrate Types

As the last ice age ended, about 18,000 years ago, the ice caps began to melt and return their water to the oceans, and sea level rose. About 7,000 years ago, sea level had reached a point where it began to flood the irregular limestone on the northern Belize shelf in the current location of Ambergris Caye. As this area was flooded by the rising sea, a new reef began to form over the old Pleistocene reef, Corozal Bay was formed. Ambergris Caye began to develop around a topographic high of Pleistocene limestone that at that point still protruded above sea level, and mangroves were able to root and grow in the shallow water around the limestone outcrop, trapping carbonate sand and mud so that the island began to form and grow, a process that continues up to today. (From Ambergris Website)

The upper bedrock under the Corozal Bay Wildlife Sanctuary is semi-continuous, well cemented, hard limestone layer (Cornec, 2002) composed of Tertiary limestones and dolomites which extends offshore into Corozal Bay. These rocks range in age from Paleocene to Pliocene and probably Pleistocene (Flores, 1952; King et al, 1992; MacLeod and Holland, 1998). Below this layer is a sequence of soft, conglomeratic marls (containing abundant pebbles and cobbles of hard limestone) of unknown thickness (Figure 7). It should be noted that the marl contains no clay and should be classified as carbonate mudstone. The soil cover on land varies from 60 cm thick to nil and consequently the top of the limestone bedrock is widely exposed at the surface. The terrain is a gently undulating coastal plain with maximum relief believed to be less than 2 meters. Undulation is related directly to top bedrock topography.

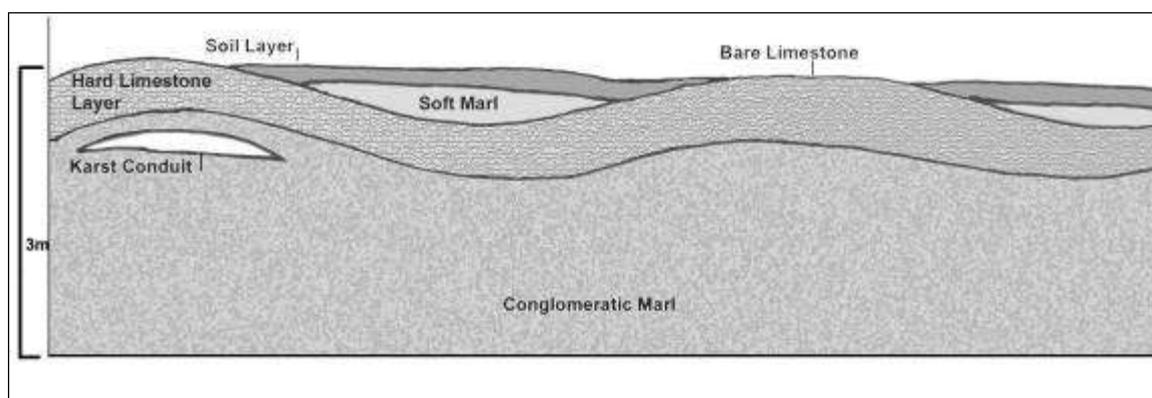


Figure 7: Schematic Geological Cross Section of Bedrock of the area (Information compiled from several quarries and test pits in and around the area)

The hard limestone bed has also been observed in the immediate offshore area in Corozal Bay (at least to 400 meters from shoreline), where the softer parts of this layer have been eroded away leaving semi-continuous patches of hard limestone exposed on the sea floor.

All of the exposures of bedrock show nearly horizontal bedding with slight northeastward dip of the strata (towards Corozal Bay). West of the project area, major waterways such as Progreso Lagoon, New River and others further to the west are believed to be located along SW-NE trending faults downfaulted to east (see discussion in King et al, 1992). This is the major fault trend in eastern Belize (see e.g. Lara, 1993) caused by movement of the Caribbean plate against the North American plate in the Tertiary-Recent.

Despite the fact that no evidence of tectonic activity has been seen in the area it should be borne in mind that this coastal area of Belize remains a tectonically active area (see discussions in James and Ginsburg, 1979; and McCann and Pennington, 1990). The northeast corner of Belize lies on a stable fault block or horst that formed as a result of the eastward sliding of the Caribbean and North American plates. No faults or folding of the limestone strata have been noted, although the courses of nearby large waterways (lagoons and rivers) are believed to be directly related to regional faults.

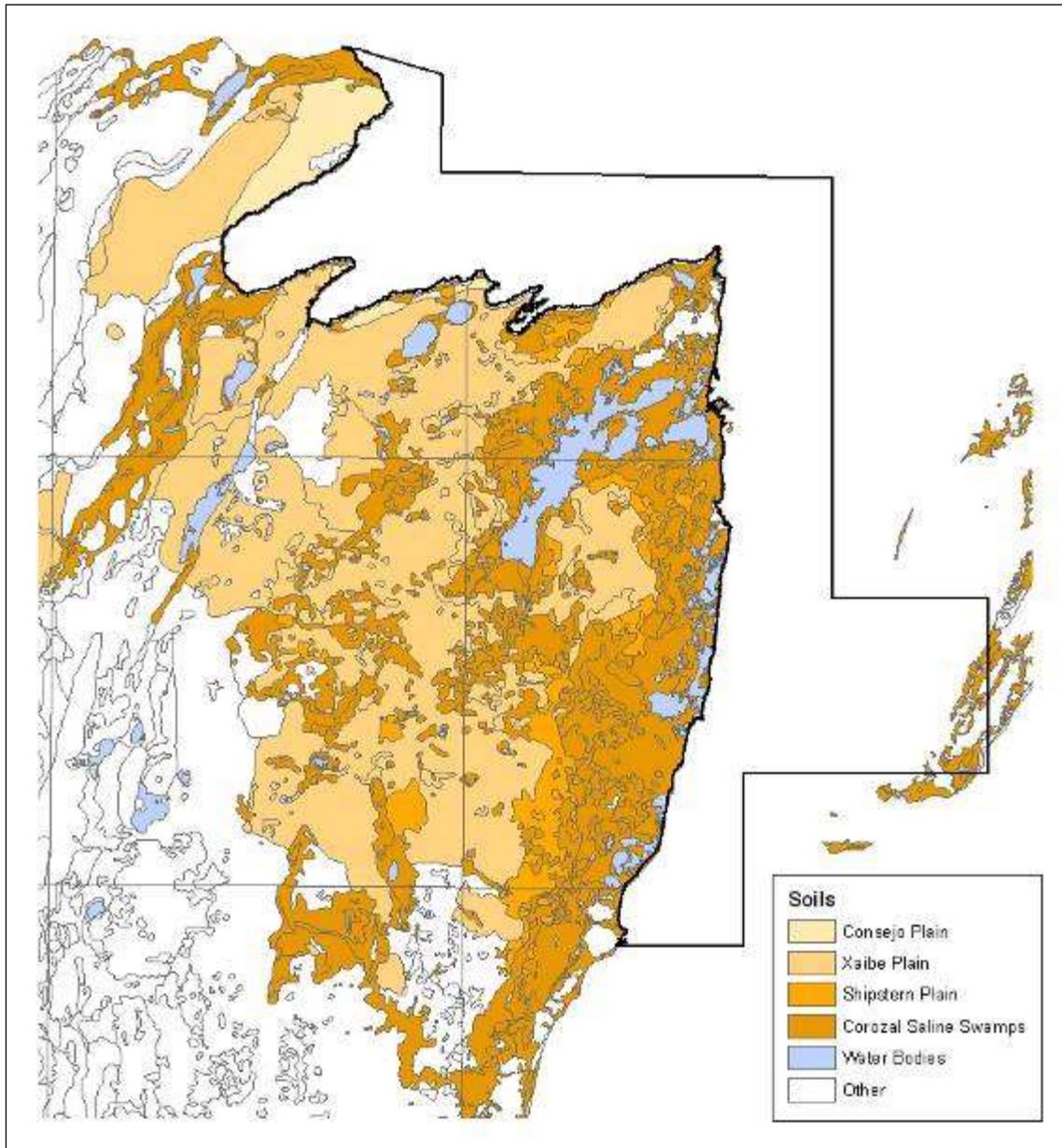


Fault line of Northern Belize (After James and Ginsburg, 1979)

A petroleum survey in Sarteneja (Placid Oil Company, 1982) showed that the predominantly limestone and dolomite rock layer extended to a depth of 5,980 feet and showed no significant hydrocarbon source potential.

Corozal Bay Wildlife Sanctuary is bordered by the northern coastal plain of Belize, which is composed of the youngest limestones to be found in Belize, being formed in the Pleistocene. These limestones provide the parent material for the different soil types found in the area. Soil classification is based on a Land System/Suite-Subsuite system. Suites are defined in terms of parent materials although sometimes soil features such as colour and mineralisation are also used.

The Land Resources Assessment of northern Belize in 1992 sought to categorise land types according to their potential productivity levels, and make recommendations as to the best land use that could be used within a specific land system. Four land system categories designated by King et. al. (1992) are found within the Corozal Bay Wildlife Sanctuary (Map 4).



Map 4: Soil distribution adjacent to Corozal Bay Wildlife Sanctuary.

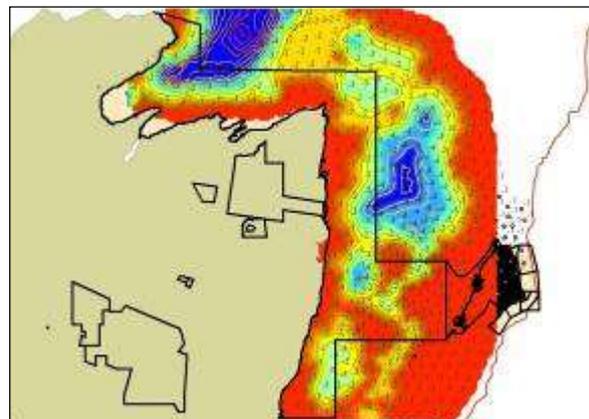
Each land system has one or more soil types associated with it, each with its own distinctive sub-suites:

- Corozal Saline Swamp (ZY)
- Shipstern Plain (ZN)
- Consejo Plain (JI)
- Xaibe Plain (ZI)

Land System	Sub-unit	Main Soil Type	Characteristics
Corozal Saline Swamp	Savanna	Shipstern + Ycacos	Corozal Saline Swamp: This land system consisting of recent soils, occupies the low lying areas seasonally inundated by saline water (including the saline floodplain of Shipstern Lagoon and the coastal fringe). Limited by seasonally waterlogged conditions and salinity, conditions are harsh for all but the most adapted plants, and are unsuitable for any form of agriculture. Vegetation is dependant primarily on salinity levels, those areas with higher salinity having mangrove associations whereas those areas with a much lower salinity have vegetation and wildlife more typically found in freshwater areas.
	Swamp	Ycacos	
	Mangrove	Ycacos	
	Tree savanna	Shipstern + Ycacos	
	Saline Plain	Buttonwood	
Xaibe Plain	Flat Plain	Xaibe, Puluacax + Remate	Much of the broadleaf forest lies on Xaibe soils of the Flat Plain sub-unit, grading to the Lower Slope subunit towards inundation areas. The main soil types to be found in the Xaibe Plain are the Xaibe, Puluacax and Remate subsuites. These are equal in abundance in the Flat Plain areas, but the imperfectly drained Puluacax subsuite predominates in the lower plain areas.
	Lower Slope	Puluacax > (Remate + Xaibe)	
Shipstern Plain	Glady Forest Plain	Puluacax < (Xaibe, Remate + Ycacos)	As with the Lower Plain Xaibe, the dominant soil subsuite is the Puluacax, giving soil with poor drainage characteristics. Xaibe, Remate and Ycacos subsuites are also present. These soils are formed under conditions of intermittent lime enrichment.
	Clumped Tree Savanna	Ycacos > (Puluacax + Xaibe + Remate)	
	Mangrove	Ycacos	
Consejo Plain		Consejo	Consisting of black peat soils of the Consejo Subsuite, the shallow soils are imperfectly drained, leading to waterlogging at some times of year, and water stress at others.

1.4.3 Bathymetry

Water depths in the Corozal Bay Wildlife Sanctuary, rarely exceed 2 meters (Map 5), and do so only where karst erosion has formed underwater caves and depressions in the bedrock. Depths are even shallower close to shore and can become impossible to navigate because of the bedrock found just inches below mud deposits. A series of channels drain southwards, reaching depths of 5 meters.



Map 5: Bathymetry of Corozal Bay Wildlife Sanctuary

1.4.4 Tides and Water Movement

The maximum tidal range is 37- 45 cm on exposed seaward shores and from 0 to 15 cm in lagoons with tidal exchange (Ebanks, 1975). The prevailing direction of the surface current within the Corozal Bay is southerly, with strong currents of up to 5 knots in river outlets especially during and after heavy rainfall (Majil et. al. draft).

1.4.5 Water Parameters

Surveys took place in the dry season (4th April 2012) and the wet season (3rd August 2012). Additionally, a rapid assessment of the water quality in the bay was undertaken during the wet season on the 10th August 2012 after an extreme weather event, Hurricane Ernesto, passed through the bay.

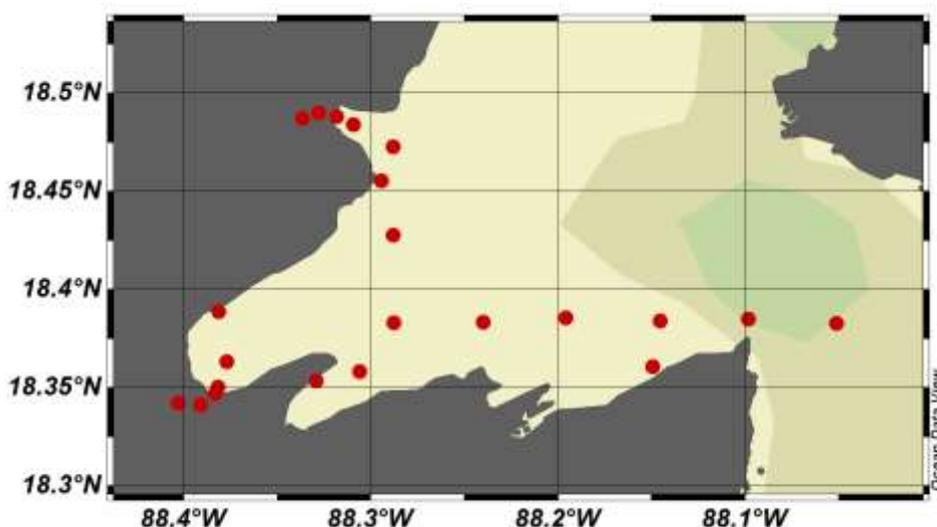


Figure 9. Full set on monitoring points in the bay.

Distinct changes in physical oceanography can be observed in the bay between dry and wet seasons, attributable to the influence of the two rivers which feed directly into the bay – the New River and Rio Hondo (Figure). In the dry season, salinity in the bay was higher and the water was cooler than in the wet season (Table). Such a change shows that in the wet season, Corozal Bay is a positive estuary, with fresh, warm water intruding into the bay and influencing conditions throughout.

Season	Salinity (ppt)			Temperature (°C)		
	Mean ± SD	Maximum	Minimum	Mean ± SD	Maximum	Minimum
Dry	13.02±4.13	21.38	1.95	28.48±0.24	28.90	28.00
Wet	6.89±3.21	11.33	2.24	30.85±0.60	32.10	30.20

Table 9: Salinity and temperature records within the bay proper (excluding measurements taken in rivers) for the dry season survey (4th April 2012) and wet season survey (3rd August 2012)

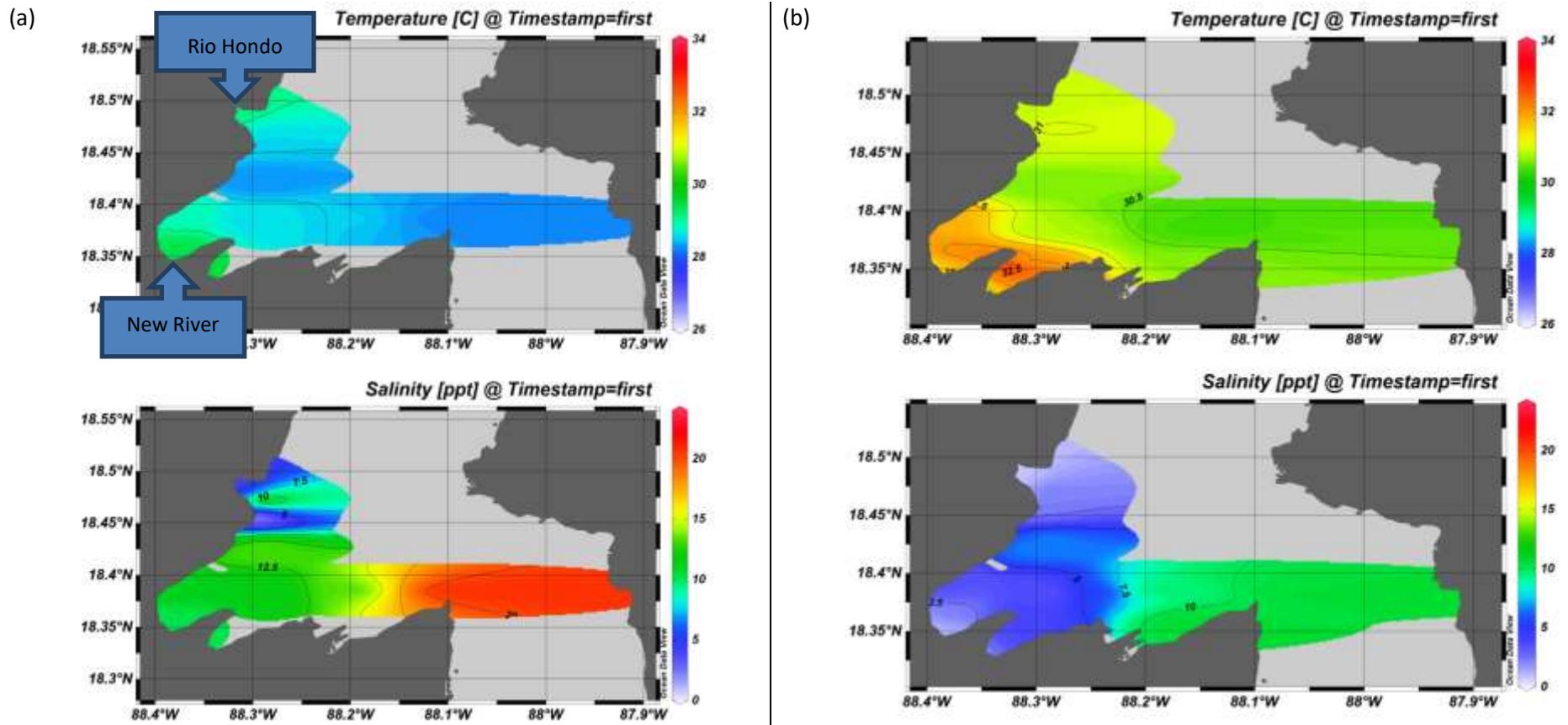


Figure 10: Temperature (°C) and salinity (ppt) for surface readings in (a) the dry season and (b) the wet season. Location of the mouths of the two rivers, Rio Hondo and New River, is indicated on the upper left map.

Severely hypoxic conditions were encountered in the New River in the wet season, with a mean dissolved oxygen (DO) content of $39.19 \pm 25.25\%$, in places as low as 21.00% (Figure 10). However, there is a steep gradient of DO content from the river mouth into the bay, where DO% is $96.39 \pm 4.60\%$.

Before the tropical storm event, the thermoclines and haloclines were evident in the water column, indicating a high stability of water. After the tropical storm, this stability had been interrupted and there was little evidence of thermoclines or haloclines. Such a mixing of water causes sediment to be stirred, releasing nutrients into the water column and decreasing water clarity, with potential knock-on effects to seagrass beds (Figure 11).

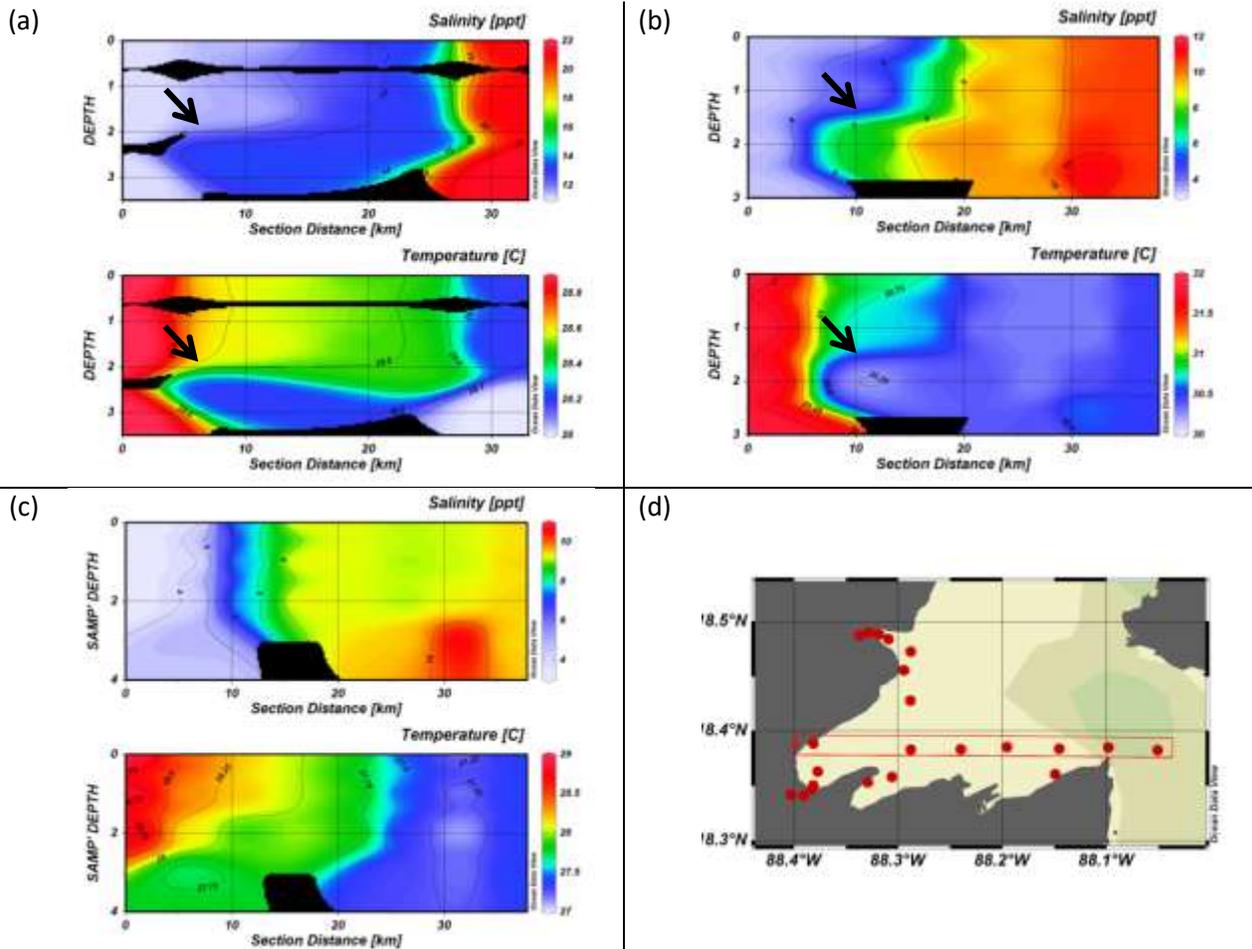


Figure 11: Cross-section of the horizontal transect in the bay (d) of salinity (ppt) and temperature (°C), in (a) the dry season, (b) the wet season and (c) after the tropical storm. Arrows highlight the location of haloclines and thermoclines where they exist.

After a tropical storm event, once the water has been mixed and stability has decreased, low energy events would be able to maintain this unstable, mixed state with suspended sediment. However, surveys took place just two days after TS Ernesto, and evidence of a thermocline reforming at the mouth of the New River (Figure) demonstrates that the system is quick to recover. This is most likely

due to the presence of a shallow sediment bank at the mouth of the New River, inhibiting water movement.

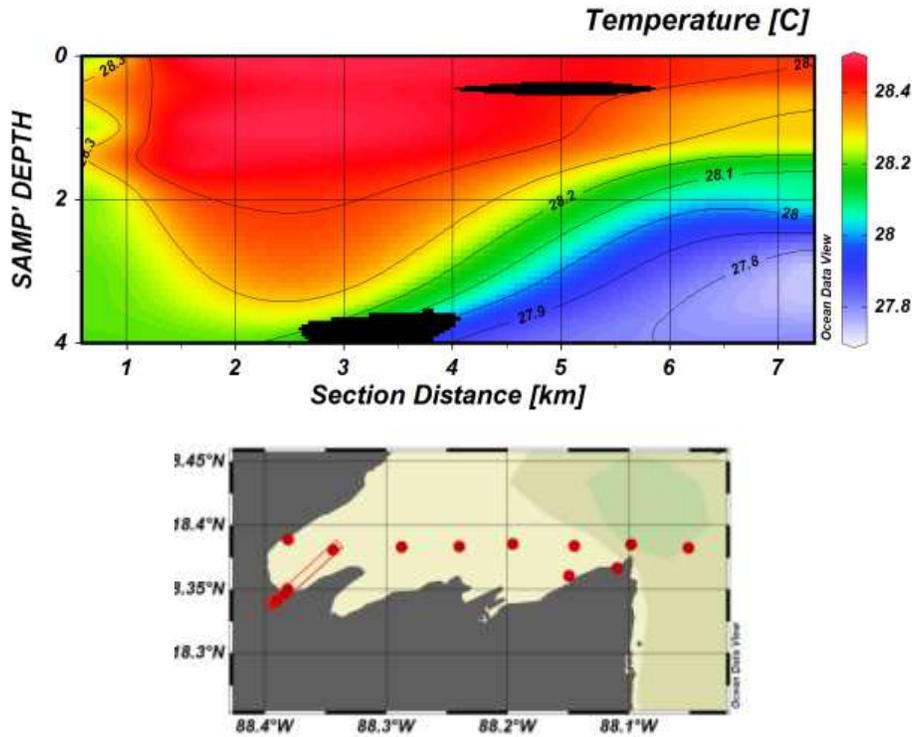


Figure 12: Cross-section of the water column along the New River transect, showing a cool body of water forming a thermocline at 4km, resulting from the shallow sediment bank at 3-4km along the transect.

In general, the water in Corozal Bay is turbid, with clarity dropping in the rivers. In the dry season, maximum vertical visibility of 160cm was found north of Corozal Town. The clarity was improved throughout the bay in the wet season, reaching a maximum of 287cm in the same location north of Corozal Town.

The pH of water in the bay did not change significantly between seasons or after the severe weather event, maintaining a median value of approximately pH 8, and never falling below 7.26. This slightly alkaline nature of the water may be due to the activity of bacteria in the sediment.

1.5. Biodiversity

Corozal Bay Wildlife Sanctuary occupies an important biogeographic position both within Belize, and within Meso America, being the confluence of several major ecological regions – North American, South American and Antillean. This position demonstrates itself in the different elements that make up the land – Yucatan affinities mix with species more often associated with South America. This, along with the heterogeneity of the habitats and protection from major human impacts, leads to this area being one of the most species-diverse in the region.

1.5.1 Ecosystems

The predominant ecosystems of the area is Coastal and Marine, a key ecosystem complex prioritized by IUCN for the MesoAmerican region. Whilst the Wildlife Sanctuary itself doesn't include the coastal vegetation, the land has a major impact on the coastal waters and barrier reef, filtering water that enters the sea through large mangrove savannas, helping to prevent sedimentation of the sea grass beds and reef, and is therefore included within this assessment.

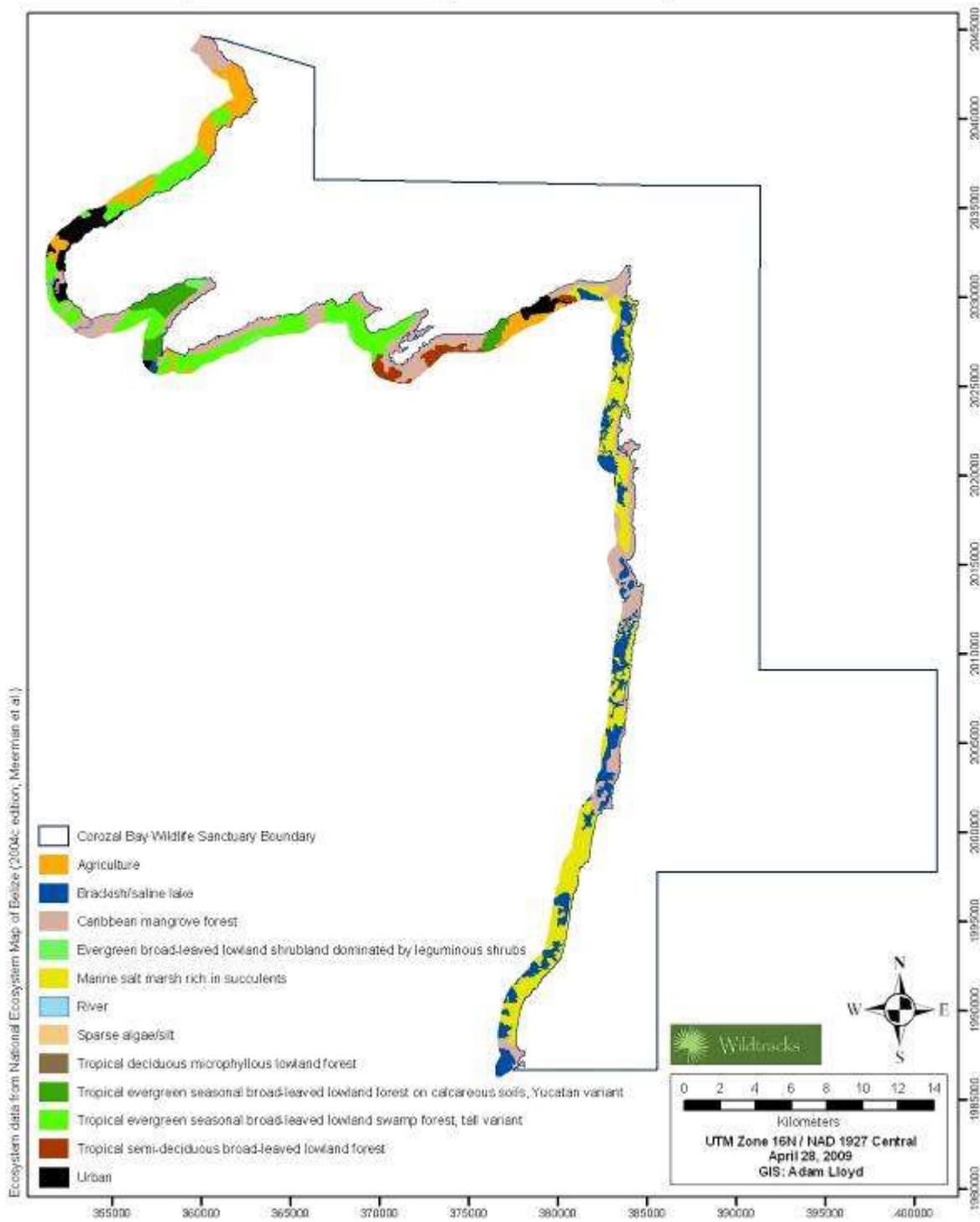
Elsewhere in the country, spreading coastal development is increasingly impacting wildlife within these habitats – this is starting to impact the northern and north east portion of the Bay. However, much of the eastern coastline bordering the Wildlife Sanctuary, however, remains a wilderness area.

Coastal Ecosystems: Within the coastal survey area, all habitats can be characterized as low-lying and saline with a spectrum running from permanently inundated habitats closer to the sea, to drier ones to the west. Boundaries and distinctions between one and the next are rarely discrete, more often merging together. Definitions and categorization of these habitats and their sub-units are reflected in various mapping work, from the early and comprehensive work of Wright et al (1959) to the most recent by Meerman & Sabido (2001).

Within this coastal survey, the habitats fall largely within 5 of the categories defined by Meerman and Sabido (2001):

- Mixed mangrove scrub
- Dwarf mangrove scrub
- Marine salt marsh with many succulent species
- Tropical littoral forest and beach communities
- Coastal fringe Rhizophora mangle – dominated forest

Corozal Bay Wildlife Sanctuary: Coastal Ecosystems



Map 6: Coastal Ecosystems of Corozal Bay Wildlife Sanctuary.

Mixed mangrove scrub

All three species of mangrove occur here (*Avicennia germinans*, *Laguncularia racemosa* and *Rhizophora mangle*), along with buttonwood (*Conocarpus erecta*). The canopy height ranges from 3-6m in this general locality. It is found on fractionally more elevated (0.05 – 0.10m) terrain than either the dwarf mangrove or freshwater mangrove scrubs, in areas that are not permanently waterlogged, but which may be seasonally wet (but rarely inundated) for protracted periods. Many tracts of this habitat type are interspersed amongst the others.



Dwarf mangrove scrub

This formation is located on the extensive coastal mudflats, and is characterized by stunted Red Mangrove with a noticeably even canopy of between 1m and 1.5m. Other than the flat and even canopy, this habitat is also readily identified as being a virtual single-species stand of Red Mangrove (*Rhizophora mangle*). Density varies considerably from very sparse to almost impenetrable, and appears to be directly correlated with water level. Areas that are dry for significant periods tend to have a sparse covering; areas that are seasonally inundated tend to be moderately dense, whereas areas that are permanently inundated (usually less than 10cm of inundation) tend to be extremely dense. Relatively vast tracts of this habitat can be found along the eastern coastline, behind the coastal ridge.



Marine salt marsh with many succulent species

This habitat type is described by Meerman & Sabido (2001) as highly heterogeneous and containing patches dominated by different species, grouped to indicate one main salt marsh community type. It is typically located in areas that are seasonally partially inundated with brackish waters, and is represented as an assemblage of *Rhizophora mangle* with an often thick ground cover of sawgrass (*Cladium jamaicense*) and interspersed with



occasional specimens of White Mangrove (*Laguncularia racemosa*), buttonwood (*Conocarpus erecta*), and a few succulents.

The Central American Ecosystems Mapping for Belize recognises two distinct saline mudflat habitats of relevance to the Sanctuary: “dwarf mangrove scrub” and “marine salt marsh with many succulent species”. These can be considered as two ends of a spectrum within a single habitat: saline savanna, within the context of this survey. At one end of the spectrum is dwarf Red Mangrove growing in permanently inundated, sheltered coastal lagoons, in water less than approx 10cm deep; at the other end is an open sawgrass savanna, dotted with *Salicornia*, *Distichlis*, an array of other succulent and herbaceous species and occasional specimens of *Laguncularia racemosa* and stunted *Rhizophora mangle*. These two habitats are very distinct, but the two merge in areas as a two species assemblage of Sawgrass (*Cladium jamaicense*) and dwarf Red Mangrove (*Rhizophora mangle*) that does not fit neatly into one category or the other. This overall habitat is that mapped as “saline savanna” by Wright (1959) and later by King et al (1992), and distinguished by King from the coastal fringe habitat.

Tropical littoral forest and beach communities

Whilst this habitat is more typically bordered on the seaward side by low herbaceous beach vegetation and by mixed mangrove scrub on the inland side, within the survey area it is often found with a narrow coastal fringe of Red Mangrove on the seaward side. It is always located on land that is not permanently waterlogged, usually a minimum of 0.3m above sea level. It is more species-rich than the coastal fringe – on the Balam Jungle Estate coast it includes Black Poisonwood (*Metopium brownei*), coastal dwarf Bullet Tree (*Bucida spinosa*), sea grape (*Coccoloba uvifer*), chit palm (*Thrinax radiata*), seaoxeye (*Borrchia frutescens*), coastal lantana (*Lantana involucrate*) and the introduced coconut (*Cocos nucifera*).



Littoral forest is present as a narrow belt of a broader species assemblage, sandwiched between coastal fringing Red Mangrove (*Rhizophora mangle*) and the habitat behind. It is generally confined to a very narrow coastal ridge, free from seasonal inundation, permitting the growth of species rather less tolerant of the extreme salinities on both the seaward and landward sides.

Coastal fringe *Rhizophora* mangle–dominated forest

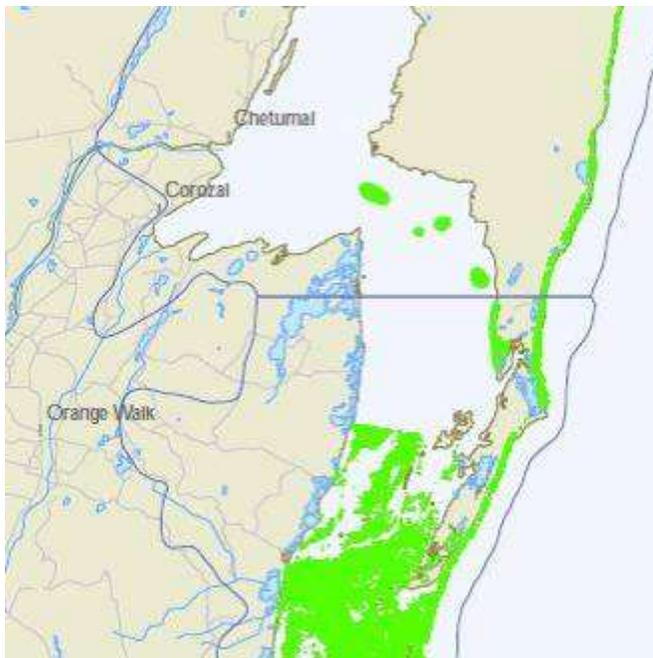
As the name implies, this is typically a narrow single species belt of Red Mangrove (*Rhizophora mangle*), located along the coastal beach. It develops in, or immediately adjacent to areas that are permanently waterlogged, with the characteristic stilt roots often projecting several metres into the sea.



Within Corozal Bay Wildlife Sanctuary, much of the east coast is fringed with this habitat. The width of the mangrove from the landward side to the stilt roots projecting into the open water varies considerably. In some places *Rhizophora* mangle forms an almost impenetrable barrier to entry from the seaward side, in others it is very open.

Seagrass

The most important component of marine flora within the protected area is the seagrass, a flowering plant growing in large, *Thalassia*-dominated patches on the shallow seabed, particularly to the south. Seagrass meadows are essential for maintaining the ecological health of the shallow



marine ecosystems within the bay, with an important role in nutrient cycling and sediment stabilization. They are also a critical ecosystem for many fish and invertebrate species - an acre of seagrass can support up to 40,000 fish and 50 million small invertebrates (Seagrass Ecosystems Research Laboratory, 2005).

Within Corozal Bay Wildlife Sanctuary, seagrass beds are essential for the maintenance of the West Indian manatee population, and also fill a critical role as a nursery area for many reef fish (including commercial species such as tarpon, hogfish, yellowtail snapper and great barracuda).

The primary species is *Thalassia testudinum*, found throughout the Wildlife Sanctuary in densities ranging from sparse to dense. *Halodule wrightii* is found interspersed with the *Thalassia*, particularly

in the less saline areas, and in shallow waters. A third species, *Ruppia maritime*, has been reported from the brackish waters of a number of the coastal lagoons.

1.5.2 Mammal Species of CBWS

Table 10: Mammal Species of the Corozal Bay Wildlife Sanctuary	
Bottle-nosed Dolphins	<i>Tursiops truncatus</i>
West Indian Manatee	<i>Manatus trichechus</i>

Corozal Bay Wildlife Sanctuary has two species of marine mammal recorded within its boundaries – the bottle-nosed dolphin and the West Indian manatee (Table 10).

The Belizean coast is home to the largest population of Antillean manatee (*Trichechus manatus manatus*) in the Caribbean (Morales-Vela *et al*, 2000). 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 & LaCommare, 2004). Today, the Antillean manatee is considered threatened throughout its range. It is listed as ‘Vulnerable’ under the International Union for the Conservation of Nature categories (IUCN, 2008).

On a national level, the first legislation for the protection of manatees was the Manatee Protection Ordinance (1933-1936) (Quintana-Rizzo & Reynolds, 2007), which stemmed from over-hunting pressures (Auil, 1998). The manatee was also included as an endangered species in the Wildlife Protection Act No.4 of the Forest Department in 1981, which prohibits the killing, taking or molesting of manatees (Auil, 1998). In 1996, the Conservation Division of the Forest Department implemented regulations prohibiting swimming with manatees.

Three ratified Wildlife Sanctuaries (Corozal Bay, Swallow Caye, and Southern Lagoon (Gales Point) have been established within Belize specifically as a conservation strategy towards the more effective protection of this species. The protection of key areas for manatee use may increase population numbers and serve as a source for recovering populations in nearby countries such as Honduras and Mexico (Quintana-Rizzo & Reynolds, 2007). Despite this, the current population is expected to decrease by over 20% in the next 40 years if effective conservation actions are not put in place. (Self-Sullivan & Mignucci-Giannoni, 2008).

The distribution of manatees within Belize has been studied since the 1960’s (Charnock-Wilson, 1970; Bengtson & Magor, 1979; Morales-Vela *et al*, 2000; Auil, 1998), with past population estimates ranging from 92 in 1977 (Bengtson & Magor, 1979) to 318 in 1997 (Auil, 1998). The 1997 survey also demonstrated that manatees prefer inshore habitats to offshore ones, specifically lagoons and rivers. The majority of the early surveys carried out between 1994 and 1997 did not fully investigate many of these preferred habitats where manatees are now known to congregate. Accuracy of aerial surveys is heavily dependent on season, weather and water turbidity conditions, and it is accepted that all these past population estimates may have a large margin of error (Auil, 2004). The current total regional population of manatees is estimated at 2,500 mature individuals,

approximate 1,000 of which live in Belizean waters (Auil, pers. com.), though this estimate is based on extrapolation, and may not be an accurate representation of the current population.

From these surveys and other more site-specific studies, six sites have been identified in Belize under the Belize Manatee Recovery Plan (Auil, 1998) as priorities specifically for manatee conservation (Figure 13). These are areas with extensive seagrass, available freshwater and space with secluded inlets, resulting in a high probability of animal presence.

Priority Manatee Areas in Belize

- **Corozal Bay area** and Rio Hondo (including Four Mile Lagoon)
- a 25km radius around **Belize City** (including the Belize and Sibun Rivers and the cays).
- **Southern Lagoon** including Quashie Trap Lagoon
- **Placencia Lagoon**
- **Indian Hill Lagoon**
- **Port Honduras** (including Deep River and Seven Hills Lagoon)

Figure 13: Priority Manatee Areas in Belize (Auil, 1998)

The Belize Marine Mammal Stranding Network (BMMSN), established in 1999 by the Coastal Zone Institute and Authority is responsible for responding to reports from the general public on stranding of manatees as well as cetaceans and sea turtles. Data provided by the BMMSN on manatee deaths demonstrate that throughout Belize, manatee face increasing threats. These are primarily human impacts, from a number of causes:

- Boat traffic-related fatalities
- Alteration and destruction of habitat e.g. by tourism activities or dredging
- Entanglement in fishing gear/ Incidental catch through poor fishing practices
- Illegal Hunting/Poaching
- Natural and man-made factors e.g. pollution

The highest verified known cause of stranding is due to collision with watercraft (Figure 14). Other causes of stranding are due to poaching, hunting, and drowning, as well as perinatal deaths (defined as occurring in the period around the time of birth from 5 months before to 1 month after). However, the majority of deaths remain undetermined (Figure 10).

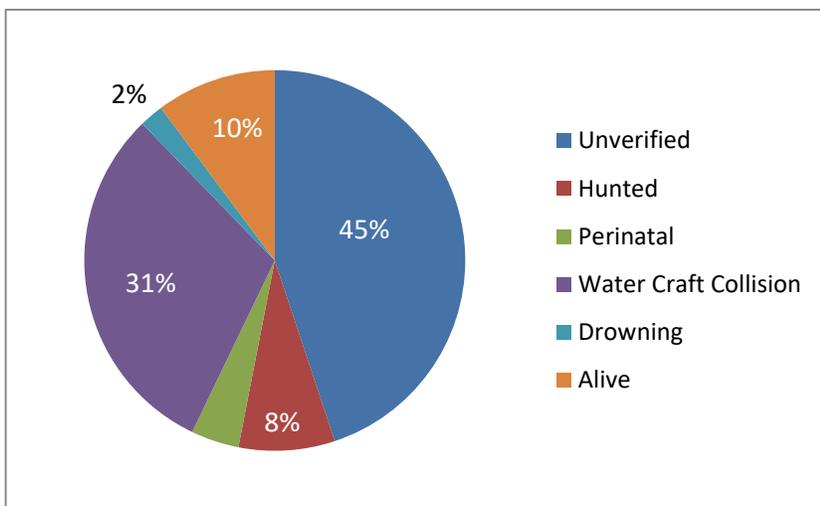


Figure 14: All reports categorised by cause of stranding between 2005 and 2010 which includes reports of both dead and live manatees (Glaves, 2011)

During all national surveys, Corozal Bay and the contiguous Chetumal Bay have consistently been highlighted as a priority area for manatees. The estuarine system is very shallow with numerous coastal lagoons and inlets, localised areas of seagrass beds, and scattered deeper ‘holes’ with cold-water upwellings in the seabed. These particular habitats make the area important for feeding and resting of manatees. Historical population estimate for the Corozal Bay / Chetumal Bay System – surveys in 1994/1995 suggest a previous average of 49 adults and 1 calf (Morales-Vela *et al*, 2000), with groupings of 1 to 2 individuals being most commonly observed within the area. More recently, SACD have started seasonal aerial surveys, and have geo-referenced all manatee sighting, to provide more in depth information on the manatee population of the Bay, and are strengthening their transboundary partnership with Ecosur for a greater understanding of population dynamics on both sides of the Bay. A dry season survey was completed in 2011 and a norté season survey in 2012. Both these surveys were conducted as a series of three replicate flights to provide greater accuracy. A wet season survey is still to be completed.

During the 2011 dry season surveys, a total count of 55 manatees were seen over three survey replicates, with a mean of 18.3 individuals per survey. Poor water visibility in the northern portion of the Wildlife Sanctuary leads to a hypothesis that these numbers under-represent the population actually present. In contrast, many more individuals were seen in the 2012 norté season aerial surveys with a total count of 132 over three survey replicates, with a mean of 44 individuals per survey. Again, water conditions in the northern portion, whilst improved, were still not considered favorable for identification of all individuals, suggesting that the total count is an underestimation.

Mean group size for the norté season survey was 2.3, with the largest group sighted at eight individuals in two separate surveys. The average group size for the dry season survey was 1.5, with the largest group of individuals being 6 (Figure 15). The larger groups of 5 and 6 individuals seen on three occasions could be breeding herds, based on their behaviour.

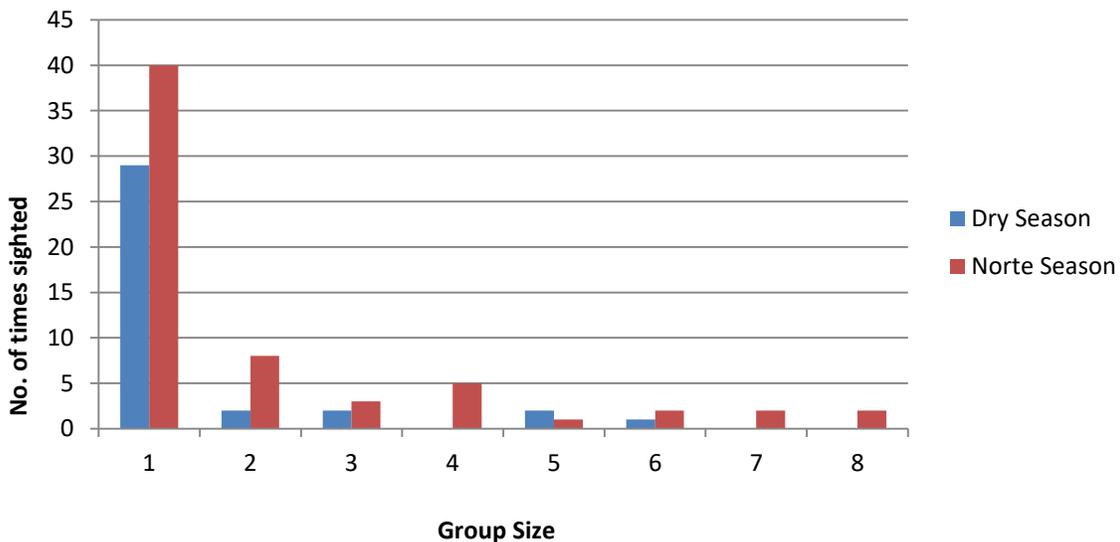


Figure 15: frequency distribution of manatee group size for 2011 dry and 2012 norté seasons

Corozal Bay Wildlife Sanctuary: Manatee Sightings, March – May 2011

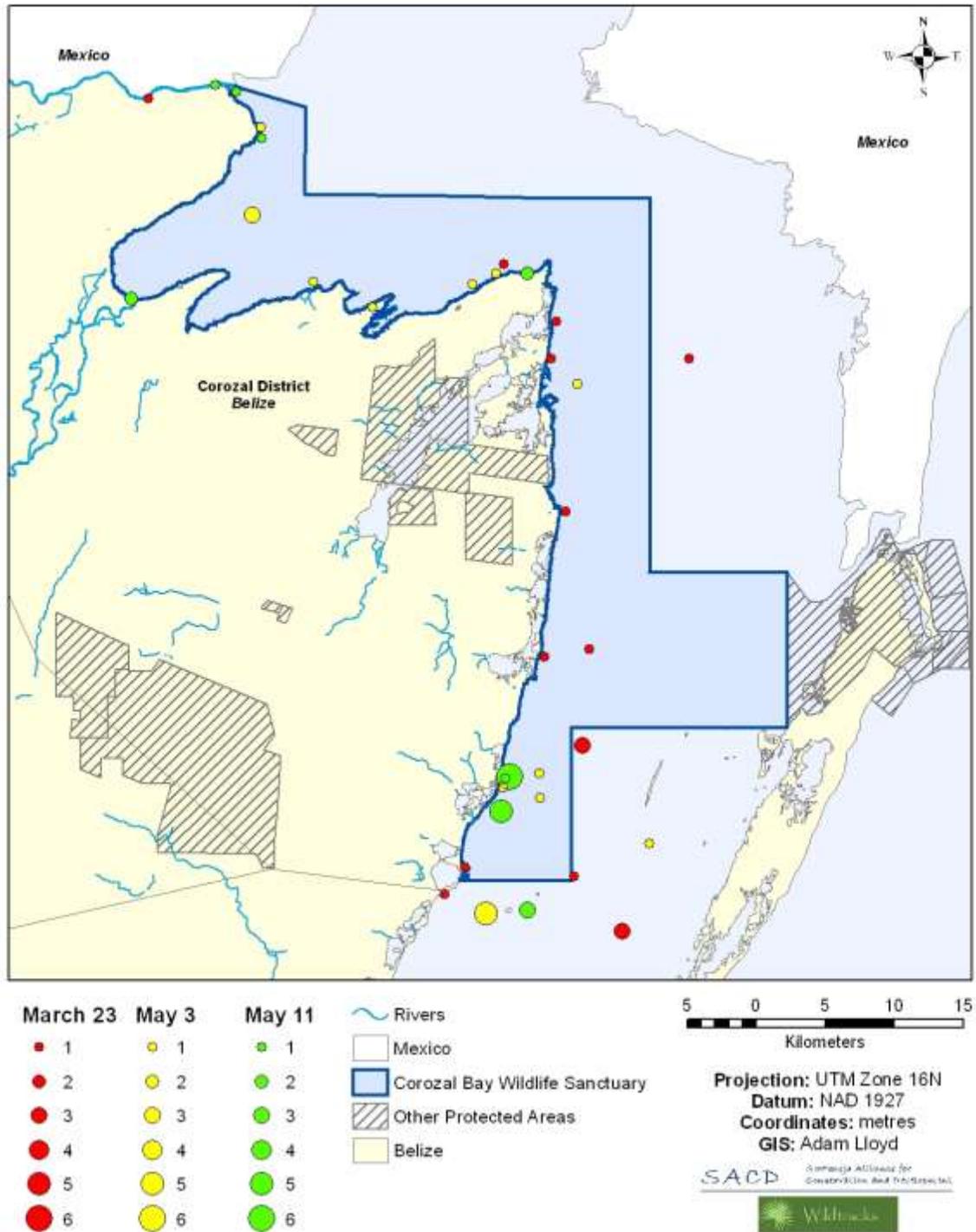


Figure 16: Results from aerial surveys conducted during the Dry Season, 2011

Corozal Bay Wildlife Sanctuary: Aerial Survey Manatee Sightings (2012)

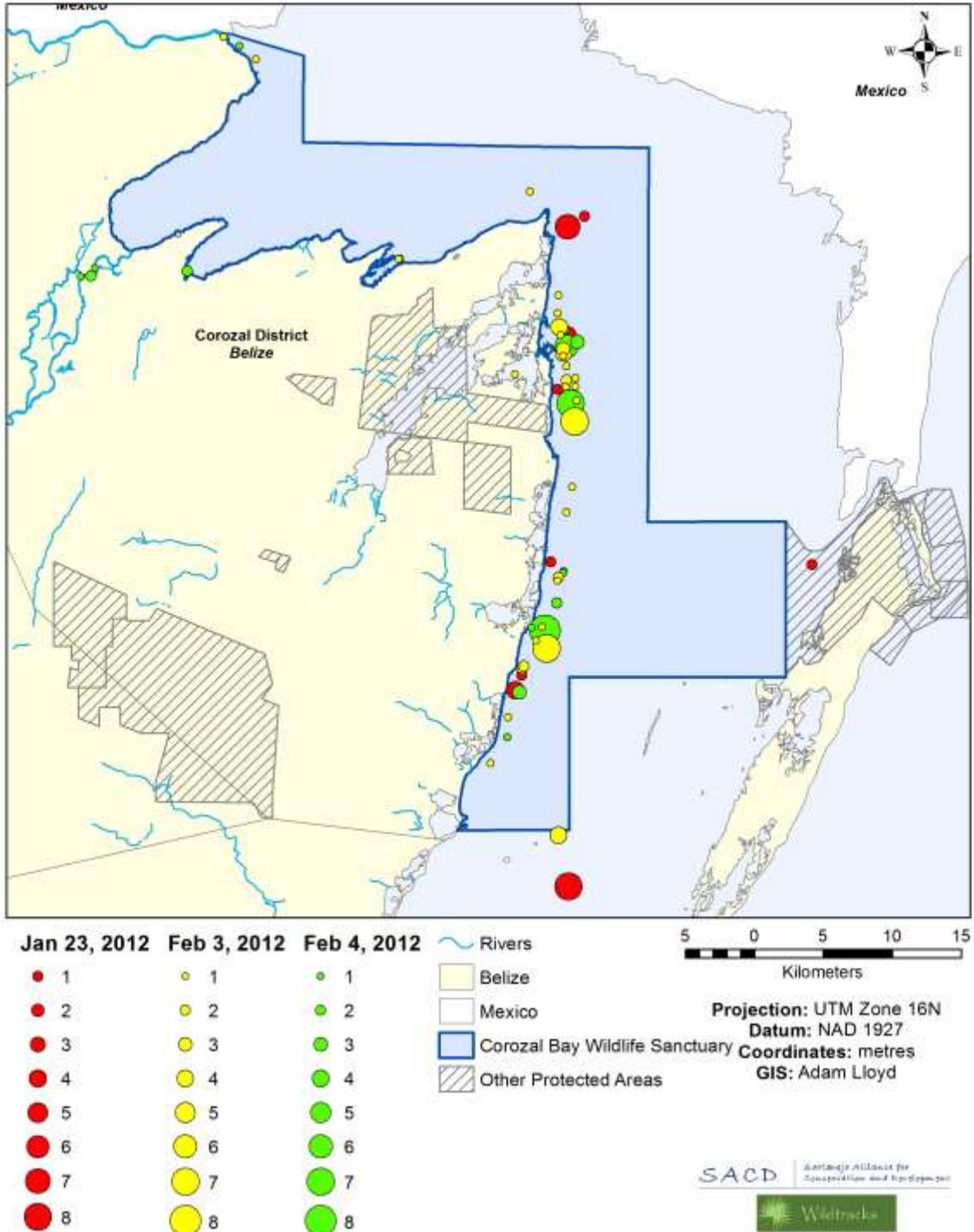


Figure 17: Results from aerial surveys conducted during the Norté Season, 2012

The majority of the sightings, especially in the norté season, are around three known manatee resting holes in the CBWS. Manatee resting holes are often in areas that experience slower currents, protection from wave action, abundance of seagrass and less boating traffic. They are characterized by depressions in the substrate, and have been correlated with resting behavior and presence of manatees in Belize (Bacchus, M et. al. 2009). The majority of manatees were seen on the east coast (44% individuals in the dry season, 83% individuals in the norté season), however this may have been partly due to poor visibility on the north coast during the surveys. Manatees were also recorded from rivers and south of the Wildlife Sanctuary border.

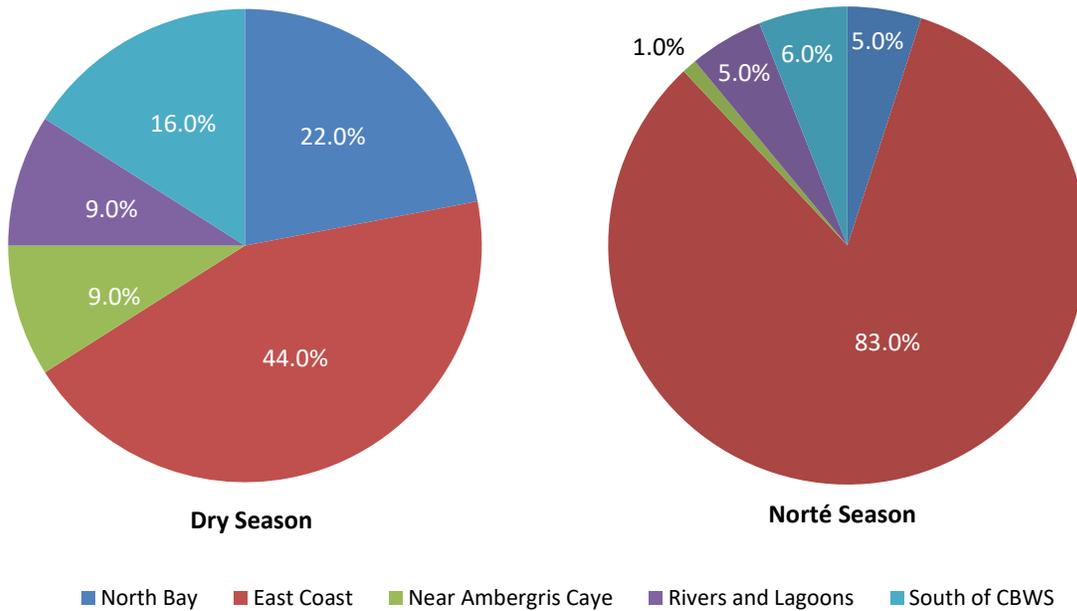


Figure 18. Manatee sighting distribution by area for 2011 dry (left) and 2012 norté (right) season aerial surveys

It is anticipated that Corozal Bay Wildlife Sanctuary will become even more important in the future as these threats increase, particularly with the increase in tourism-related activities further south resulting in increased boat activity and dredging, which may lead to manatees migrating further north towards Corozal Bay to escape such pressures.

A series of interviews conducted with fishermen of Sarteneja, the primary stakeholder community, showed a high level of knowledge on many aspects of the manatee, with 96% of respondents considering manatees important to Belize, and all respondents aware that manatee should no longer be hunted. Of the 78 people interviewed, only 2 had not seen a manatee and 74% had observed manatees in Corozal Bay. 11 of these interviewees had also caught manatees in the past

for consumption, though all respondents agree that currently, manatee are not hunted by the community (Chan, 2007).

It is recognized that there are no current accurate population estimates specific to Corozal Bay, even within the local community. Surprisingly, there was a near 50% split in interviewees thinking there was fewer or greater numbers of manatees than there was in the past (SACD/Wildtracks stakeholder meeting, December, 2008). In order to be able to manage the Wildlife Sanctuary as an effective conservation area for manatees, a priority activity therefore needs to be the collection of more accurate population data.

In collaboration with SACD, Wildtracks and the local fishermen, ‘No Wake’ signs are being erected in specific highlighted areas, in an effort to reduce the incidence of boat collisions. The fishermen also highlighted the need for more care in the use of gill nets to prevent manatees from becoming entangled in fishing gear. This includes not placing the nets in areas where the manatees congregate, and across creek mouths. Although entanglement is rare there have been reports of calves caught in nets (Auil and Valentine, 2004).

Whilst highlighting increased boat speed and traffic as the primary threat to manatee populations within Corozal Bay, the local fishermen also provided further information on other perceived threats to the local manatee population and some possible ways to reduce the affect of these threats (SACD/Wildtracks stakeholder meeting, December, 2008).

Illegal poaching of manatees in the Corozal Bay area has been a continuing concern. Although manatees are not currently hunted in Corozal Bay by Belizeans, they have been reported as being hunted by Mexican fishermen (SACD, 2006). Recent funding by PACT is focused on employing rangers to provide surveillance patrols in Corozal Bay Wildlife Sanctuary, to prevent future poaching from occurring.

The alteration and destruction of coastal habitats and pollution (especially from Corozal and Chetumal) are concerns which must be monitored carefully to structure a balance that provides for mankind whilst conserving the habitats of the manatees.

1.5.3 Bird Species of Corozal Bay Wildlife Sanctuary

Corozal Bay is known to support numerous wetland birds, with small mangrove cayes and areas of high vegetation providing nesting and foraging habitat also of importance to terrestrial bird populations. A number of bird surveys have been conducted over the years under SACD and Wildtracks, with the identification of several species restricted to the open estuarine environment of the Bay, and others restricted to littoral forest or mangrove habitat, such as the Clapper Rail (*Rallus longirostris*), with a reliance on mangrove forest that makes them sensitive to land use change for development in coastal areas. and others reliant. The coastal savannah area surveyed appears to be an important resting location or even overwintering ground for several species of migratory songbird. Palm Warblers (*Dendroica palmarum*) are one such species. While Jones (2003) describes them as uncommon winter visitors on the mainland, they were recorded during several surveys at both the beginning and the end of the survey period, suggesting that they may be resident in the area during the winter months.

The Black Catbird (*Melanoptila glabrirostris*), a Yucatan endemic, is also limited primarily to coastal areas along the northern coast, and is threatened by development of coastal areas and conversion of adjacent ecosystems for agriculture (Jones & Vallely, 2001). While it is locally common in the Corozal Bay area, its restricted range keeps total numbers low.

A number of seabirds have been recorded - Sandwich Terns (*Sterna sandvicensis*), while common in coastal areas during the winter, have almost been eliminated as a breeding species due to development of the cayes for tourism and other uses (Jones & Vallely, 2001).

A number of nesting colonies are located within or adjacent to the Wildlife Sanctuary. The two small mangrove cayes of Cayo Falso provide the sheltered structure for a large magnificent frigatebird and pelican colony, with cormorants and great egrets, reddish egrets, roseate spoonbills, white ibis and boat billed herons also utilizing the cayes. Little Guana Caye, established as a bird sanctuary under the National Lands Act, in 1977, for the presence of the largest nesting colony of reddish egrets in the Caribbean and is also known to have nesting white ibis (*Eudocimus albus*), tricolored herons (*Egretta tricolor*), and roseate spoonbills (Kramer & Kramer, 2002). Species surveys of this caye have also listed boat-billed heron (*Cochlearius cochlearius*).

These colony nesting species are charismatic and a major tourism attraction to the area. When disbursing to feed, they populate not only the shallow coastal lagoons, and those of Deer Caye, but also those of Bacalar Chico National Park / Marine Reserve and are thought to travel as far inland as Crooked Tree Wildlife Sanctuary (established for its rich waterbird population), providing an important tourism resource. Because of the fragility of large breeding colonies such as these, these species appear on the national list of species of concern (Meerman, 2005; draft), and any increase in tourism and boat activity in the area should take into consideration their requirements for minimal disturbance for nesting success during the nesting season.

American White Pelicans (*Pelecanus erythrorhynchos*), while not observed during the survey period, are seen occasionally in January in groups of 6-10 (Zoe Walker, personal communication). Although still uncommon in Belize, sightings have been increasing in coastal areas north of Belize City over the past two decades (Jones, 2003).

The forest vegetation of the coast and cayes adjacent and within the Wildlife Sanctuary will also be of importance to Neotropical migratory birds – a recent study highlighted the importance of this type of vegetation in the adjacent Sarteneja peninsula. The Yucatan Peninsula is highlighted as an important flyway for migrants crossing the Gulf of Mexico. Sixty-three species of migratory landbirds were recorded, including a number of species of concern in the United States - the prothonotary warbler (*Protonotaria citrea*), willow warbler (*Empidonax traillii*), and small numbers of wood thrush (*Hylocichla mustelina*), bay-breasted warbler (*Dendroica castanea*), Kentucky warbler (*Oporornis formosus*) and Canada warbler (*Wilsonia canadensis*). In general, migrants showed a preference for forested and mangrove habitats whilst avoiding open habitats such as savanna – forest clearance in stopover areas is therefore expected to have an adverse effect on migratory success (Bayly and Gomez, 2008).

1.5.4 Fish Species of Corozal Bay Wildlife Sanctuary

The shallow bays and inlets of Corozal Bay Wildlife Sanctuary provide a protected nursery habitat for a variety of fish species common to the shallow coastal lagoons of the area - the high temperatures generated in the shallow waters, and the reduced salinity prevent coral and coral reef communities establishing within the area.

Knowledge of species of the east waters of the Wildlife Sanctuary was also increased through a recent survey of Deer Caye, which identified the most abundant species within the project area as yellowfin mojarra (*Gerres cinereus*), grey snapper (*Lutjanus griseus*) and, surprisingly, bonefish (*Abula vulpes*). The bonefish, important for the fly-fishing tourism sector, tends to prefer shallow coastal waters, and was seen in large numbers (>500 individuals). All were juvenile, suggesting that this is an important nursery area, supplying the Bulkhead Shoal flats, favoured by the San Pedro sport fishermen. Bonefish are regulated under Belize Fisheries Department regulations, with restrictions on buying and selling of this species.

Also highlighted within the survey was the importance of the lower section of the mangrove-lined creek as a spawning area, with an extremely high density of fry and fingerlings. Large numbers of juvenile yellowfin mojarra, locally important as a commercial species, were also present further up the creek, as were Mayan cichlids (*Cichlasoma urophthalmus*), more frequently thought of as a freshwater / brackish water species.

Throughout the survey area, fish density was highest associated with limestone bedrock with its associated algal growth (*Batophora oerstedii*), and with the sparse seagrass patches (turtle grass

(*Thalassia testudinum*) and shoal grass (*Halodule wrightii*). The exceptions are the shallow waters of the west-facing bays, which provide ideal habitat for the common southern stingray (*Dasyatis americana*), and for the peacock flounder (*Bothus lunatus*) and chequered pufferfish (*Sphoeroides testudineus*).

To supplement the fish survey, a number of interviews were conducted with local fishermen in the area (Mr. Blanco, with fish traps set directly east of Deer Caye, on the west coast of Ambergris Caye; and Mr. Moreno, with a fishing camp located on the tip of the southern caye of the Deer Caye system).

Reports suggest that the Critically Endangered goliath grouper (*Epinephelus itajara*) was, at one time, relatively common in the bay, but overfishing has reduced numbers of this species. The habitats surveyed by Deer Caye are not ideal for this species, and the area not considered critical for its survival. Corozal Bay is reported to have at least five shark species (Bonfil, 1997) can be found within the general area, with bull, blacktip, nurse and bonnethead sharks (*Carcharhinus leucas*, *C. limbatus*, *Ginglymostoma cirratum* and *Sphyrna tiburo*) reported from the Bulkhead Shoals area to the southern end of the Wildlife Sanctuary, southeast of Deer Caye. The channels in this area are thought to be an important nursery area for these Elasmobranchs, and recent surveys have highlighted the presence of the only documented bull shark nursery in Belize (Figure 19; Graham, 2011).

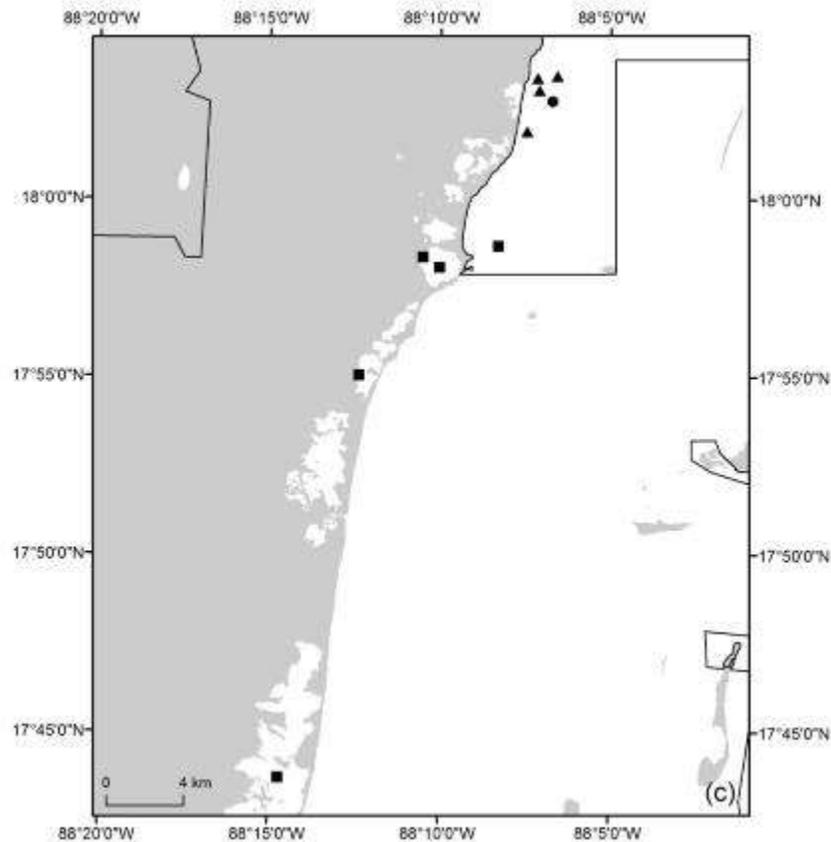


Figure 19. Distribution of captures of sharks, *Carcharhinus leucas* (▲) and rays, *Himantura Schmardae* (●) and *Dasyatis guttata* (■) throughout the Spanish Point and coastal lagoon region (Graham, 2010).



A juvenile bull shark (*Carcharhinus leucas*) captured and tagged with a conventional spaghetti tag placed at the base of the first dorsal fin. Bull sharks are pan-globally distributed and considered near threatened and a species of concern due to noted declines in abundance in several countries.

Bull sharks¹⁸ are a broadly distributed species found in the coastal and estuarine tropics and subtropics. Capable of tolerating a broad range of salinities from freshwater to the open sea (Thorsen 1971), bull sharks are more vulnerable than most elasmobranch species due to its coastal and riverine habitats preferences and localised extirpations have been recorded in Nicaragua by Thorsen (1982). With very late age at maturity (14-15 years for males and 18+ years for females based on Branstetter and Stiles 1987), longevity estimated at least 27 years and a low natural mortality of 0.166 year⁻¹ (Smith et al. 1998), bull sharks are highly vulnerable to exploitation. Pregnant females and juveniles prefer shallow coastal and estuarine areas with warm water, similar conditions to those encountered near Spanish Lagoon and

nearshore coastal areas where the five individuals were captured. The size ranges of the bull sharks captured suggests that the animals were between 2-4 years old based on size birth of 56-81 cm (Compagno 1984) and a conservative growth estimate of 16 cm a year during the first two years of life (Branstetter and Stiles 1987).

According to Heupel et al (2007) there are “three criteria to be met for an area to be identified as a nursery: (1) sharks are more commonly encountered in the area than other areas; (2) sharks have a tendency to remain or return for extended periods; and (3) the area or habitat is repeatedly used across years.” Although additional studies will be required to ascertain all these criteria are met, we were reliably informed by the fishers who fish the coast surveyed that the number of elasmobranchs in the area sampled and the small size of the sharks in particular was unusual and uncommon, suggesting that the Spanish Point area serves as an elasmobranch hotspot. No similar captures of bull sharks have been made during other surveys undertaken cross the past five years in other parts of Belize by Graham and her team. There are two other aspects that highlight this find as important: the proposed development site contains numerous rays of three species (only two species captured but the third *Dasyatis americana*) was also sighted), a favored food of bull sharks and all species that contribute to Belize’s thriving marine tourism that brings in over US\$500,000 a year to the Hol Chan and Shark Ray alley and Caye Caulker Shark Ray Alley annually.

¹⁸ This section on the bull shark / ray survey comes directly from the SACD/Wildtracks report produced by R. Graham, 2010

During the course of the assessment, two batoids or ray species were captured using the longlines. A much greater number were observed of both species during the entrance to and traverse of the lagoons. The relatively high capture of longnose stingrays in the Spanish Point Lagoon system forms the basis for further investigation. Longnose stingray *Dasyatis guttata* (Family Dasyatidae) is a little known species of ray considered by the IUCN to be Data Deficient indicating that there is insufficient data to assess its conservation status. With a range including the Western Atlantic, Gulf of Mexico, Caribbean, this ray is tolerant of broad salinity ranges during different stages of its lifecycles and is usually coastally constrained, and often found on muddy bottoms and near mangroves.

Reaching up to 2m in disc width, with females growing larger than males, longnose stingrays feed mainly on benthic invertebrates and small fish (Froese et al 2010). Females can bear a litter of 1–2 pups every 5-6 months in March and November in Brazil (Yokota and Lessa 2000), with similar seasonality in Belize (Graham unpublished data). Pups are born live about 12.3–15.3 cm disc width following gestation in a single functional uterus. Developing embryos are sustained by yolk and later histotroph ("uterine milk") produced by the mother modified to nourish the young in a similar manner to a placenta (aplacental viviparity) (Yokota and Lessa 2000). The life cycle of this ray includes birth in relatively fresh water, migration to more saline waters and then occupation of areas with variable salinities as adults. A mixture of juvenile and adult rays of both sexes were captured which suggests that the Spanish Point site is important for this species at different life stages, particularly as a site where maturing longnose rays move to due to the lower salinity. The mixture of sizes further suggests that the lagoons serve as potential pupping grounds as large females were found inside the lagoons where the salinity is lowest, a key variable noted in pupping grounds in Brazil (Yokota and Lessa 2000) and also recorded in the Placencia Lagoon during a Southern Belize elasmobranch assessment conducted in 2006 (Graham 2006). The low reproductive rate makes the species highly vulnerable to overexploitation from fisheries and other impacts to their reproductive success as they are biologically incapable of replacing themselves rapidly. Longnose stingrays are prey for a range of sharks ref and are fished in Belize for shark bait and in neighboring Guatemala for food.

Similar to the longnose stingray, the Caribbean whiptail stingray (*Himantura schmardae*) (Family Dasyatidae) is also listed as Data Deficient by the IUCN. An even greater paucity of information exists for this species than for *D. guttata*. According to Fishbase (www.fishbase.com) this species reaches a maximum disc width of 2.0 m. Although at least 7 individual rays were sighted during the surveys both inside the lagoons and nearshore coastal areas, only one individual, a small female measuring 51 cm DW was captured during the surveys. Although size at maturity is unknown, recent research conducted by R. Graham and her team at the offshore location of Lighthouse Reef Atoll suggests that females are sexually mature at 124cm DW and males display calcified claspers at 129 cm DW. Captures of pregnant females suggest that like the longnose stingray, the CWS has a single functional uterus (located on the left side of the body). Although Fishbase suggests that this species is ovoviviparous, the CWS may in fact display aplacental viviparity since other *Himantura* species are known to produce histotroph for developing embryos. Like the Longnose stingray, the Caribbean whiptail is highly vulnerable to overexploitation due to a low population doubling time of 4.5-14 years assuming that fecundity is close to 100%. Although finding these rays offshore was surprising, surveys conducted at other locations in

Belize have suggested that nearshore coastal areas function as critical nursery habitats for the pups and young of the year Caribbean whiptail stingrays. Although Caribbean whiptail rays and longnose stingrays seem to occupy a similar ecological niche and some overlap, there is a degree of segregation based on the substrate and life histories with young CWS preferring shallow mud and seagrass bottoms and sub-adults and adults of both sexes broadly distributed in areas with sandy and seagrass bottoms either close to the coast or near the barrier back reef and patch reefs.

Based on fisher interviews conducted by R Graham, *H. schmardae* is captured on longlines and in gillnets and is cut up and used as bait in the shark fishery primarily conducted by transboundary fishers working in Belize's waters. Rays are increasingly processed for their meat as shark populations decline and become scarce.

Corozal Bay is known as a sport fishing area, with bonefish, permit (*Trachinotus falcatus*), tarpon (*Megalops atlanticus*), common snook (*Centropomus undecimalis*) and crevalle jack (*Caranx hippos*) all being targeted. Unregulated fishing, however, is thought to have severely reduced populations from former levels.

1.6 Commercial Use of Corozal Bay Wildlife Sanctuary

The majority of the commercial users of Corozal Bay Wildlife Sanctuary are fishermen – either fishing for commercial finfish species for sale, or involved in the sport fishing industry. A baseline has been developed for the traditional finfish fishermen, considered the primary users of the marine resources.

1.6.1 Commercial Fishing

Fish trap data, a socio-economic survey of Sarteneja (the focal community of this plan) and community consultations with fishermen of Sarteneja and the other stakeholder communities, have provided extensive information on targeted fish species and fishing activities within Corozal Bay Wildlife Sanctuary.

An estimated 33 to 35 fishermen are considered to be dependent or largely dependent on the small scale fishery of Corozal Bay Wildlife Sanctuary (Table 11). The majority of these (50% +) are from Sarteneja, with the highest dependency, whilst those from Corozal and Consejo have greater opportunities for employment in other areas.

Community	Estimated number of fishermen*	Fishing Methods	Relative Dependency
Sarteneja	15	Beach traps, gill nets, cast nets	High
Chunox	4 - 5	Gill nets, cast nets	High
Copper Bank	4 - 5	Gill nets, cast nets	Medium
Consejo	7	Gill nets, cast nets	Low
Corozal	3	Gill nets, cast nets	Low

* Traditional fishermen considered dependent on fishing in Corozal Bay Wildlife Sanctuary for the majority of their income

Table 11: Origin of Fishermen of Corozal Bay Wildlife Sanctuary



Photo: R. Graham

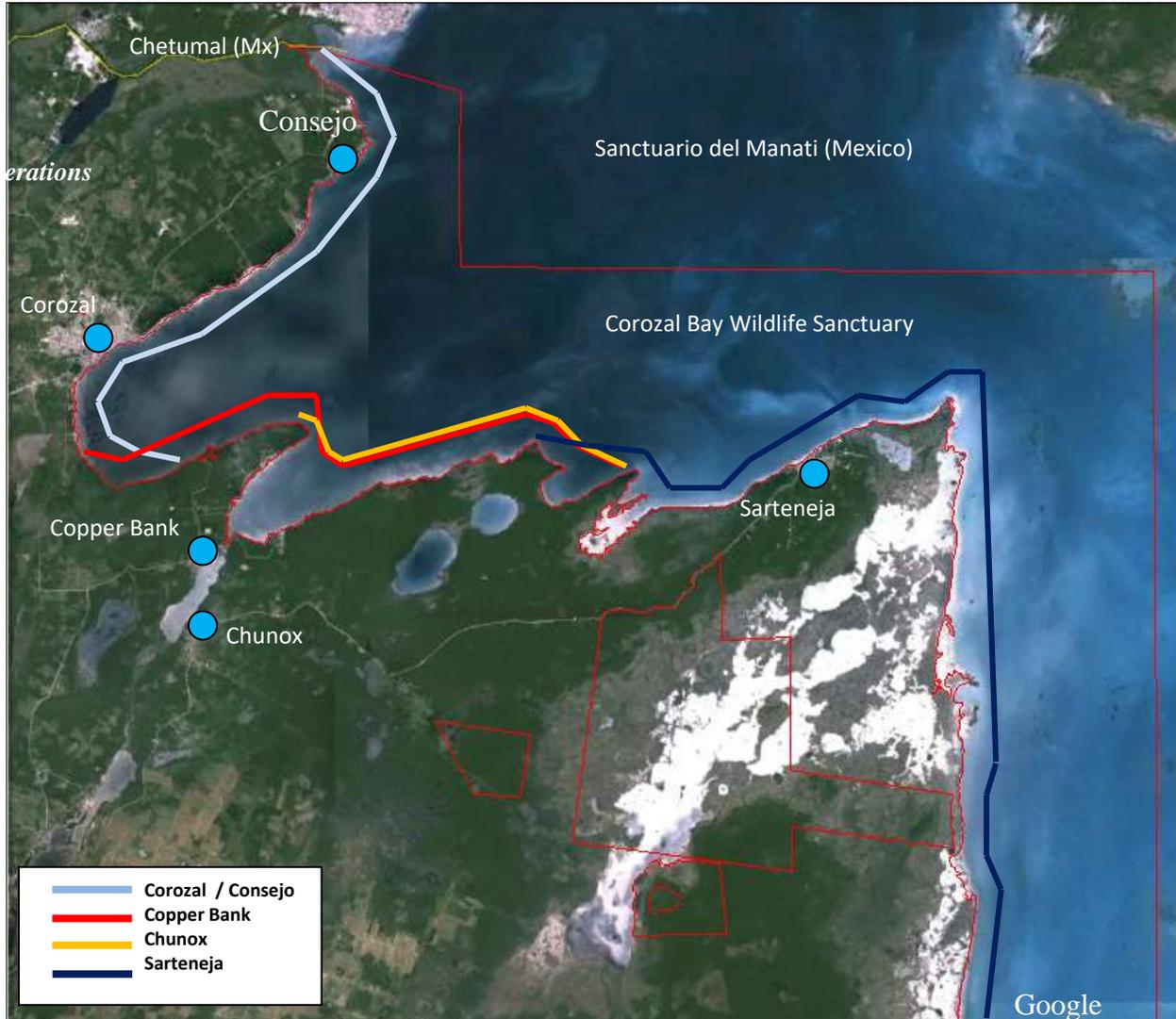


Photo: R. Graham



1.6.2 Fishing Areas

Mapping exercises in the stakeholder communities demonstrate that there is a loose division of the fishing area per community, with Sarteneja using the largest percentage of the Wildlife Sanctuary (Map 4). Fishing activities are almost exclusively within 300m of the shore, focused on catching species that move up and down the coastline, using a variety of fishing methods and equipment.



Map 4: Fishing areas per community (SACD Community Consultations, Sarteneja, Chunox, Copper Bank and Corozal, 2009 – 2011)

The area of highest overlap is Warree Bight, a sheltered bay accessed by Sarteneja, Chunox and Copper Bank fishermen.

1.6.3 Target Species

Fourteen species are regularly fished from Corozal Bay Wildlife Sanctuary for commercial or home-use purposes (Table 12), with four of these considered key targets for fishery management.

Common Name	Local Name	Species Name
Horse eye jack	Jurel	<i>Caranax latus</i>
Crevalle jack	Jurel	<i>Caranx hippos</i>
Atlantic spadefish	La Vieja	<i>Chaetodipterus faber</i>
Striped mojarra	Chiwa	<i>Eugerres plumieri</i>
Yellowfin mojarra	Mojarra	<i>Gerres cinereus</i>
Blue Striped Grunt	Chac chi	<i>Haemulon sciurus</i>
Mutton Snapper	Pargo	<i>Lutjanus analis</i>
Grey snapper	Pargo	<i>Lutjanus griseus</i>
Lane snapper	Pargo	<i>Lutjanus synagris</i>
White Mullet	Mullet	<i>Mugil curema</i>
Striped Mullet	La Lisa	<i>Mugil cephalus</i>
Cero	La Ciera	<i>Scomberomonis regalis</i>
Great Barracuda	Picuda	<i>Sphyraena barracuda</i>
Mayan Cichlid	Xpinta	<i>Cichlasoma uprothals</i>

Table 12: Species fished regularly from Corozal Bay Wildlife Sanctuary (Fish trap data, 2011)

A profile of the demand for different species of fish by Sarteneja for both home and for commercial purposes was assessed through a survey of 150 households (SACD, 2009), providing information on species considered culturally important to the diet of the community (Table 13).

Family	% respondents (of 150)	Species	
Stone Bass (Gerridae)	55	Striped Mojarra	<i>Eugerres plumieri</i>
		Yellowfin Mojarra	<i>Gerres cinereus</i>
Snapper (Lutjanidae)	23	Grey Snapper	<i>Lutjanus griseus</i>
		Lane Snapper	<i>Lutjanus synagris</i>
		Mutton Snapper	<i>Lutjanus analis</i>
Barracuda (Sphyraenidae)	15	Great Barracuda	<i>Sphyraena barracuda</i>
Jack (Carangidae)	4	Horse-eye Jack	<i>Caranax latus</i>
		Crevalle Jack	<i>Caranax hippos</i>

Table 13: Preferred Target Species (Sarteneja Socio-economic Survey, 2009)

Two fish families were highlighted as preferred species within the community, and therefore targeted by local fishermen. There is a clear cultural preference for striped mojarra ('chiwa' or 'stone bass' - *Eugerres plumieri*), as well as the closely related yellowfin mojarra ('mojarra' - *Gerres cinereus*), this family being favoured by 55% of respondents. The Lutjanidae – the snapper, particularly the grey (or mangrove) snapper ('pargo' - *Lutjanus griseus*) is favoured by 23% of respondents) (Figure 20).

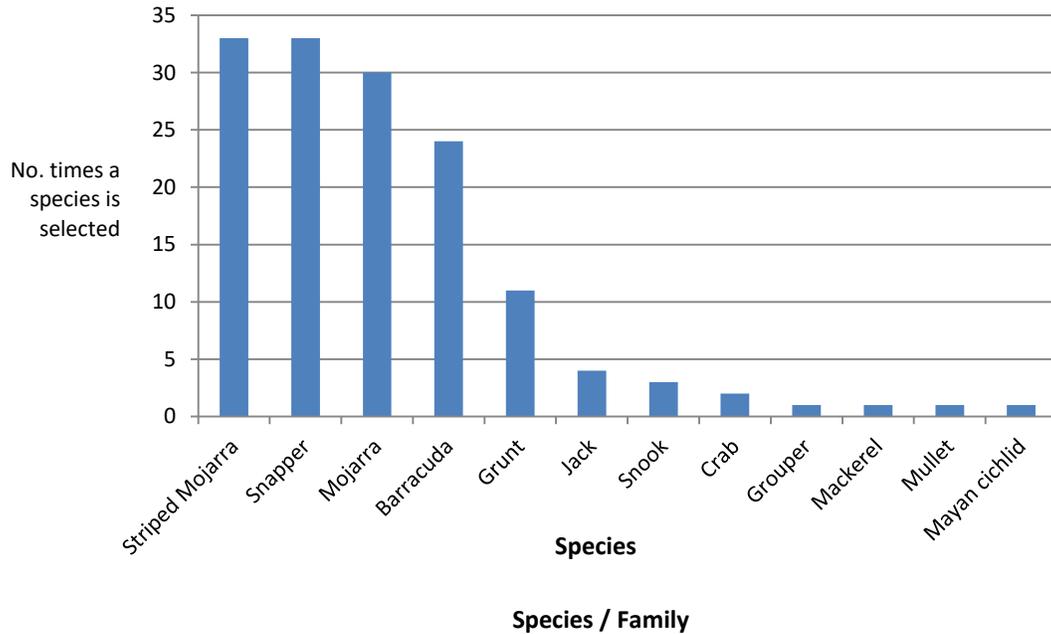


Figure 20: Preferred fish species targeted by fishermen in Corozal Bay Wildlife Sanctuary (SACD, 2009)

Whilst these results are specifically for Sarteneja, community participants in management planning workshops in Chunox, Copper Bank and Corozal (March - June, 2009) also agreed with these preferences.



Grey snapper ('pargo') *Lutjanus griseus*



Yellowfin Mojarra ('mojarra')
Gerres cinereus



Striped Mojarra ('chiwa')
Eugerres plumieri

Community consultations with fishermen suggest that not all these species are available throughout the year... some enter the estuarine system in large numbers only seasonally, to spawn (Figure 21), generally running during the first north wind of the north front season and at the start of the first tropical storm.

Species	J	F	M	A	M	J	J	A	S	O	N	D
Striped mojarra - <i>Eugerres plumieri</i> (Chiwa)												
Striped Mullet - <i>Mugil cephalus</i> (Lisa)												
Crevalle Jack - <i>Caranx hippos</i> (Jurel)												
Mackerel - <i>Scomberomnis regalis</i> (Cero)												
Yellowfin mojarra - <i>Gerres cinereus</i> (Mojarra)												
Grey snapper - <i>Lutjanus griseus</i> (Pargo)												
Lane Snapper – <i>Lutjanus synagris</i> (Pargo)												
Mutton Snapper - <i>Lutjanus analis</i> (Pargo)												
White Mullet – <i>Mugil curema</i> (Mullet)												
Snook - <i>Centropomus undecimalis</i> (Robalo)												
Blue-striped grunt - <i>Haemulon sciurus</i> (Chac chi)												

Figure 21: Species seasonality within Corozal Bay Wildlife Sanctuary (SACD / local fishermen, 2009)

An assessment of the beach trap catch data collected in 2011 demonstrates that the preferred species are also those that have the greatest representation in the catch.

1.6.4 Types of Fishermen

Five types of Sarteneja fisherman were identified as using the Wildlife Sanctuary, some for commercial purposes, others for home use (Table 14)

Each has a specific set of equipment, dependent on the type of fishing and distance travelled to reach the fishing area, and target a specific suite of species.

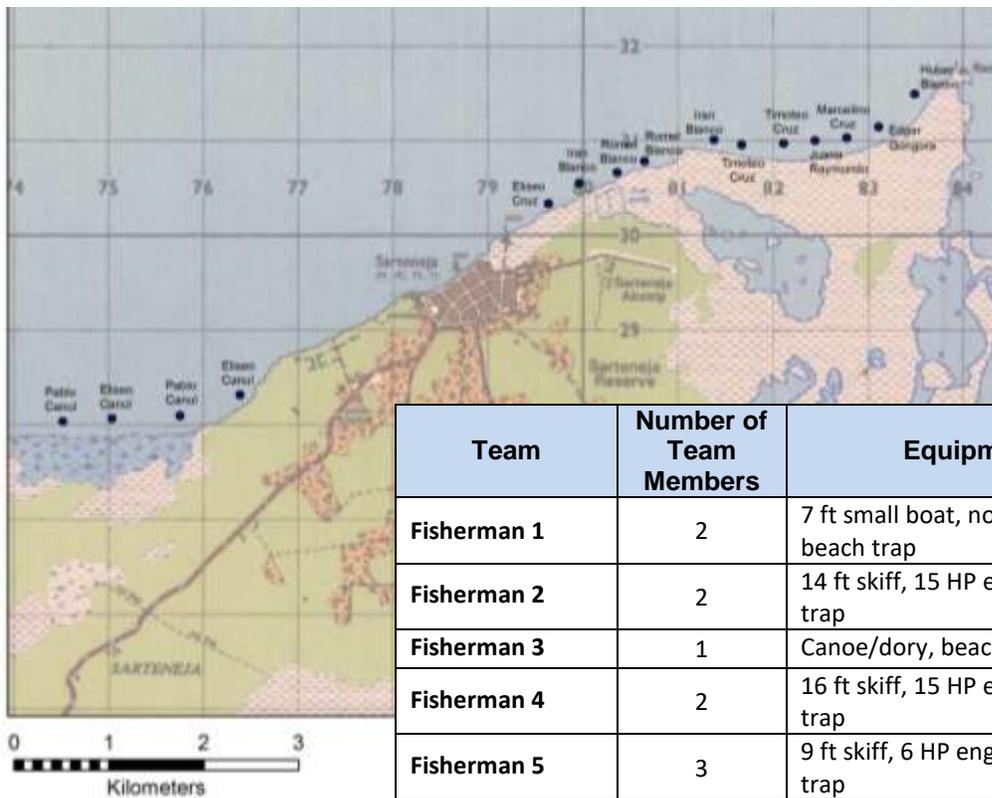
Types of Fishermen	
Commercial	<ul style="list-style-type: none"> ▪ Beach Trap ▪ Gill Net ▪ Seasonal Gill Net ▪ Sport Fishing
Non-Commercial	<ul style="list-style-type: none"> ▪ Cast Net

Table 14: Types of Fishermen in Sarteneja

The consistent primary commercial users of CBWS in Sarteneja are the 15 or so commercial fishermen who use traditional beach traps or gill nets, along with their assistants. Fishing with a cast net is considered a traditional recreational activity by the majority of men, generally in the shallow waters in front of the community, with the catch providing additional food for the family. Community consultations in other communities show a much lower dependence on the fish resources.

Additionally, CBWS is the target of incursions primarily by Mexican fisherman, with illegal gill net fishing and, in the past, opportunistic manatee poaching. Honduran and Guatemalan fishermen are also known to frequent the southern end of the Wildlife Sanctuary.

Beach Trap Fishermen: Sarteneja is the only community of CBWS to have beach traps, consist of a line of wooden sticks spaced 2 ft apart extending 250-300ft from shore, leads into a circle 25-30ft in diameter, and target species that move parallel to the shore. This is considered a traditional fishing method for the area, with traps being passed from father to son. 10 trap fishermen man 15 traps, set in permanent locations along the coastline east and west from Sarteneja (Map 5, Table 15). Fishing is seasonal, with traps opened in mid-April and removed in mid-November. The take is very discriminatory, with fish netted live and sorted at point of capture. By-catch (non commercial species / undersized) is thrown back alive.



Map 5: Location and ownership of beach traps

Team	Number of Team Members	Equipment
Fisherman 1	2	7 ft small boat, no engine, beach trap
Fisherman 2	2	14 ft skiff, 15 HP engine, beach trap
Fisherman 3	1	Canoe/dory, beach trap
Fisherman 4	2	16 ft skiff, 15 HP engine, beach trap
Fisherman 5	3	9 ft skiff, 6 HP engine, beach trap
Fisherman 6	2	25 ft skiff, 40 HP engine, beach trap
Fisherman 8	2	23 ft skiff, 40 HP engine, beach trap

Table 15: Beach trap fishermen equipment

Commercial gill net / cast net: 4 teams of between 2 to 3 people from Sarteneja use gill nets on the East Coast, behind Deer Caye / Cayo Negro or on the north coast, depending on the time of year and water conditions (Table 16). Nets are set in the evening and pulled in early morning. These nets are not discriminatory, and kill by-catch and undersized fish as well as those targeted. Cast nets are then used during the day – sometimes within the coastal lagoons and creeks.



Four teams of gill net fishermen use Corozal Bay Wildlife Sanctuary

Team	Number of Team Members	Equipment
Fisherman 1	2	Gill net, 60/75HP engine, 25 ft skiff
Fisherman 2	3	Gill net, 60/75 HP engine, 25 ft skiff
Fisherman 3	2	Gill net, 40 HP engine, 12 ft skiff
Fisherman 4	3	Sink net, 30 HP engine 20 ft sailboat, 8 HP 9 ft skiff

Table 16: Gill net fishermen

Seasonal gill nets

A number of Sartenejans, whilst not fishing in CBWS as their primary source of income, use gill nets commercially during peak fish movement times in front of Sarteneja or on the East Coast (primarily October / November, with the first north fronts. These nets are not discriminatory, and kill by-catch and undersized fish as well as those targeted. Species targeted are jack, snook, and snapper.

Cast Net Fishing: Cast nets (or throw nets - 8-12ft circular nylon nets with a mesh size of 1.5 inches and about 20 small lead weights around the outer edge) are used by many fishermen in the shallow waters in front of Sarteneja when the lobster season is closed, for relaxation and to catch fish for the table. Cast nets are normally used in the early morning or evening, for better lighting, and to avoid the heat of the day. There are seldom more than four or five fishermen active at any one time, and the catch is small (generally between 10 and 20 fish). Approximately 10 people from Sarteneja use cast nets on a regular basis (once every two weeks or more) throughout the year in front of Sarteneja, at Warree Bight and Rocky Point, in the creeks, both for recreation and for the table. Species targeted are striped and yellowfin mojarra (chiwa and mojarra) and the sailfin catfish (vaca).



Sport Fishing

Sport fishing in the Wildlife Sanctuary is primarily catch and release, but guides will sometimes keep a fish for the tourist / family to eat. Four sport fishing guides fish from Sarteneja, in addition to an unknown number from Corozal and San Pedro, using specific areas of the Wildlife Sanctuary, such as the Punta Caul sink hole for tarpon, and the Spanish Point and Deer Caye areas for bonefish. Sport fishermen are far more selective, with a narrower range of target species, primarily focused on tarpon, permit, bonefish, snook, and barracuda, driven by market demand from the sport fishing industry.

Type of fisherman	Species Targeted
Commercial Beach Trap	Striped mojarra (chiwa), yellowfin mojarra, grey snapper, lane snapper, mutton snapper (rare), schoolmaster (rare), blue striped grunt, crevalle jack, horse-eye jack, Atlantic spadefish, great barracuda, white mullet, snook, needlefish, cero Bonefish and permit are also caught within the beach traps, but are generally released following the legislation banning the possession of these species.
Cast net	Chiwa, mojarra, la vaca,
Commercial gill net	Grey snapper, lane snapper, mutton snapper (rare), school master (rare), crevalle jack, horse eye jack, barracuda, white mullet, snook, mackerel, cero, young sharks (casson), cobia
Sport fishing	Tarpon, bonefish, barracuda, jacks, snook (a little), permit
Seasonal gill nets	Grey snapper, striped mojarra, yellowfin mojarra

Table 17: Species catch per fisherman type

Illegal Fishing Incursions: There are also incursions from commercial fishermen from Mexico, Honduras and Guatemala, on a more intensive and less selective scale than the local fishing practices, and considered a greater threat to the viability and sustainability of the fishing industry within the Wildlife Sanctuary. As recommendations are focused on enforcement activities against use of the Wildlife Sanctuary by this sector, they are not included within the assessment activities, other than as a threat.

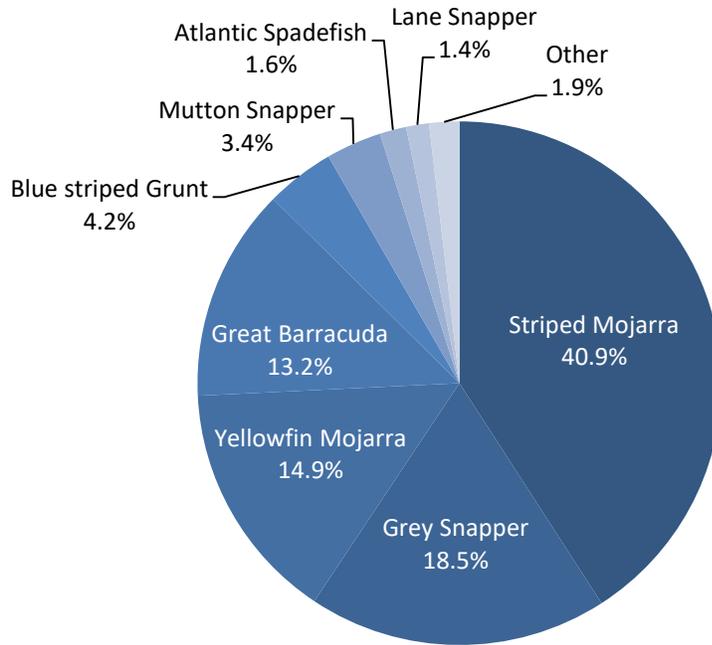
1.6.5 Profile of the Beach Trap Fishery

The beach trap fishery of Sarteneja has been the focus for community sampling of current fish catch and fishing effort during 2011, to provide a baseline for improved planning for sustainable use. The survey covered 9 of the 15 traps (65%) between June and November, with sampling of catch at point of extraction by the sampling team (SACD and local fishermen, assisted by Wildtracks and Blue Ventures). 32 catch samples were conducted (Table 18), with each trap being sampled between 1 and 9 times during the trapping season. Unfortunately external conditions resulted in sampling gaps occurring in April and May, and again in September and October, when sampling was not feasible.

All catches were mixed, with 1,343 individual fish over a range of 15 commercial species. The most abundant species was the striped mojarra ('chiwa' – *Eugerres plumieri*), with a total of 549 individuals sampled (representing 40.9% of the total catch), followed by the grey snapper ('pargo' – *Lutjanus griseus*) with 248 (18.5%), the yellowfin mojarra ('mojarra' – *Gerres cinereus*) with 200 individuals (14.9%), and great barracuda ('picuda' – *Symphaena* with 177 (13.2%) (Figure 22; 23). The remaining species were represented by less than 100 individuals each. Blue swimming crabs (*Callinectes sapidus*) were also frequently caught in the traps and sold commercially.

Month	No. surveys conducted
April	-
May	-
June	2
July	10
August	4
September	-
October	-
November	16
Total	32

Table 18: Temporal spread of surveys



Species

Figure 22: Percentage catch per species (SACD beach trap data, 2011)

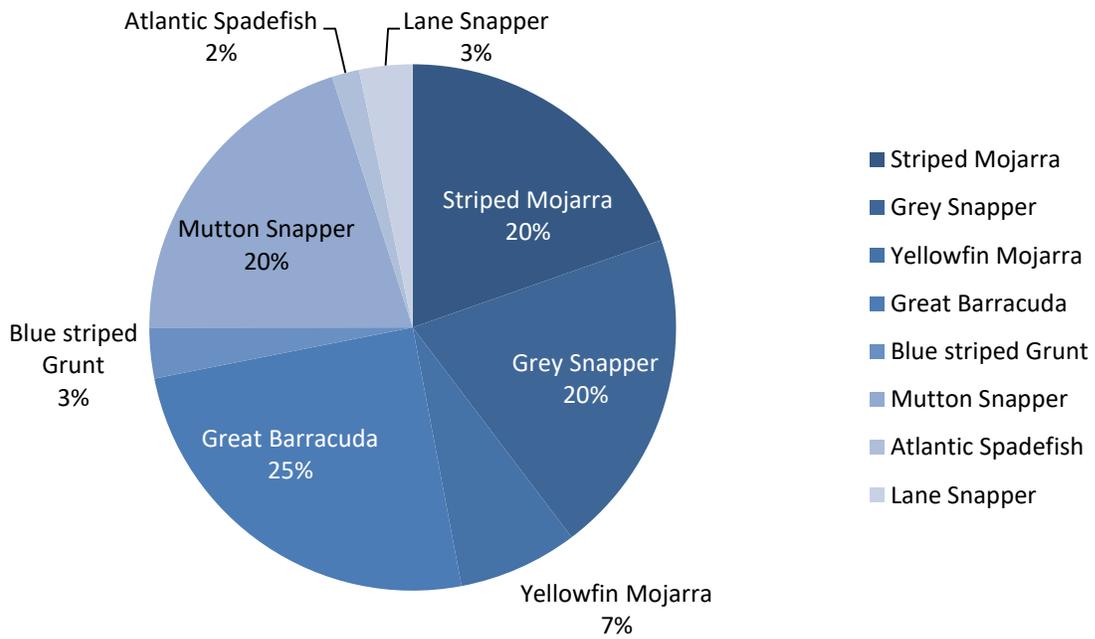


Figure 23: Percentage catch biomass per species (SACD beach trap data, 2011)

Species		Total Number	Total Biomass (g)	% of catch mature (L ₅₀)	Mean Length	Mode Length
Striped Mojarra	<i>Eugerres plumieri</i>	549	93,530.0	88.5%	23.3	23.0
Yellowfin Mojarra	<i>Gerres cinereus</i>	200	35,037.7	99.0%	24.1	22.5
Grey Snapper	<i>Lutjanus griseus</i>	248	95,686.1	88.7%	28.9	27.6
Mutton Snapper	<i>Lutjanus analis</i>	46	15,600.2	0.0%	26.9	28.0
Lane Snapper	<i>Lutjanus synagris</i>	19	8,662.0	94.7%	30.2	31.4
Great Barracuda	<i>Sphyraena barracuda</i>	177	118,545.8	2.26%	45.2	43.0
Blue-striped Grunt	<i>Haemulon sciurus</i>	57	14,8772.6	100.0%	23.6	23.0
Atlantic Spadefish	<i>Chaetodipterus faber</i>	22	7,973.6	-	20.7	20.0
Striped Mullet	<i>Mugil cephalus</i>	7	2,682.9	42.9%	34.7	33.0
White Mullet	<i>Mugil curema</i>	7	1,713.5	100.0%	29.5	25.0
Crevalle Jack	<i>Caranx hippos</i>	4	8,006.3	0.0%	53.8	51.0
Horse Eye Jack	<i>Caranx latus</i>	3	740.0	100.0%	26.4	23.0

Table 19: Catch sample summary

The by-catch consisted of ten species. Three of these are sport fish species (permit, bonefish and palometa), two are stingrays (southern stingray and longnose stingray), and the lookdown, catfish, chequered puffer, burrfish, redfin needlefish and yellow tail jack, as well as undersized commercial fish - all by-catch was returned live to the water, where possible. There were incidental mortalities caused by a small number of fish being caught in the chicken wire wall of the trap (generally barracuda), or becoming prey to brown pelicans or magnificent frigatebirds as they were being thrown back into the water.



The lookdown (Selene vomer), part of the beach trap by-catch, though occasionally taken for home use

1.6.6 Catch per Species

Percentage catch per species can be estimated from the total catch, as can species length frequency and seasonality of catch. Mojarra (striped mojarra (*Eugerres plumieri*) and yellowfin mojarra (*Gerres cinereus*)) and snapper (grey snapper (*Lutjanus griseus*)) made up the majority of the catch, with catch analysis being focused primarily on species of these families.



Mixed mojarra catch

Striped Mojarra ('Chiwa' - *Eugerres plumieri*)

The locally preferred striped mojarra or 'chiwa' (*Eugerres plumieri*) is also the most frequently caught species, with 549 individuals, representing 40.9% of the sampled catch. Striped mojarra catch ranged from 15cm to 32.2cm in length, with a mean total length of 23.3cm and mode of 22cm (Figure 24). The total sampled catch is estimated at 93.6kg for 32 trap events, 23.7% of the total catch biomass, and an average of 2.9kg per trap. All fish under 15.0cm are returned live to the water at point of capture, during the catch sorting process, as part of the traditional fishing practice.



Striped Mojarra (*Eugerres plumieri*)

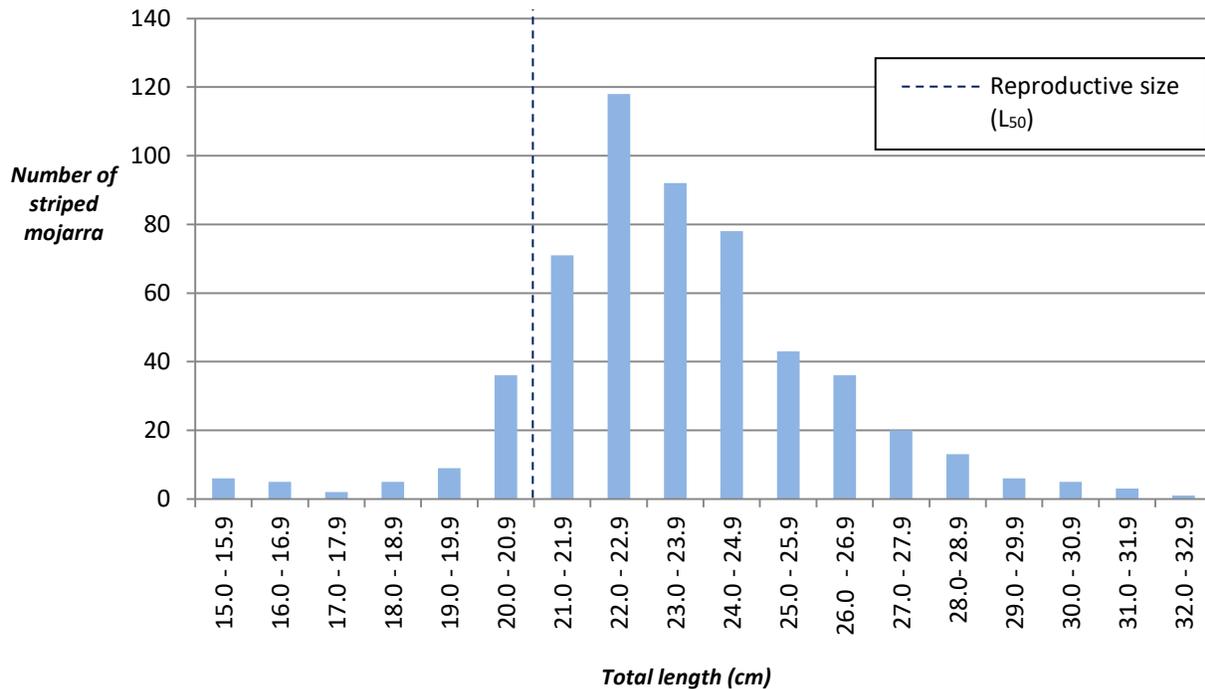
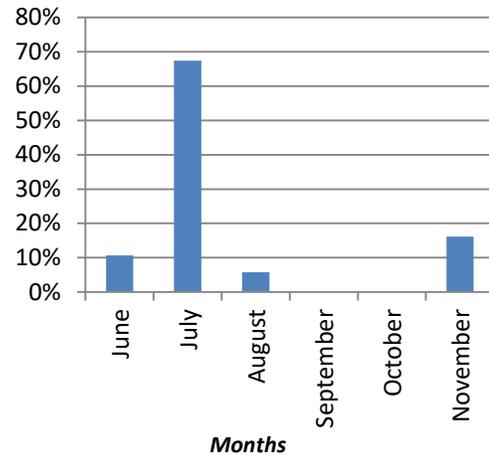


Figure 24: Size range of striped mojarra (*Eugerres plumieri*) sampled from beach traps, total catch data, 2011

This species matures at a total length of between 18.0 cm and 22.0 cm (7.0 to 8.5 inches). Based therefore on an estimated average maturity at 20.0cm total length, the majority of individuals in the catch (88.5%) are reported to be in the range where at least 50% of the population is thought to be sexually mature (L_{50}).

Striped mojarra are present throughout the beach trap season (Figure 25), but has a very seasonal abundance, peaking in July, with 47.9% of the sampled catch being caught in one trap event (Trap 3) on 8/7/2011. July brings the first major rains of the wet season, reducing the salinity of the estuarine system.

% of striped mojarra per beach trap



Yellowfin Mojarra ('mojarra' – *Gerres cinereus*)

**Figure 25: Striped mojarra ('chiwa' – *Eugerres plumieri*) - Seasonality of catch. (n=56.2)
NB: No data for September or October**

The yellowfin mojarra (*Gerres cinereus*), the second preference as a food fish in Sarteneja, represents 14.9% of the total sampled catch. Yellowfin mojarra ranged from 19.0cm to 44.9cm in total length, with a mean size of 24.1cm and mode of 22.0cm (Figure 26). The total sampled catch is estimated at 35.0kg for 32 trap events, an average of 1.1kg per trap. All fish under 19.0cm are returned live to the Bay as by-catch, as part of the traditional fishing practices. Total length at maturity is estimated at between 17.0 cm and 20.0 cm (approximately 7.0 to 8.0 inches). Based on an averaged length at maturity of 19.0cm, 99.0% of individuals in the catch are reported to be in the range where at least 50% of the population is thought to be sexually mature (L₅₀).



Yellowfin mojarra (*Gerres cinereus*)

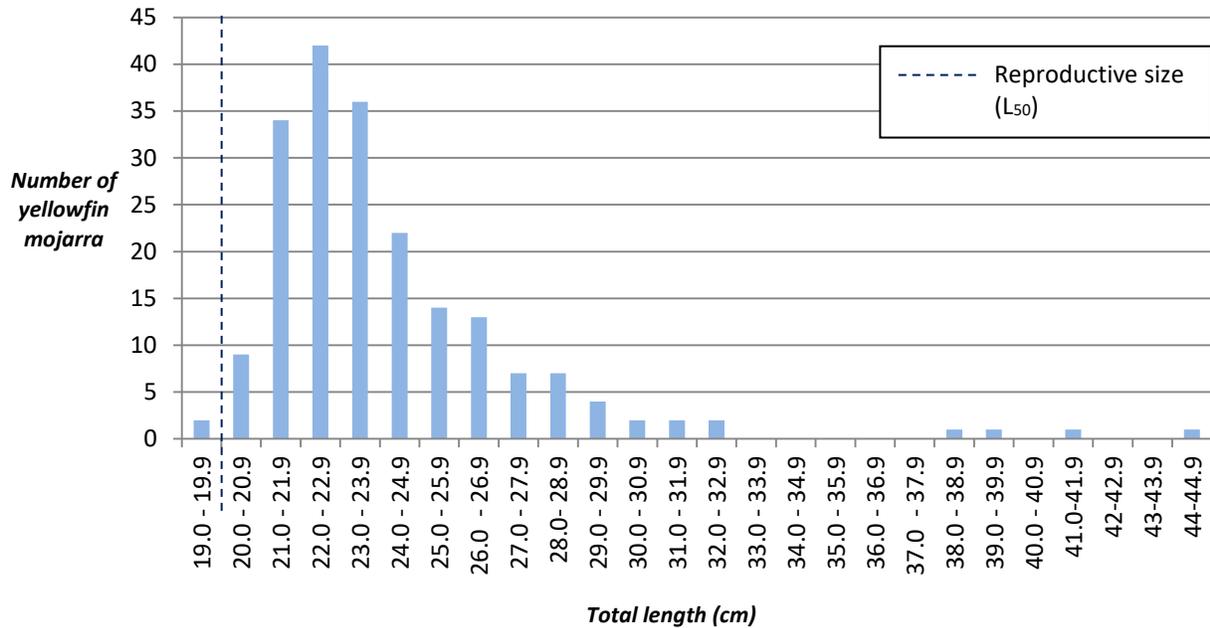


Figure 26: Size range of yellowfin mojarra (*Eugerres plumieri*) sampled from beach traps, total CBWS catch data, 2011.

The yellowfin mojarra, like the striped mojarra is present throughout the beach trap season (Figure 27), but is very seasonal in abundance, peaking in July with the advent of the first major rains of the wet season.

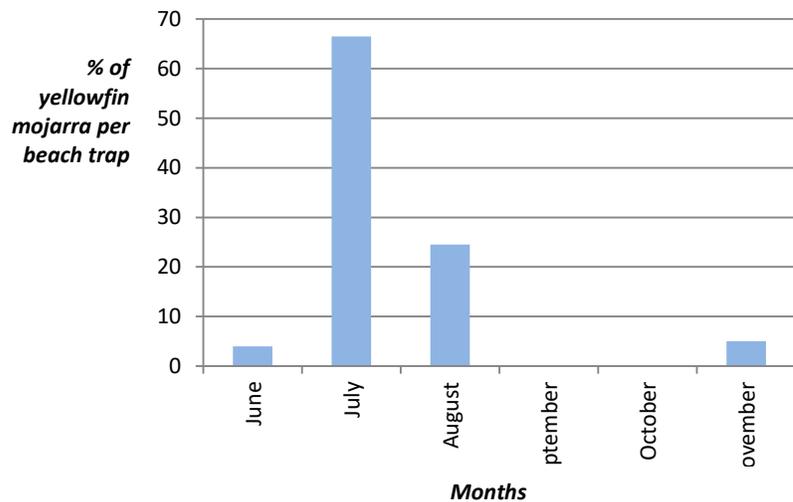


Figure 27: Yellowfin mojarra - Seasonality of catch
NB: No data for April, September or October (n=200)

Grey Snapper ('Pargo' – *Lutjanus griseus*)

Three species of snapper were represented within the catch, with the majority (248 individuals, - 79.0% of the snapper catch) being grey snapper (*Lutjanus griseus*). 15.0% of the snapper catch was mutton

snapper (*Lutjanus synagris*), with the remaining 6.0% being lane snapper (*Lutjanus analis*) (Figure 28). Lane and mutton snapper were not caught in the same catches – mutton snapper were the most seasonal, all individuals being caught in November, whilst lane snapper occurred in catches from June to August.

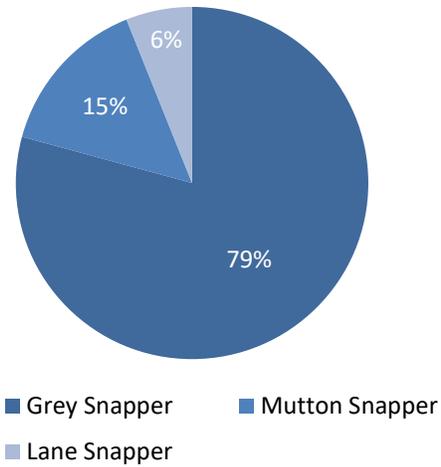


Figure 28: Relative abundance of snapper species in catch samples (n=248)

The Grey snapper catch ranged from 20.0cm to 40.3cm in total length, with a mean size of 29.0cm and mode of 28.0cm (Figure 29). The total sampled catch is estimated at 95.7kg for 32 trap events, an average of 3.0kg per trap. This species matures at a size of 18.0 – 33.0 cm (7.0 – 13.0 inches; Allen, 1985). Based on a length at maturity of 25.0cm, the majority of individuals in the catch (88.7%) are reported to be in the range where at least 50% of the population is thought to be sexually mature (L_{50}).

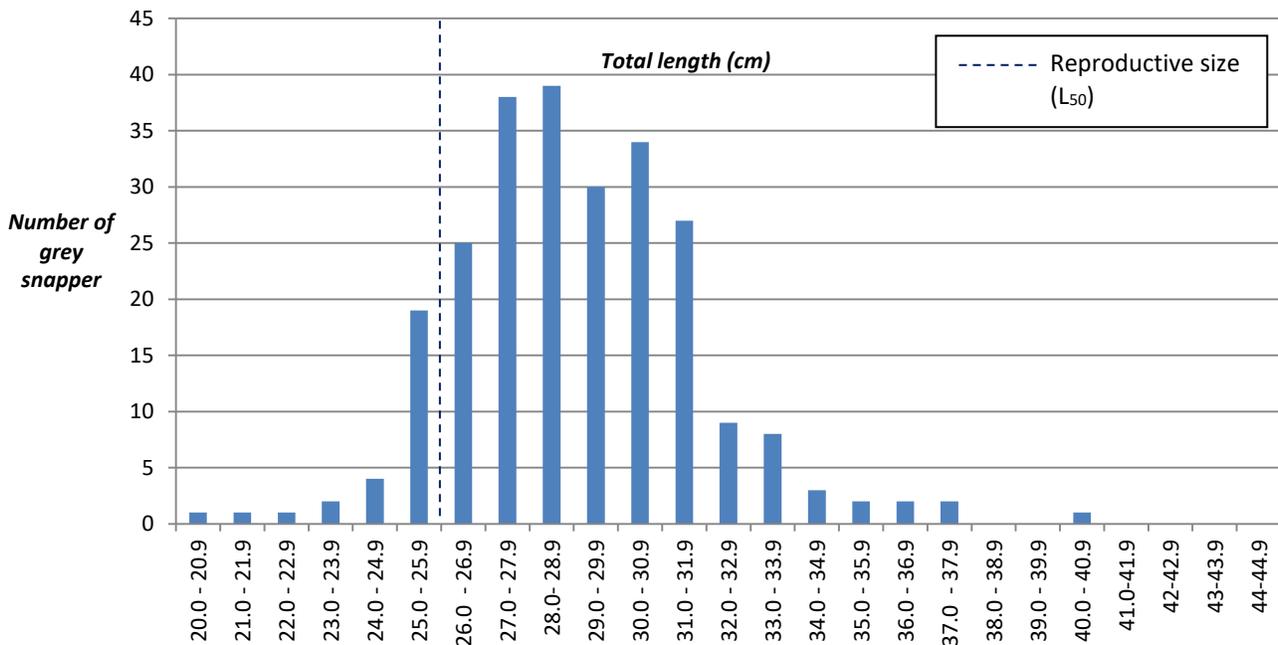


Figure 29: Size range of grey snapper (*Lutjanus griseus*) sampled from beach traps, total CBWS catch data, 2011

Whilst present throughout the beach trap season, grey snapper are more abundant in the catch towards the start of the season, with the average number of fish caught per trap event gradually reducing through the year (Figure 30).

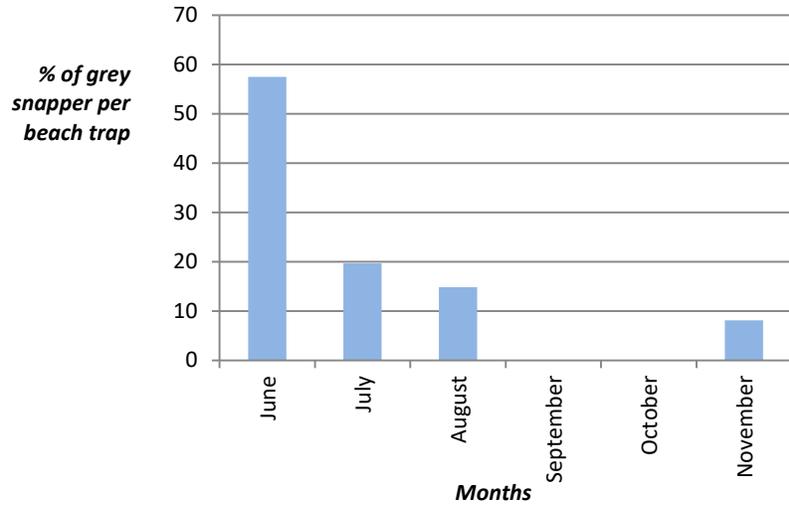


Figure 30: Grey snapper (*Lutjanus griseus*) – seasonality of catch

NB: No data for April, September or October

2.0 Conservation Planning

Whilst a full conservation planning exercise has not yet been completed for Corozal Bay Wildlife Sanctuary, conservation targets and threats have been identified, and a shortened conservation planning process has been used to highlight strategies and actions relevant to improving management of West Indian manatees, seagrass, commercial fish species and the estuarine environment (more specifically, water quality).

2.1 Conservation Targets

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

Seven targets have initially been identified for the purpose of this Plan, at a coarse enough scale to encompass the diverse guilds and individual species of conservation concern within the Wildlife Sanctuary. Three of these targets (seagrass, mangroves and estuarine ecosystem) are broad ecosystem categories, two are species assemblages (native fish species and bird nesting colonies), and one is an individual species (the vulnerable West Indian manatee)

- Native Commercial Fish Species
- West Indian Manatee
- Elasmobranchs
- Bird Nesting Colonies
- Seagrass
- Mangroves
- Estuarine Ecosystem

2.1.1 Commercial Fish Species

Fishing within the Corozal Bay Wildlife Sanctuary has been identified as a traditional resource-use activity, practiced from generation to generation, generating an income for families, and providing an important protein source in stakeholder communities. More recently, there has also been a focus on sport fishing, from Corozal, San Pedro and Sarteneja – an area of interest that is predicted to increase over the coming years, as Corozal Bay become known for its permit, bonefish tarpon and snook populations.

Management Goals

The current status of Commercial Fish Species is considered to be **FAIR**. The goal is to increase this status to **GOOD** by the end of the 5-year management period.

- Maintaining and improving the native fish populations of the protected area,
- Developing mechanisms to ensure the continuity of sustainable traditional fishing for the stakeholder communities – whether for the table or for tourism purposes (catch and release).
- Providing alternatives for local fishermen
- Increasing their participation in management of the fishery as a sustainable resource, and increased economic benefit.

Commercial Species: A profile has been developed of the fish resources of Corozal Bay Wildlife Sanctuary used by the communities for both home and for commercial purposes. This was achieved with the assistance of local fishermen, and through a survey of households in Sarteneja (considered the primary stakeholder), Chunox and Copper Bank (SACD, 2008; Catzim et. al, 2008). Those species considered of greatest value to the communities were identified (Figure 12), and seasonal variation in species-availability was assessed.

When analysed for the number of times a species was selected over all (1st to 4th) preference categories, striped mojarra ('chiwa') and grey snapper ('pargo') both ranked as preferred species, followed by yellowfin mojarra ('mojarra') and great barracuda ('picuda'). 'Chac chi' (blue-striped grunt - *Haemulon sciurus*) and 'jurel' (crevalle jack - *Caranx hippos*) (Figure 31).

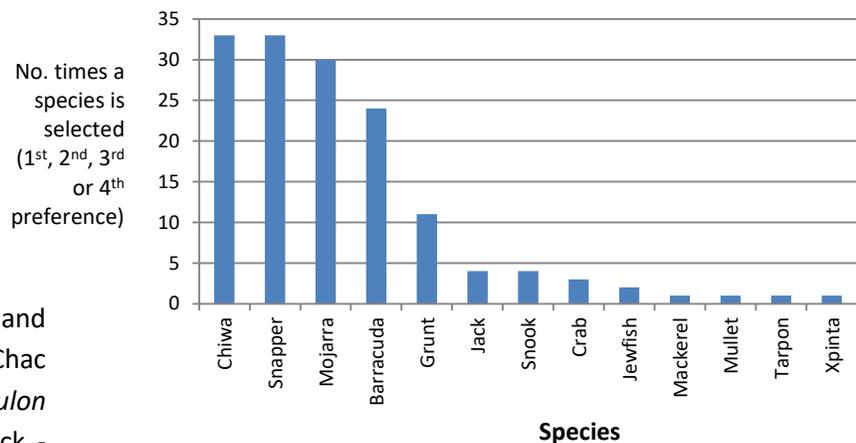


Figure 31: Number of times a species is selected (SACD, 2008)

There is a clear cultural preference for ‘chiwa’ or ‘stone bass’ (striped mojarra - *Eugerres plumieri*), as well as the closely related ‘mojarra’ (yellowfin mojarra - *Gerres cinereus*) and ‘pargo’ (grey snapper - *Lutjanus griseus*). There is also a preference shown for ‘picuda’ (great barracuda - *Sphyræna barracuda*). Other fish (and ‘xaiba’, the blue swimming crab) are also taken, but not considered primary targets by the fishermen or their families. Whilst these results are specifically for Sarteneja, community participants in management planning workshops in Chunox, Copper Bank and Corozal (March - June, 2009) agreed with these preferences. Not all these species are available throughout the year...during the workshop, a timeline was developed, showing species seasonality (Figure 32).

Species	J	F	M	A	M	J	J	A	S	O	N	D
Chiwa (striped mojarra - <i>Eugerres plumieri</i>)												
Lisa (Striped Mullet - <i>Mugil cephalus</i>)												
Crevalle Jack (<i>Caranx hippos</i>)												
La Ciera / Mackerel (Cero - <i>Scomberomonis regalis</i>)												
Mojarra (yellowfin mojarra - <i>Gerres cinereus</i>)												
Pargo (Grey snapper - <i>Lutjanus griseus</i>)												
Robalo (Snook - <i>Centropomus undecimalis</i>)												
Chac chi (Blue-striped grunt -)												

Figure 32: Species seasonality within Corozal Bay Wildlife Sanctuary (SACD / local fishermen, 2009)

Other fish species of concern include the Critically Endangered ‘cherna’ (Goliath Grouper - *Epinephelus itajara*), once common within the Bay, but now only encountered as small individuals, and in limited numbers. Community consultation in 2005 highlighted a spawning aggregation site for snapper (possibly lane snapper (*Lutjanus synagris*)).

Conservation planning is a key part of management planning, and was conducted for Corozal Bay Wildlife Sanctuary, following the national Management Planning framework (Level One). Under this framework, an assessment was made of the status and viability of the fish stocks, as well as the threats to the protected area based on community input. The viability of the Commercial Fish population was considered to be **FAIR** (requiring urgent human intervention to restore numbers to viable levels), based on the reductions seen over the years in the fish populations, with the goal to increase this status to **GOOD** by the end of the 5-year management period.

2.3.1 Trends

Community consultations suggest that fish stocks within the Wildlife Sanctuary are considered to have fallen significantly since the arrival of gill nets between twenty and thirty years ago. Many commercial fish species populations have decreased over the last fifteen years, including the goliath grouper and the smalltooth sawfish. Current trends continue to point to a decrease, as indicated by local fishermen from Sarteneja, Chunox and Copper Bank during community consultations, household surveys, and workshops (Figure 33).

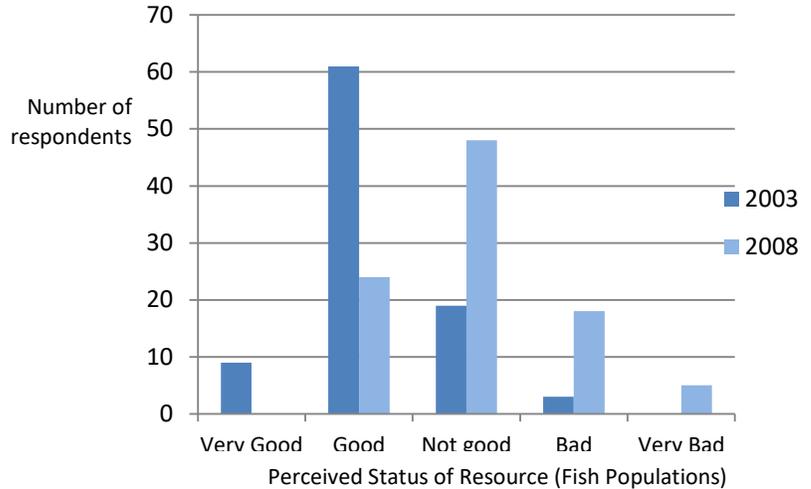


Figure 33: Perceived Status of Resource (Commercial Fish Populations of CBWS) (SACD, 2008)

The majority of respondents believe that over-fishing, largely caused by gill nets, is the main reason for the decline in fishing resources (Figure 34). Also cited was the overfishing of juveniles / undersized individuals, and illegal fishing from foreign incursions.

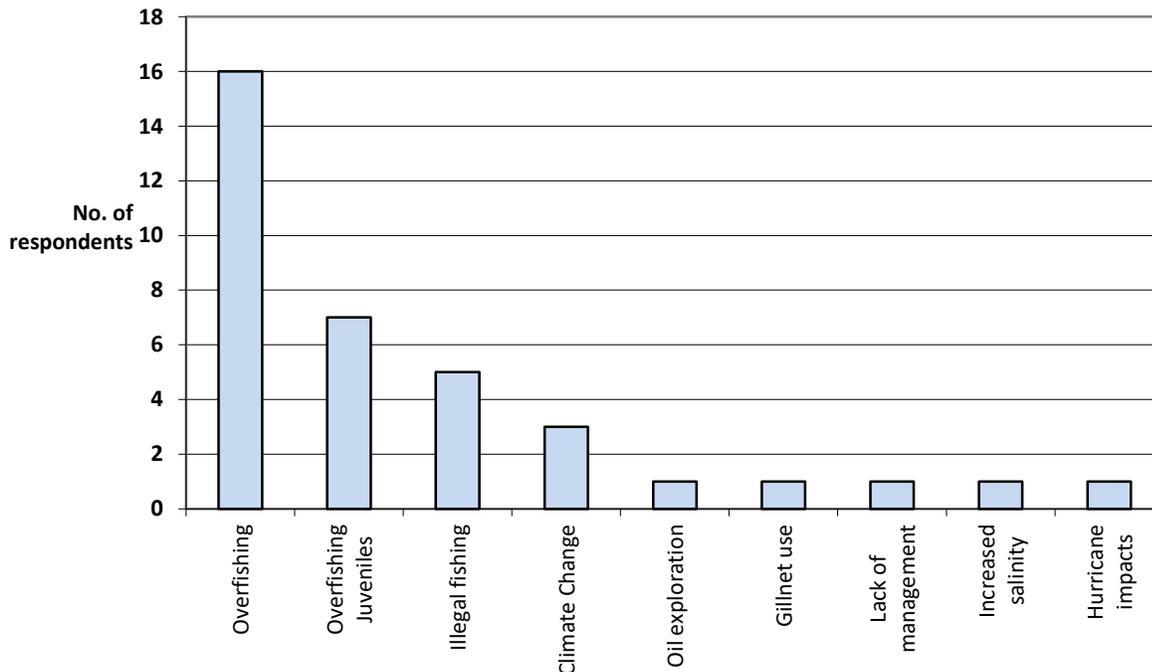


Figure 34: Reasons Cited by Community Respondents for Decline in Fish Stocks (SACD Socio-economic Survey data, 2009)

When asked to provide possible solutions, respondents suggested the following:

- 19% suggested increased patrols within Corozal Bay Wildlife Sanctuary
- 15% suggested increasing enforcement of laws within Corozal Bay Wildlife Sanctuary
- 17% suggested stricter laws for fisheries management in Belize
- 12% suggested increasing community involvement and participation in management
- 10% raising the level of education to reduce the number of young people needing to go into fishing

2.3.2 Key Pressures and Threats

The conservation planning process also identified the threats to fish population viability, and to the estuarine system as a whole (Table ...). Unsustainable fishing is the highest ranked threat for the system - it occurs throughout the area, is happening now, and therefore is considered urgent, and is reported to be having a substantial effect on the local fish populations. Whilst the majority of target fishery species are not considered in threat of immediate local extinction, past fishing has reduced goliath grouper to a currently non-viable population, and small tooth sawfish (*Pristis pectinata*), once present in large numbers, has been extirpated from the system, as a result of unsustainable fishing practices and illegal, transboundary fishing incursions.

Ten impacts were identified during the assessment, of which the four most critical were considered to be:

- **Mangrove Clearance**
- **Water Pollution**
- **Transboundary Fishing**
- **Unsustainable Fishing**

Each impact was assessed using a modified RAPPAM assessment methodology (WWF, 2003), both as a pressure and as a threat¹⁹ on the system, based on the extent, impact and permanence of the activity.

Corozal Bay Wildlife Sanctuary: Key Pressures and Threats

- Inappropriate caye development
- Inappropriate land use/ industrial development
- Inappropriate fishing practices:
 - Gill nets
 - Non catch and release sport fishing
 - Unsustainable fishing
- Agricultural runoff
- Mangrove clearance
- Sedimentation
- Oil exploration and drilling
- Sewage pollution
- Insufficient enforcement
- Transboundary impacts – fishing agricultural runoff and tourism (sport fishing)

¹⁹ Pressures are considered as past direct and indirect negative impacts on the biodiversity, whilst threats are the future potential negative impacts (Ervin, 2003).

The highest pressures are considered to come from coastal mangrove clearance, with increased pressure for waterfront properties (Figure 35). Pollution from poor sewage treatment in Chetumal is also a cause for concern, as is agricultural runoff originating from farming areas along the New River, Rio Hondo and Progresso watersheds, all of which include Mennonite farmlands, with heavy use of agrochemicals, extensive cattle farms, and, adjacent to the Rio Hondo, inundated rice fields. Transboundary fishing has been highlighted as both a pressure and threat, and is considered to be having a greater impact on the fish populations than local fishing. It is recognized that without further financial and human resources to increase surveillance and enforcement activities, fishing levels are not going to decrease.

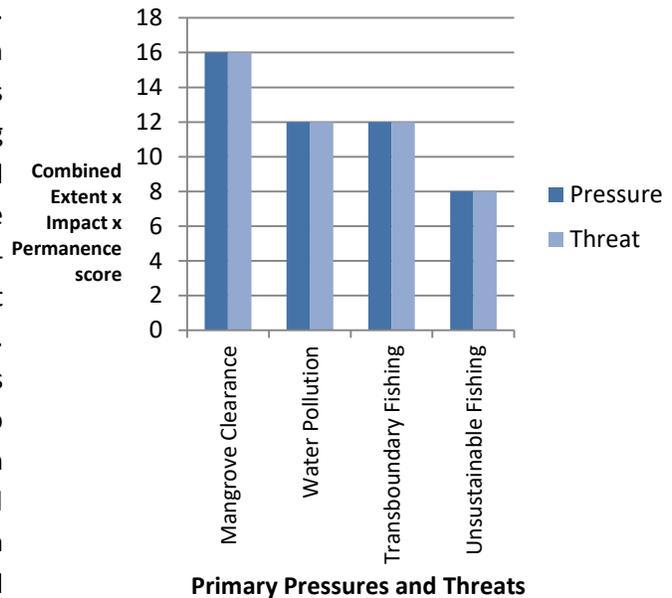


Figure 35: Primary Pressures and threats for Corozal Bay Wildlife Sanctuary

A situation analysis was completed for the fisheries resources (Figure 6), based on the output of consultations and workshops, highlighting a number of important factors, including:

- The lack of knowledge available for developing effective management strategies
- The need for improved surveillance and enforcement

This assessment takes a first step towards providing the information required on the local fishery for input into the decision making process. With the assistance of the fish population trends, threat assessment and the situation analysis, a number of management strategies and actions have been developed as part of the management planning process, towards restoration of the fish stocks to previous levels.

During community consultations and surveys, a number of other, more specific past impacts on Corozal Bay Wildlife Sanctuary have also been highlighted:

- Use of dynamite during oil exploration activities in early 1980's, causing extensive fish and marine mammal deaths
- Hurricane impacts
- Changing salinity following opening of Mexican canal (Canal de Zaragoza) to the Caribbean Sea in 2005, allowing at least ten times as much Caribbean water into the Bay as previously, increasing salinity

...as well as concerns over the implications of climate change, and predicted increasing hurricane impacts.

Surveillance and Enforcement Recommendations

1. Provide all local fishermen active in the Wildlife Sanctuary with ID permits for Corozal Bay, recognized by Forest Department
2. Regular patrols along East Coast targeting Mexican fishermen – night patrols, creeks etc.
3. Establish protocol and collaborative agreements with Fisheries Department and Belize National Coast guard for fast responding to reports of transboundary incursions
4. Regular patrols throughout Wildlife Sanctuary for non-local fishermen
5. Patrol to pass identified critical mangrove nursery areas to check for impacts (mangrove clearance). Follow-up with Forest Department / Department of the Environment

Strategic Actions			Desired Status
1	Build knowledge base of fish species Corozal Bay Wildlife Sanctuary	<ul style="list-style-type: none"> ▪ Which species are declining? ▪ Where are the critical nursery areas? 	Knowledge of species of fish using CBWS, seasonality, spawning areas etc. available to guide location of provisional management zones and surveillance and enforcement activities
2	Build knowledge base of traditional fishermen and fishing activity within Corozal Bay Wildlife Sanctuary	<ul style="list-style-type: none"> ▪ Who are the traditional fishermen? ▪ Where do they fish? ▪ How do they fish? 	Knowledge of traditional use areas for fishing, available to guide location of provisional management zones and surveillance and enforcement activities
3	Build knowledge of illegal fishing activities	<ul style="list-style-type: none"> ▪ What are the illegal fishing problems? ▪ Who is fishing illegally? ▪ How do they fish? ▪ Where do they fish? 	Knowledge of illegal use areas for fishing, available to guide location of provisional management zones and surveillance and enforcement activities
3	Define provisional management zones	<ul style="list-style-type: none"> ▪ Which areas should be protected as key nursery areas? ▪ Which areas should be maintained for traditional fishing? ▪ Which areas are important for sport fishing? ▪ Which areas are important for community Subsistence Fishing Area? 	Provisional management zones are defined by SACD in partnership with the local fishermen, and based on the information from Strategic Actions 1 and 2

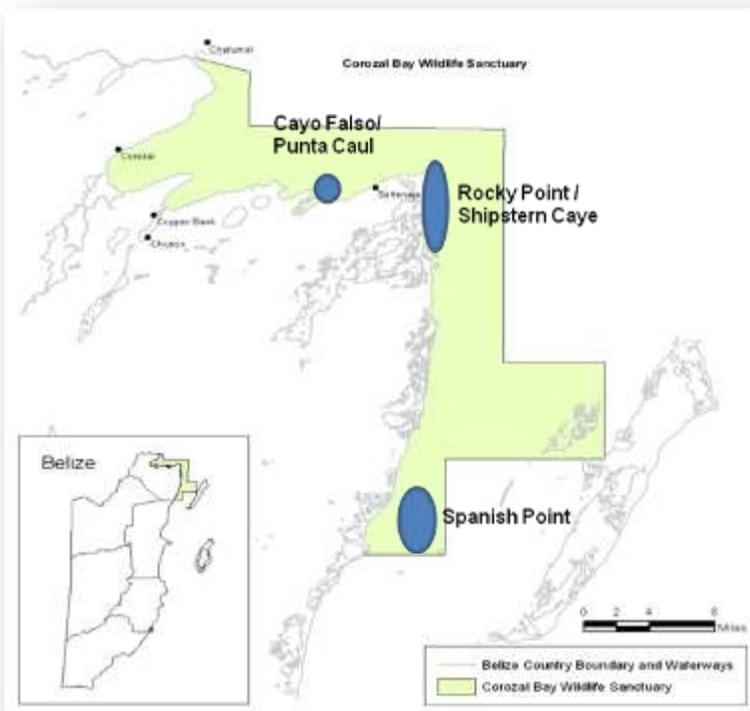
Strategic Actions			Desired Status
4	Develop Management Zone Rules and Regulations	<ul style="list-style-type: none"> ▪ What activities should be allowed in each management zone? ▪ What rules and regulations should be in place for effective management? 	Rules and regulations for each zone are developed by SACD in partnership with the local fishermen, and based on the information from Strategic Actions 1, 2 and 3. Rules and regulations should be distributed throughout stakeholder communities.
5	Develop patrol Operating Procedures	<ul style="list-style-type: none"> ▪ What should rangers do if the encounter traditional fishermen? ▪ What should rangers do if they encounter community recreational fishing activity? ▪ What should rangers do if they encounter illegal fishing activity? 	Standard Operating Procedures for patrols, to guide ranger response to surveillance and enforcement situations.

2.1.2 West Indian Manatee

The West Indian manatee (*Trichechus manatus*) has been identified as an endangered species protected in Belize by law under the Wildlife Protection Act, No.4 Of 1981, and as a Vulnerable species under the IUCN Redlist (IUCN, 2008). Corozal Bay Wildlife Sanctuary was designated for its importance as a core area for manatees in Belize, particularly for mating and calving. Despite this designation, and the laws that protect manatee, the population has decreased as a result of the continued poaching, loss of seagrass areas and boat collisions, exacerbated by limited law enforcement due to limited resources.

Corozal Bay is contiguous with Chetumal Bay to the north, on the Mexican side of the border, and manatees, known for not recognize international borders, have been tracked moving from one side of the bay to the next (Auil, 2008), and the area was established as a transboundary attempt to protect this species

Community meetings have been held in Sarteneja, Chunox and Copper Bank to identify those areas particularly important for the manatee population (Map 2), for installing no-wake signs (Figure 5) and guiding targeted patrols.



Map 8: Key Manatee Areas of Corozal Bay Wildlife Sanctuary

 Key Manatee Areas



Installing No-Wake Zones in key manatee areas

West Indian Manatee - Management Goal

By 2022, maintain and increase viability of the manatee population within Corozal Bay Wildlife Sanctuary from the 2012 baseline.

The current Viability Rating for the West Indian Manatee in Corozal Bay Wildlife Sanctuary is considered to be **GOOD**, with the goal of maintaining or improving this rating over the five years of the management plan.

West Indian Manatee – What is the current status of this resource?

The current population size of West Indian manatee within the Corozal Bay Wildlife Sanctuary is at least 40 (maximum number recorded during an aerial survey), with mating itinerant males moving in and out of the Wildlife Sanctuary, and possibly 100+ (based on protocols used to estimate national populations from aerial survey data). The population is relatively stable, being reproductive with few reported strandings. From the data available, the birth rate is considered higher than the mortality rate (mortality is primarily of calves, not adults), the majority of users respect no-wake zones and protected area guidelines, reducing the threat of boat strikes, and poaching for last year (2011) was zero (local fishermen), attributed to the presence of SACD patrols.

West Indian Manatee – What is impacting the resource?

Three primary direct threats have been identified:

- Coastal Development
- Water Pollution
- Poor Use Practices

Consultations with local fishermen suggest that entanglement in nets is not considered a high threat, and has not been reported within the last ten years (last report was in the Chunox area, approximately 12 years ago).

Indicators

- Seasonal aerial survey results (3 per year, each with 3 replicates)
- Results from resting hole surveys
- Live and carcass stranding results
- Community awareness surveys

West Indian Manatee - Strategic Activities

Strategic Actions			Desired Status
1	Build knowledge base of manatee use within Corozal Bay Wildlife Sanctuary	<ul style="list-style-type: none"> ▪ Where are manatees found? ▪ What do they do where? 	Build knowledge of use of the Bay by this species through patrol reports and report from local fishermen
2	Build knowledge of areas where manatees are targeted for their meat	<ul style="list-style-type: none"> ▪ Who is targeting manatees? ▪ Where do they target them? ▪ When do they target them? ▪ Where is the meat sold? ▪ 	Knowledge of illegal slaughter of manatees, to guide surveillance and enforcement activities
3	Identify areas of high boat / manatee collision potential	<ul style="list-style-type: none"> ▪ Where are the areas where there is high potential for boat/manatee collision? ▪ Which boats are most active in these areas? 	Knowledge of areas where installation of further 'no wake' zones maybe important, and identification of sector to be targeted for manatee awareness activities
4	Develop patrol Operating Procedures	<ul style="list-style-type: none"> ▪ How should the patrol act when encountering manatees? ▪ What should rangers do if they encounter people chasing manatees? ▪ What should rangers do if they encounter people slaughtering manatees? ▪ What should the patrol do if they encounter a sick, injured or orphaned manatee? 	Standard Operating Procedures for patrols, to guide ranger response to surveillance and enforcement situations.

Recommendations

- 1 Implement monitoring recommendation from Conservation Plan for Manatees of CBWS
- 2 Regular patrols along East Coast targeting Mexican fishermen – night patrols, creeks etc.
- 3 Establish protocol and collaborative agreements with Fisheries Department and Belize National Coast guard for fast responding to reports of transboundary incursions
- 4 Regular patrols throughout Wildlife Sanctuary checking for unattended gill nets
- 5 Respond to reports of stranded / dead manatees in collaboration with Wildtracks and the Marine Mammal Stranding Network

2.1.3. Elasmobranchs

Also of consideration is the importance of the area for Elasmobranch species – the Critically Endangered smalltooth sawfish (*Pectinis pectinata*) was once common in the shallow bay and coastal lagoons, but is thought to be locally extinct (though reports suggest that three individuals were caught in late 2008 in the lagoons just south of the Wildlife Sanctuary). Bulkhead Shoals area is highlighted locally for its importance as a shark nursery area, for species such as bonnethead sharks (*Sphyrna tiburo*).

2.1.3 Bird Nesting Colonies

A number of nesting bird colonies in the CBWS have been identified as of national conservation importance (Meerman, 2005), and importance as a tourism feature by the Sarteneja Tour Guide Association. Cayo Falso, with one of the few remaining magnificent frigatebird nesting colonies in Belize, also provides a nesting site for roseate spoonbills, boat-billed herons, brown pelicans, cormorants, reddish and great egrets, whilst other cayes within and adjacent to the protected area host white ibis, tricoloured herons and, in the coastal lagoons, two of the most important Wood Stork colonies within the entire region. Many of these birds use not just to Corozal Bay Wildlife Sanctuary, but also other wetland areas, including Crooked Tree.

Bird Nesting Colonies - Management Goal

Protection of the identified bird nesting colonies within Corozal Bay Wildlife Sanctuary, and reduction of potential threats.

Bird Nesting Colonies – What is the current status of this resource?

Nesting colonies are still persisting on the majority of cayes. The white ibis colony on Shipstern caye (Cayo Conejo) has never recovered following the destruction of nests and collection of eggs by a local fisherman more than ten years ago. Other nesting colonies have not been the focus of monitoring efforts, so past population fluctuations are unknown.

Bird Nesting Colonies – What is impacting the resource?

Recently, natural disasters have had a huge impact on the nesting islands, with Hurricane Dean, in particular, doing structural damage to mangrove canopies, temporarily reducing nest site availability. Other, human-based impacts have also been identified:

- a constant threat of development on even the smallest cayes, removing their value as colony nesting sites.
- the birds nesting on the East Coast cayes and the wood storks nesting in Bulkhead Lagoon are reported to be threatened almost daily by harvesting of the eggs and nestlings as a food source or for sale in Sarteneja or Mexico.
- there is concern that fishing activities and poor tour guiding practices will disturb the birds during the nesting season, affecting reproductive success.

Bird Nesting Colonies - Specific Pre-Surveillance and Enforcement Activities

Strategic Actions			Desired Status
1	Build knowledge base of bird nesting colonies within Corozal Bay Wildlife Sanctuary	<ul style="list-style-type: none"> ▪ Where are the nesting colonies? ▪ Which species is found in which colony? ▪ What is the observed nesting period for each species? 	Build knowledge of bird nesting colonies through targeted patrol reports and reports from local fishermen. Map locations.
2	Build knowledge of threats	<ul style="list-style-type: none"> ▪ Who is targeting the bird colonies? ▪ When do they target them? ▪ Where do they sell the eggs and nestlings? 	Knowledge of disturbance of nesting colonies will guide surveillance and enforcement activities, and awareness activities connected with these species
3	Identify important feeding areas for dispersing fledglings	<ul style="list-style-type: none"> ▪ Where do the newly fledged birds feed? ▪ What threats are there to these feeding areas? 	Knowledge of important feeding areas, and identification of sector to be targeted for awareness activities connected with these areas

Surveillance and Enforcement Recommendations

1. Patrol route to pass identified bird nesting colonies and check for impacts
2. Signs to be erected near bird nesting cays raising awareness of regulations protecting birds, and presence of surveillance activities

2.1.4 Mangroves

Mangroves are a major contributor to the CBWS marine environment, supporting a diverse range of birds, mammals, crustaceans and fish. In their multifunctional capacity, they form the basis of a complex marine food chain, creating breeding habitat, establishing restrictive impounds that offer protection for maturing offspring in the shallow, coastal lagoons, stabilizing bottom sediments, and protecting shorelines from erosion. They also have an important role in preserving water quality through reducing pollution by filtering suspended material and assimilating dissolved nutrients. The north east of Belize has some of the most extensive mangrove habitat in Belize.

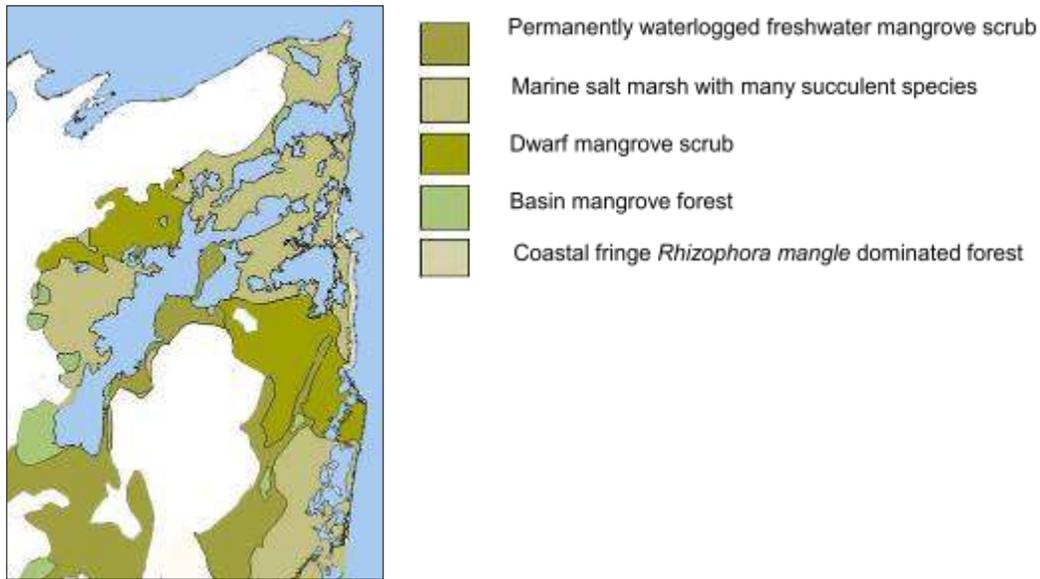
As mangroves grow along the Belize coastlines, lagoons and estuaries, attractive to foreign investors and the retirement sector, there is an increasing threat of significant reduction of their extent, due to human impacts such as land reclamation and land development of waterfront property. Presently, there is no monitoring of coastal land use change within the CBWS, and no action taking place to address these issues.

Mangrove - Management Goal

Identification of critically important mangrove nursery areas, and collaboration with land owners for protection. Increasing stakeholder awareness of the importance of mangroves in coastal protection, nursery habitat for commercial fish species and structural support for bird nesting colonies.

Mangrove – What is the current status of this resource?

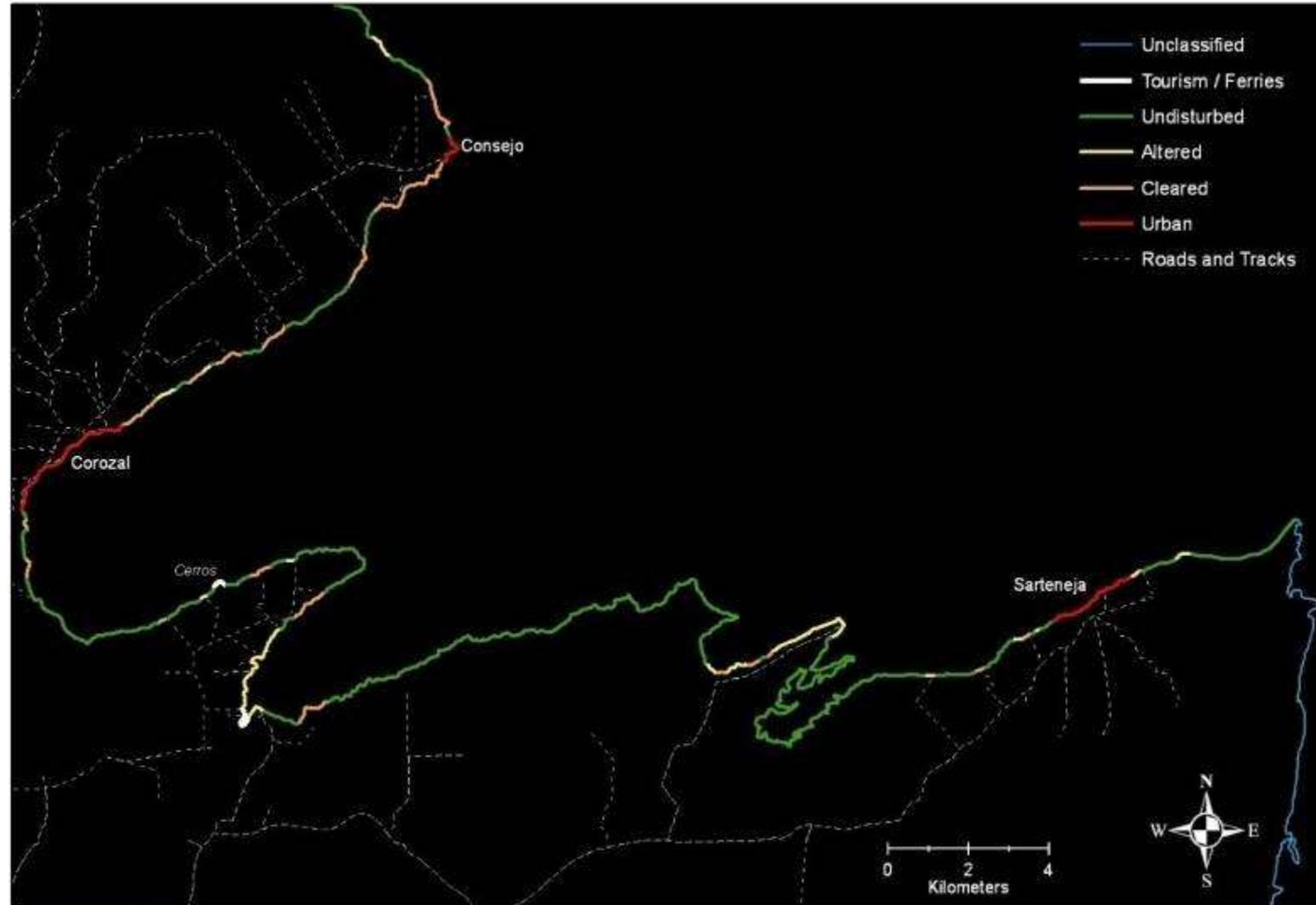
Whilst the majority of the extensive mangrove flats within northern Belize remain more or less intact (Map 9), coastal development is an increasing threat to the extent of these mangrove ecosystems on the shores of Corozal Bay Wildlife Sanctuary.



Map 9: Mangrove and other coastal ecosystems of the north-east coastal area

The coastal mangrove so important to the integrity of the ecosystem functionality of Corozal Bay Wildlife Sanctuary does not, unfortunately, lie within the protected area, which only stretches to the high water mark, and does not include the fragile coastal lagoon systems. Initial satellite imagery provides some indication of the level of impact (Map 10).

Preliminary Assessment of Coastal Development: Jan 24, 2009



Data derived from interpretation of Landsat scene acquired Jan 24, 2009; source dataset obtained via USGS Glovis Service

Map 10: State of coastal mangrove – Corozal Bay Wildlife Sanctuary (remote sensing analysis)

Mangrove – What is impacting the resource?

Coastal mangroves face one major human-based threat – clearance for development. With the high market value of waterfront properties, mangroves are being cleared at a rapid rate, despite a moratorium on mangrove clearance currently being in place. Mangrove clearance has to have a permit – not such permits have been issued in Corozal District.

Mangrove - Specific Pre-Surveillance and Enforcement Activities

Strategic Actions		Desired Status
1	Finalise baseline mapping of mangrove ecosystems adjacent to CBWS <ul style="list-style-type: none"> ▪ Which mangrove ecosystems are found in the coastal areas? ▪ How accurate is the current ecosystem mapping? ▪ Where are the most critical mangrove areas in terms of ecosystem functionality? 	GIS mapping of coastal ecosystems, and ground truthing to ensure accuracy. Production of more accurate baseline ecosystem mapping of mangroves and other coastal ecosystems, with identification of critical areas (high-value nursery areas, bird-nesting cays etc.).
2	Analysis of current human impacts <ul style="list-style-type: none"> ▪ Where have human impacts affected the mangrove ecosystems? ▪ Where are potential human impact areas? 	Mapping of current impacts to mangrove ecosystems, and potential high impact areas will guide surveillance and enforcement activities, and mangrove awareness activities
3	Discuss mangrove clearance threats with Forest Department and Department of the Environment to develop plan of action for mangrove clearance issues associated with CBWS <ul style="list-style-type: none"> ▪ What does the new mangrove legislation cover? ▪ How can SACD, FD and DoE work to ensure impacts to critical mangrove areas are reduced? ▪ How can SACD work with land owners to raise awareness of the importance of leaving mangroves 	Knowledge of mangrove legislation and an action plan for tackling mangrove clearance issues, with input and support from FD and DoE). Integration of mangrove issues into Communication Plan, to increase awareness of local landowners and reduce potential conflict

Surveillance and Enforcement Recommendations

1. Patrol to pass identified critical mangrove areas to check for impacts (mangrove clearance).
Follow-up with Forest Department / Department of the Environment
2. Signs to be erected near critical mangrove areas raising awareness of importance of mangroves to the local fisheries sector

2.1.5 Seagrass

Seagrass meadows are found throughout Corozal Bay Wildlife Sanctuary, with a reduction in density from the more saline southern end to the north eastern portion, where the influence from the New River and Rio Hondo reduces salinity. It is a critically important ecosystem within the Wildlife Sanctuary, serving as a nursery area, refuge and feeding ground for many faunal species, including the West Indian manatee and commercial and sport finfish species.

Management Goal

The current Viability Rating for Seagrass in Corozal Bay Wildlife Sanctuary is considered to be **GOOD**, with the goal of maintaining or improving this rating over the five years of the management plan.

Current Status of Seagrass

Seagrass is known to be present in patches or as extensive meadows throughout Corozal Bay Wildlife Sanctuary and in lagoon systems close to resting holes. There is currently only limited dredging / development in coastal areas. Nutrient and other inputs from rivers could affect quality and health of seagrass beds. Limited knowledge of the extent of the ecosystem could affect effective management for its protection.

Indicators

- Mapping of seagrass beds
- Time trends of seagrass distribution
- Seagrass toxicity and health tests
- Manatee feeding locations and proximity to other areas of use

Recommendations

1. Patrol to pass identified seagrass areas to check for impacts (dredging, sediment runoff). Follow-up with Forest Department /Geology Department / Department of the Environment
2. Integrate SeagrassNet monitoring into patrol activities
3. Mapping of seagrass areas within Corozal Bay Wildlife Sanctuary (including density and health)
4. Collect adequate information to affirm rating, then maintain and improve the current rating in the face of ongoing development, increasing tourism and pollution.

2.1.6 Estuarine Environment

human development pressures from within Belize, and from Mexico to the north, threaten the water quality of the Bay impacting key ecosystems of the area, and the conservation of critical and important species in the Bay.

The maintenance of good water quality in this estuarine system, the largest in the entire Meso-American Reef region, has also been highlighted as critical to the health of the northern Belize Barrier Reef, as it empties into the reef lagoon to the south of Ambergris Caye.

There is currently no monitoring for water quality in the Wildlife Sanctuary, though it is known that human activities have greatly impacted the area, including the ongoing pumping of untreated sewage from Chetumal into the water, and agricultural runoff from the two major rivers that empty into the system, carrying sediment, heavy metals, and possibly nitrogenous fertilizers leaching from the agricultural lands.

It is hoped that by proper monitoring of key water quality parameters the health of the ecosystems within the CBWS can be assessed on an ongoing basis. This will allow the development of actions to improve the water quality of the system in collaboration with the transboundary partners – Ecosur and CONANP.

There is currently no baseline data on basic water parameters such as salinity, temperature, pH changes, dissolved oxygen levels, light levels, and nutrient levels - as increased agriculture and development leads to more runoff into Corozal Bay, it will be critical to have an understanding of how these pressures are affecting water quality and how changes in water quality affect certain components of the ecosystem as a whole.

This pilot project develops a framework for the Sarteneja Alliance for Conservation and Development, in partnership with Wildtracks, Ecosur and the University of Belize to initiate and maintain water quality monitoring within the Bay, based on a number of key sites (to be determined), to determine the feasibility and cost of developing a systematic, long-term water quality monitoring within the Bay.

2. Project Components

There are three independent water monitoring project components that, together, combine to provide the information required for a reliable, strong foundation for guiding management activities:

- **Component A: Hydrological Characterization of the Corozal Chetumal Estuary**
- **Component B: Establishing water quality monitoring within Corozal Bay**
- **Component C: Identification of water contaminants originating in the Rio Hondo Watershed**

Each Component is based on partnerships that already exist or are being developed, to ensure that SACD has the expertise available to collect the information required, interpret it, and integrate it into management activities.

Component A: Hydrological Characterization of the Corozal Chetumal Estuary

Background: The Corozal / Chetumal estuarine system is the largest to empty onto the Mesoamerican Reef. Ecosur have characterised the Mexican side of the Corozal / Chetumal estuarine system, with seasonal water depth, temperature and salinity mapping (<http://www.ecosur.mx/unidades/chetumal/ofe/ocean/geo-grafica/ge.html#>). Extending this characterisation to the entire system will enable the managers of both Corozal Bay Wildlife Sanctuary and Santuario del Manati to better understand the system, seasonal water flows, how this can affect both the aquatic life of the Bay, and the flow of sediment and contaminants through the system to the reef.



Objective: To provide a baseline on the hydrological characteristics of Corozal Bay Wildlife Sanctuary, and the Corozal / Chetumal estuarine system

Component B: Establishing water quality monitoring within Corozal Bay

Background: Phase A provides the baseline for system level management – Phase B overlays site level management requirements, providing information on monthly variations in water parameters for a better understanding of the dynamics of the Corozal Bay system. This will assist in understanding the seasonal patterns and requirement in a number of conservation targets – particularly the commercial fish species, West Indian manatee, and elasmobranchs.

As well as general water parameter monitoring, it will also target areas within the Wildlife Sanctuary highlighted as current or potential impacts – adjacent to coastal communities, coastal developments, and river mouths, to monitor changes that require management actions.

Component C: Identification of water contaminants originating in the Rio Hondo Watershed

Background: There are transboundary concerns as to the level of contamination entering the Corozal / Chetumal estuary from the Rio Hondo watershed. The University of Belize has funded the initial preparation phase for water testing within the watershed, to define contaminants, points of origin and level of contamination, developing communications with SACD towards a collaborative partnership, ongoing monitoring and transfer of skills. An SACD participant has been for training at

Ecosur, through UB, to build skills in spectrophotometer use for contamination identification - pesticides and selected heavy metals. The first of three training activities has already been completed at Ecosur (Chetumal Campus).

Surveillance and Enforcement Recommendations

1. Patrol to include water sampling once SACD has testing equipment
2. Patrol river mouths to check for fish kills, or respond to fish kill reports

2.2 Threats

A number of threats were identified during the assessment of Conservation Targets (Table ...). The four key impacts were further evaluated during the threat assessment conducted as part of the national management effectiveness assessment.

Key Pressures and Threats

Ten impacts were identified during the assessment, of which the four most critical were considered to be:

- **Mangrove Clearance**
- **Water Pollution**
- **Transboundary Fishing**
- **Unsustainable Fishing**

Each impact was assessed using a modified RAPPAM assessment methodology (WWF, 2003), both as a pressure and as a threat²⁰ on the system, based on the extent, impact and permanence of the activity.

The highest pressures are considered to come from coastal mangrove clearance, with increased pressure for waterfront properties. Pollution from poor sewage treatment in Chetumal, and from agricultural runoff originating from farming areas along the New River and Rio Hondo is also a cause for concern. Transboundary fishing has been highlighted as both a pressure and threat, and is considered to be having a greater impact on the fish populations than local fishing. It is recognized that without further financial and human resources to increase surveillance and enforcement activities,

²⁰ Pressures are considered as past direct and indirect negative impacts on the biodiversity, whilst threats are the future potential negative impacts (Ervin, 2003).

Corozal Bay Wildlife Sanctuary: Key Pressures and Threats

- Inappropriate caye development
- Inappropriate land use/ industrial development
- Inappropriate fishing practices:
 - Gill nets
 - Non catch and release sport fishing
 - Unsustainable fishing
- Agricultural runoff
- Mangrove clearance
- Sedimentation
- Oil exploration and drilling
- Sewage pollution
- Insufficient enforcement
- Transboundary impacts – fishing agricultural runoff and tourism (sport fishing)

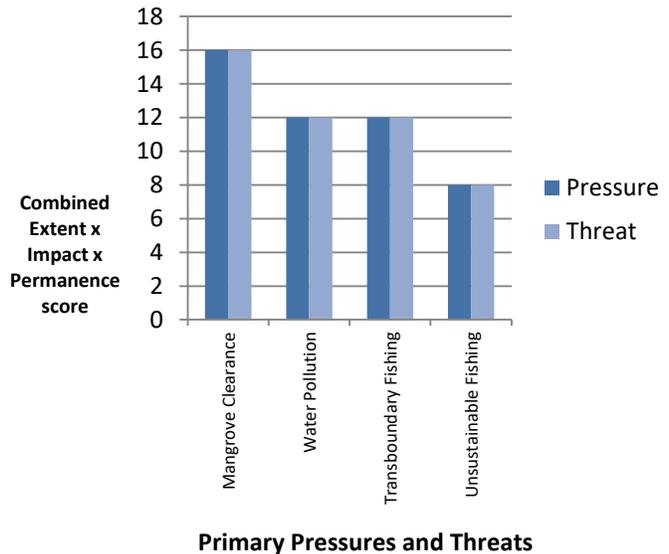


Figure 36: Pressures and Threats on Corozal Bay Wildlife Sanctuary

fishing levels are not going to decrease. Unsustainable fishing is predicted to decrease in the future, with the increased enforcement presence and the limited resources available.

Conservation Target	Coastal Development	Limited Surveillance and \enforcement	Transboundary water contamination	Illegal incursions by Mexicans	Unsustainable fishing practices	Mangrove clearance	Poor tour guiding practices	Boat Collisions
Native Fish Species								
West Indian Manatee								
Bird Nesting Colonies								
Seagrass								
Mangroves								
Estuarine Ecosystem								
Shark Species								

Figure 37: Threats identified during Conservation Planning

3.0 Management Planning

3.1 Management and Organizational Background

The Sarteneja Alliance for Conservation and Development (SACD) has been operating since 2007, and was registered on 18th September, 2008. It is a community-based organization dedicated to improving the quality of life of the stakeholder communities of Corozal Bay Wildlife Sanctuary through conservation, protected areas management and promoting the sustainable use of the natural resources. The Alliance provides a mechanism for effective communication, collaboration and

Alliance Members

Sarteneja Tour Guide Association (STGA)
 Sarteneja Fishermen Association (SFA)
 Wildtracks
 Shipstern Nature Reserve (SNR)
 Local business/tourism
 Education
 Local fishermen

networking between local individuals, associations and organizations in Sarteneja, and has a structured Executive Board composed of representatives from the active organizations in Sarteneja, and from the local fishing, education, and tourism/business sectors, forming an Alliance of community organizations:

SACD is an active promoter of conservation in Sarteneja, through a number of specific program areas, and is recognized as the co-management partner for Corozal Bay Wildlife Sanctuary by the mandated administrative agency – the Belize Forest Department. The organization is guided by its annual Operational Plan and Strategic Plan, and receives support from a number of funding partners (including OAK Foundation, Protected Areas Conservation Trust, The Nature Conservancy, Wildlife Conservation Society and Wildtracks) towards institutional strengthening and capacity building.

The SACD Goal is to “bring people together to promote conservation and development” ...

Vision Statement

“SACD is an effective alliance of organizations, focused on community development and the sustainable resource use of the Corozal Bay Wildlife Sanctuary, for the benefit of the present and future generations of Sartenejeños.”

Mission Statement

“The Sarteneja Alliance for Conservation and Development is a community-orientated, non-governmental organization dedicated to improving the quality of life of Sartenejeños through strengthening mechanisms for collaboration, support and community engagement; and through the promotion of the sustainable use of the Corozal Bay Wildlife Sanctuary.”

...through the following objectives:

Primary Objectives:

1. Ensure the conservation and sustainable use of the natural resources of the Corozal Bay Wildlife Sanctuary.
2. Increase community engagement, awareness and participation in the protection and conservation of the natural resources of the Corozal Bay Wildlife Sanctuary.
3. Support all members of the Alliance in activities towards promotion of conservation and environmentally sustainable development for stakeholder communities of Corozal Bay Wildlife Sanctuary
4. Advocate for the proper management and sustainable use of natural resources and address environmental and development issues in and around Corozal Bay Wildlife Sanctuary
5. Ensure the long term sustainability of Corozal Bay Wildlife Sanctuary

Guiding Principles

SACD operates under the following guiding principles:

- Sustainable approaches to the utilization of natural resources.
- Community participation in the design, implementation, monitoring and evaluation of management programmes and projects.
- Effective communication with all stakeholders
- Transparency at all levels
- Equality across gender, race, politics and age in all thoughts, discussions and activities

3.2 Review of Previous Management Effectiveness

A review of management effectiveness was conducted in May, 2009, as part of the National Assessment - State of the Protected Areas. 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 seven different indicator categories (Table 20).

Indicator Categories	
Indicator Category	Average Score 2009
1. Resource Information	65.9
2. Resource Administration, Management and Protection	60.0
3. Participation, Education and Socio-Economic Benefit	60.7
4. Management Planning	54.2
5. Governance	50.0
6. Human Resources	46.9
7. Financial and Capital Management	37.5
Overall	54.0%

* Indicators and Indicator categories used are from Young et. al. (2005, and scored on a scale of 1 – 4: Poor (1: ≤25%); Fair (2: >25 - 50%); Good (3: >50% - 75%); Very Good (4: >75%)

Table 20: Management Effectiveness Scores for Corozal Bay Wildlife Sanctuary per Indicator Category

Corozal Bay Wildlife Sanctuary: Strengths and Weaknesses of Indicator Categories		
Rating	Range	Indicator Category
Very Good	>75%	No Indicator Category scores 4
Good	>50 – 75%	1. Resource Information
		2. Resource Administration, Management and Protection
		3. Participation, Education and Socio-Economic Benefit
		4. Management Planning
Fair	>25 – 50%	5. Governance
		6. Human Resources
		7. Finance and Capital Management
Poor	≤ 25%	No indicator Categories rate as Poor
Assessment using modified National Indicators (Young et. al., 2005)		

Table 21: Management Strengths and Weaknesses

- Overall, Corozal Bay Wildlife Sanctuary is considered to rate at the lower end of **GOOD** in terms of management effectiveness, averaging a score of 54.0% across the national Indicator Categories, with a number of areas identified as benefitting from further strengthening.
- The weakest Indicator Category is identified as Financial and Capital Management, which rates as **FAIR**, scoring only 37.5%. Human Resources and Governance also rate as **FAIR**.
- All other indicators rate as **GOOD**

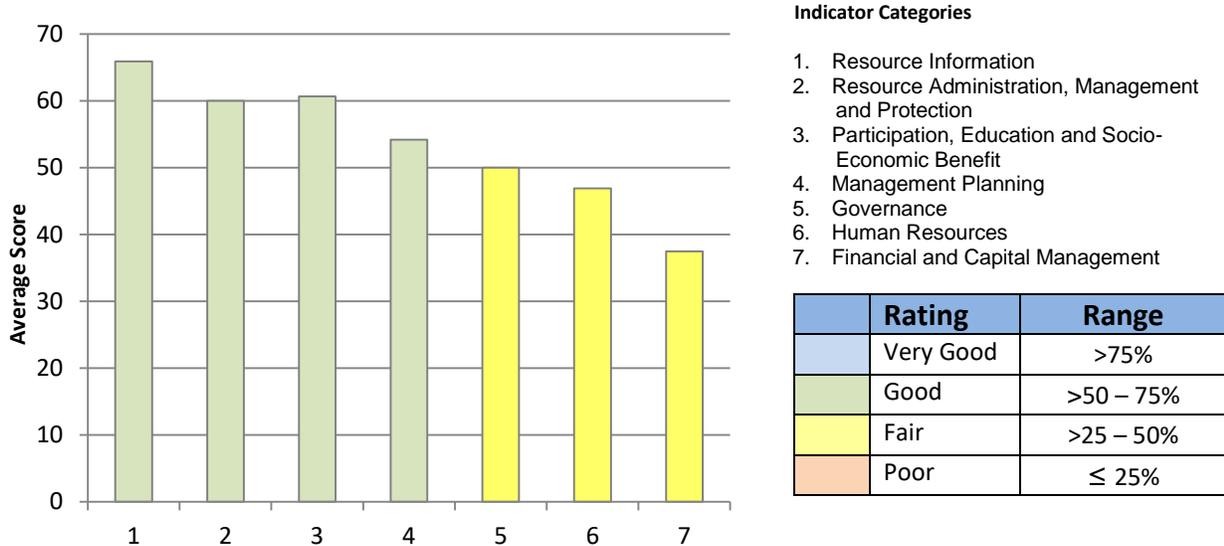


Figure 38: Results per Indicator Category

Assessment Recommendations

- Strengthen management effectiveness at system-level through system-level conservation action planning for northern protected areas (Bacalar Chico Marine Reserve and National Park, Corozal Bay Wildlife Sanctuary, and Mexican transboundary protected areas)
- Increase the effective management of marine resources through the development and implementation of zoning regulations.
- Develop and implement annual operational plans based on the strategies and actions prioritized within the management plan.
- Establish an active Advisory Committee with clear and unambiguous terms of reference and operating procedures for advisory committee.
- Strengthen visitor management through continued collaboration with tourism stakeholders, effective implementation of regulations and policies, implementation of visitor surveys and utilization of output data in planning and management.

- Locate increased financial and human resources for strengthening surveillance and enforcement through increased patrols (including at night).
- Strengthen enforcement activities through collaborative agreements with the Fisheries Department, Belize Coast Guard and Mexican authorities
- Liaise with relevant Mexican authorities, and Belizean counterparts, to lobby for proper sewage treatment in Chetumal and the cessation of dumping of raw sewage into Chetumal Bay
- Continue and extend current initiatives to increase the viability of commercial fish species.
- Develop an outline Research Programme and implement prioritized research programme activities identified in management plan.
- Lobby local and national leaders for adherence to development policies – including those for Special Development Areas – to reduce coastal development in inappropriate locations.
- Reduce mangrove clearance through collaboration with the Department of the Environment and local leaders to ensure developments follow best practices policies.
- Reduce sedimentation and pollution through collaboration with the Department of the Environment and local leaders to ensure developments follow best practices policies.
- Strengthen baseline information on cultural and archaeological resources through consultation with local and special-interest stakeholders, and initiate formal mapping of known sites, with associated conservation strategies.
- Continue developing and implementing strategies and actions to strengthen opportunities for socio-economic benefits in the stakeholder communities.
- Develop financial mechanisms to employ full time staff. Implement annual human resource assessments, and use the information to strengthen staff satisfaction to engender greater commitment to achieving management goals and to ensure retention of high calibre staff.
 - Locate funding to employ a full-time park manager and operational staff
 - Increase the number of rangers available and active within the protected area
 - Strengthen resource availability to increase access of priority areas by rangers
 - Increase the availability of technical and administrative staff
- Develop and implement plan and timeline for the placing of signage in identified priority areas
- Locate funding to improve level of maintenance of infrastructure and equipment

3.3 Management Goals

Priority Strategies for Increasing Management Effectiveness of Corozal Bay Wildlife Sanctuary

Sarteneja Alliance for Conservation and Development recognizes that:

- There is a need for effective management for Corozal Bay Wildlife Sanctuary
- There is a need to reduce fishing pressure on the reef through facilitation of alternative livelihood opportunities for traditional fishermen
- Sarteneja, as a community (and the largest traditional fishing stakeholder of the Belize reef system), needs to identify an alternative to fishing as its economic base. This alternative has been identified as tourism.

A number of key strategies and activities have been identified as priorities for the five year timeframe of the Management Plan:

- Establish SACD infrastructure and equipment for effective management of the natural resources of Corozal Bay Wildlife Sanctuary
- Institutional strengthening during four year Development Stage
 - Build human capacity of SACD – Funding of core staff during first four years (Executive Director, Programme Managers for the Natural Resource and Research and Monitoring Programmes, Education and Outreach Coordinators and Administrator)
 - Train management and field staff in key areas, including protected area management, natural resource management, and financial management
 - Ensure continued and increased community participation in management decisions and activities
 - Strengthen / establish Advisory Committees for increased community engagement and participation
- Investigate possibilities for extending protection to include key mangrove nesting colony cayes (through amendment of the SI), and coastal mangrove and lagoon systems (through purchase of priority areas – eg. those identified as priority smalltooth sawfish areas)
- Develop and implement 5-year Financial Plan to identify critical and optimal operational costs, mechanisms for reducing core costs, and financial sustainability mechanisms to meet these costs

- Coverage of operational costs for the first 4 years to provide for organizational development, strengthening and implementation of identified financial sustainability mechanisms
 - Funding for implementation of identified priority financial sustainability mechanisms
 - Reduction of recurrent costs through ownership of office
 - Establish endowment fund or similar financial mechanism (either specific to SACD, or through collaboration with GoB and other NGO's in creation of a marine Trust Fund initiative) to provide at least a portion of annual core costs
- Develop and implement effective Communication and Collaboration Plan at local, national, and particularly bi-national levels
- Develop, equip and operationalize the Research and Monitoring Programme
 - Establish and equip Research and Monitoring Programme
 - Annual assessment of management effectiveness
 - Establish consistent water quality monitoring
 - Develop Conservation Plans for Critical Endangered and Endangered species
 - Monitoring and evaluation of conservation targets highlighted under the conservation plan
- Develop, staff, equip and implement Education and Outreach Programme
 - Develop and implement Education and Outreach Plans
 - Continue implementation of field studies programme with local primary schools
 - Continue implementing the Volunteer and Internship Programme
 - Build the scholarship fund to provide annual scholarships for families of local fishermen who are reliant on Corozal Bay Wildlife Sanctuary and the Belize reef system
- Implement priority activities identified within the draft Surveillance and Enforcement Plan

3.4 Management Programmes and Objectives

Management of Corozal Bay Wildlife Sanctuary is organised under six Management Programmes, each with a specific objective.

	Programme	Objective
A	Natural Resource Management Programme	To ensure the effective conservation and sustainable use of natural resources of Corozal Bay Wildlife Sanctuary
B	Research and Monitoring Programme	To ensure adequate knowledge for biodiversity and human resource use management
C	Education and Outreach Programme	To increase community awareness and participation in the conservation of the natural resources of Corozal Bay Wildlife Sanctuary
D	Sustainable Development Programme	To ensure public use of Corozal Bay Wildlife Sanctuary is conducted in an environmentally aware and environmentally sensitive manner
E	Administration Programme	To provide SADC with an effective administration system and structure, with mechanisms to promote financial sustainability

3.4.1 Natural Resource Management Programme

Programme Objective: To ensure the effective conservation and sustainable use of natural resources of Corozal Bay Wildlife Sanctuary

A number of strategies have been identified to guide SACD towards establishment of an effective Natural Resource Management Programme:

1. Establish protocol and collaborative agreements with Fisheries Department and Belize National Coast guard for fast responding to reports of infractions
2. Regular patrols throughout Wildlife Sanctuary for enforcement against non-registered fishermen and sport fishermen
3. Provide all local fishermen active in the Wildlife Sanctuary with ID permits for Corozal Bay, recognized by Forest Department
4. Regular patrols along East Coast targeting transboundary fishermen – night patrols, creeks etc.
5. Patrol identified critical mangrove areas to check for impacts (mangrove clearance). Follow-up with Forest Department / Department of the Environment
6. Patrol identified critical mangrove nursery areas to check for impacts (mangrove clearance). Follow-up with Forest Department / Department of the Environment
7. Regular patrols throughout Wildlife Sanctuary checking for unattended gill nets
8. Respond to reports of stranded / dead manatees in collaboration with Wildtracks and the Marine Mammal Stranding Network
9. Patrol identified bird nesting colonies and check for impacts
10. Signs to be erected near bird nesting cays raising awareness of regulations protecting birds, and presence of surveillance activities
11. Signs to be erected near critical mangrove nursery areas raising awareness of importance of mangroves to the local fisheries sector
12. Patrol river mouths to check for fish kills, and respond to fish kill reports

Corozal Bay Wildlife Sanctuary is located in a conservation seascape of five interconnected protected areas (Table 22).

Protected Area	Administration	Use
Corozal Bay Wildlife Sanctuary	Forest Department	Non-extractive (though traditional fishing activities continue)
Bacalar Chico National Park	Forest Department	Non-extractive
Bacalar Chico Marine Reserve	Fisheries Department	Multiple Use
Sanctuario del Manati	Mexico	
Xcalak	Mexico	

Table 22: Protected Areas within the Conservation Seascape

It also lies within a context of community resource-use by traditional fishermen, local and foreign investment in coastal development, pollution from agricultural runoff from the two rivers (io Hondo and New River) as well as pollution from urban areas (particularly Chetumal), all of which have their effects on the viability of the natural resources.

System level conservation planning has been identified as an effective mechanism for increasing communication and collaboration between connected protected areas, providing a platform for identifying and prioritising key seascape strategies

A. Natural Resource Management Programme						
Objective: Ensure the effective conservation and sustainable use of natural resources of Corozal Bay Wildlife Sanctuary						
General Biodiversity Management						
Management Actions	Present Status (2012)	Desired Status	Year	People	Notes	
A1	Engage a Programme manager for the Natural Resource Management Programme (NRM PM)	SACD does not have a Programme Manager directing the staff	SACD has a qualified Programme Manager directing the staff	1 st	ED SACD Board	
A2	Maintain current patrol team and recruit a second	SACD has one patrol team to cover the largest mpa in Belize. To be effective, it needs a second patrol team	SACD has two patrol teams under a qualified Programme Manager	3 rd	ED SACD Board NRM PM	
A3	Increase patrols / surveillance presence in CBWS	SACD has one semi-equipped patrol boat and limited fuel	SACD has sufficient fuel, equipment and personnel for effective patrols	1 st – 5 th	NRM PM	
A4	Sign co-management agreement with the Forest Department	Unwritten recognition of SACD as co-management agency for Corozal Bay Wildlife Sanctuary by Forest Department	Signed co-management agreement between SACD and administrating agency (currently Forest Dept.)	1 st	President ED FD	Waiting for finalized co-management framework from Forest Department.
A5	Develop Memorandum of Understanding between SACD and Fisheries Department	No MoU with Fisheries Dept.	MoU signed with Fisheries Department for collaboration	1 st	ED SACD Board BFD	Very important to have clear understanding of Forest / Fisheries responsibilities and jurisdictions.
A6	Strengthen trans-boundary collaboration (Ecosur, Santuario del Manatí)	SACD has started discussions with ECOSUR and CONANP	SACD has strong partnerships with both ECOSUR and the management agency for Santuario del Manati	1 st – 5 th	ED SACD Board	

A. Natural Resource Management Programme						
Objective: Ensure the effective conservation and sustainable use of natural resources of Corozal Bay Wildlife Sanctuary						
General Biodiversity Management						
Management Actions	Present Status (2012)	Desired Status	Year	People	Notes	
A7	Identify provisional management zones	No formal zoning of management use at present – community use areas are mapped	Provisional management zones mapped and communities aware of locations	1 st	ED NRM PM	For the Operational Plan, it is suggested that a temporary conservation zone be established
A8	Ensure full community participation in management /zoning process	Fishermen being engaged in catch monitoring and alternative livelihood activities	Full community participation in management zoning process	1 st -2 nd	NRM PM	
A9	Re-vitalize Stakeholder Advisory Committee (SAC)	No SAC, no Community Outreach Officer	SAC developed in each stakeholder community, supported by Community Outreach Officer, ToR	1 st	Community Outreach Officer	Understanding of roles and responsibilities. Includes Village Council, FD,BFD, Youth Group etc.
A10	Develop local capacity for participation in surveillance and enforcement activities	SACD-CU established under PACT funding, training of 3 volunteers as Special Constables. Green Laws training.	Well trained, functional and organized surveillance and enforcement team	1 st – 5 th	NRM PM	Local fishermen, Alliance members, Green Laws training / Special Constable / Fisheries training Input from other, experienced organizations
A11	Equip Surveillance and Enforcement Team (SET)	Equipment funded under recent PACT grant. Boat and engine still identified as major gaps in equipment – currently chartering from local fishermen	Fully equipped surveillance and enforcement team	1 st	NRM Programme Manager	
A12	Develop new partnerships for surveillance and enforcement	Partnerships exist between SACD and Alliance member organizations	New partnerships developed, with MoAs signed, between SACD and Fisheries etc.	1 st	ED NRM Programme Manager	FD, BFD, Green Reef, Ecosur, UB, Coastguard, CZMAI, Police Dept., BDF

A. Natural Resource Management Programme						
Objective: Ensure the effective conservation and sustainable use of natural resources of Corozal Bay Wildlife Sanctuary						
General Biodiversity Management						
Management Actions	Present Status (2012)	Desired Status	Year	People	Notes	
A13 Demarcate CBWS boundaries, particularly at identified entry points	No boundary demarcation signs and no funding	Funding secure for signs, Boundaries clearly demarcated, particularly at identified key entry points	1 st	ED NRM Programme Manager	Key entry points - Corozal, Sarteneja, Consejo, South east boundary, mouths of New River, Lowrys Bight	
A14 Create awareness of boundaries and Patrol Unit	Distribution of information to local stakeholders on goals of SACD and locations of boundary lines	All stakeholders are aware of location of CBWS boundary lines and SACD / Patrol Unit	1 st -5 th	ED NRM Programme Manager	A presentation in each community on location of boundary, and reminder of legalities of hunting, fishing, and logging within protected areas. Request assistance in protecting CBWS. Posters	
A15 Implement Surveillance and Enforcement Activities	First year of surveillance and enforcement activities have been implemented by SACD-CU	Continued implementation of effective surveillance and enforcement activities	1 st -5 th	ED NRM Programme Manager		
A16 Review Enforcement Plan at end of year, and modify where necessary	Surveillance and Enforcement Plan completed – scheduled for review at end of each year	Annual review of Surveillance and Enforcement Plan by management and staff, with modifications to increase effectiveness	1 st -5 th	ED SACD Board NRM Programme Manager		
A17 Develop links with national and international organisations and Government agencies involved in protected areas management	Need to develop awareness of SACD and CBWS	Strong links developed with other organisations and Government agencies involved in protected area management	1 st -5 th	ED SACD Board NRM Programme Manager		

A. Natural Resource Management Programme						
Conservation Target: West Indian Manatee						
Management Actions	Present Status (2012)	Desired Status	Year	People	Notes	
A18 Develop Manatee Conservation Programme	Conservation Planning in process	Programme established by 2013 with participation from Alliance / SAC members and other key community members, and with input from technical experts	1 st -5 th	ED Wildtracks		
A19 Install and maintain manatee 'no wake' signs	'No wake' signs installed, workshop has identified priority locations.	'No wake' signs installed and maintained	1 st	ED	Save the Manatee	
A20 Strengthen links with Marine Mammal Stranding Network	SACD has seat on Marine Mammal Stranding Network	Strengthen links with Marine Mammal Stranding Network	1 st – 5 th	ED Wildtracks	CZMAI / Jamal Galves	
A21 Identify funding support for Manatee Conservation Programme	No focused programme currently in place	Programme has funding by end of the Operational Plan	1 st – 5 th	ED Wildtracks		
Conservation Target: Local fish stocks						
A22 Build knowledge base of fish species using Corozal Bay Wildlife Sanctuary	Some knowledge from past studies, but limited	Knowledge of species of fish using CBWS, seasonality, spawning areas etc. available to guide management	1 st – 5 th	ED Wildtracks	Integrated into management planning and surveillance and enforcement planning	
A23 Developing Sustainable Fisheries Plan with the local fishermen	Fishing is unregulated. Sarteneja fishermen indicated willingness to work towards sustainability at first management planning meeting	Increased capacity and engagement of local fishermen towards development and implementation of a sustainable fisheries plan, in collaboration with SACD	1 st – 3 rd	ED Wildtracks	Two-year initiative	

A. Natural Resource Management Programme						
Conservation Target: Local fish stocks						
Management Actions		Present Status (2012)	Desired Status	Year	People	Notes
A24	Continue and strengthen monitoring of fish traps catches	Initial broad species inventory data collected	Effective monitoring of fish trap catches	1 st – 5 th	NRM Programme Manager Wildtracks	Involving Cornerstone Christian Academy, Wildtracks and Blue Ventures volunteers
Other Active Conservation Measures						
A25	Ensure adequate protection of bird nesting colonies within on the cayes within CBWS	Not adequately protected	Colonies identified, mapped and effectively protected, with signs	1 st – 5 th	NRM Programme Manager Patrol Unit	Integrated into surveillance and enforcement activities
Other Conservation Measures						
A26	Investigate the feasibility of including Cayo Falso and Shipstern Caye in CBWS	Cayes currently not included in CBWS, and may be under future threat of development.	Cayo Falso and Shipstern Caye included in CBWS and therefore covered by co-management activities	1 st -2 nd	ED SACD Board	Work with local land representative. Request Forest Department for change in SI to include Cayo Falso and Shipstern Caye
A27	Explore feasibility of developing policy and plan in case a mining or oil exploration permit should be issued for CBWS	No policy or plan exists at present to be enacted should a mining permit be issued	Advanced planning as to strategies to put into place should a permit be issued	1 st	ED SACD Board	Ensure knowledge of legal aspects of situation, to allow proactive rather than reactive response
A28	Investigate reports to verify presence of sawfish within Bulkhead Lagoon and other coastal lagoon systems feeding into Corozal Bay Wildlife Sanctuary	Recent reports suggest presence of sawfish in coastal lagoon systems feeding into Corozal Bay Wildlife Sanctuary	Presence / Absence of sawfish confirmed, and if confirmed present, adequate protection measures put into place	1 st – 4 th	SACD -CU SET	Last report following heavy flooding in 2012

3.5.1 Research and Monitoring Programme

Programme Objective: To ensure adequate knowledge for biodiversity and human resource use management

The core of the Research and Monitoring Programme is based on the initial requirements highlighted in the Surveillance and Enforcement Plan and identified knowledge gaps, focused on the identified Conservation Targets. Also integrated into the Programme are strategies developed during 2010 and 2011, as part of the adaptive management process. These include strategies from the **Planning for a Sustainable Fishery** output, outputs from the **Water Quality Monitoring Sub-Programme**, and from the **Conservation Plan for West Indian Manatees of Corozal Bay Wildlife Sanctuary** (first draft).

Research and Monitoring Programme – 2013 (Draft)						
Programme Objective: To ensure adequate knowledge for biodiversity and human resource use management						
Management Actions	Present Status (2012)	Desired Status	Year	People	Notes	
Develop a framework for effective Research and Monitoring						
B1	Engage a Programme manager for the Research and Monitoring Programme	SACD does not have a Programme Manager directing the research and monitoring activities	SACD has a qualified Programme Manager directing the research and monitoring activities	1 st	ED Board	
B2	Recruit at least one research assistant and boat captain	SACD relies on the patrol team and volunteers to conduct its research and monitoring activities	SACD has a qualified Programme Manager and research assistant	1 st	ED RM Programme Manager	
B3	Develop a comprehensive Research and Monitoring Plan	SACD has a Research and Monitoring Plan but based on only limited data collection – still being refined as methods are finalised	SACD has an effective and comprehensive Research and Monitoring Plan, integrating the outputs of the 2011 planning initiatives	1 st - 5th	RM Programme Manager	
B4	Equip the Research and Monitoring Programme	SACD has limited equipment for Research, and no research boat / engine	SACD is equipped for effective research and monitoring activities, with research boat / engine	1 st - 5th	RM Programme Manager	
B5	Develop an MoU with Wildtracks and Blue Ventures towards partnerships for effective research and monitoring	SACD has a partnership with Wildtracks and works closely with Blue Ventures, but has no formal agreement with either	SACD has a formal agreement with both Wildtracks and Blue Ventures, for partnering for strengthened research and monitoring	1 st	ED RM Programme Manager	
Integrated Research and Monitoring Programme						
B6	Develop and implement Manatee Conservation Programme	Manatee Conservation Plan is in final draft format	Implementation of Manatee Conservation Programme	1 st - 5th	RM Programme Manager	1 st year of 3 year plan

Research and Monitoring Programme – 2013 (Draft)						
Programme Objective: To ensure adequate knowledge for biodiversity and human resource use management						
Management Actions		Present Status (2012)	Desired Status	Year	People	Notes
B7	Develop and implement Sustainable Fisheries Plan with the local fishermen	Baseline and recommendations for developing Fisheries Plan have been completed	Locate funding for development of Sustainable Fishery Planning	1 st – 5 th	RM Programme Manager Wildtracks	1 st year of 3 year plan Fisheries Consultant Blue Ventures
B8	Develop and implement water quality monitoring programme for CBWS	Pilot phase water quality monitoring has started. Still need to extend to nitrates / phosphates and strengthen WQM plan. Protocols being strengthened with input from ECOSUR	One year of baseline data, including nitrates / phosphates Revised monitoring protocol	1 st – 4 th	RM Programme Manager Wildtracks J. Chapman	2 nd year of 5 year plan
B9	Integrate all research and monitoring plans into a single document	First draft document completed	Finalized document	1 st – 2 nd	RM Programme Manager Wildtracks	
B10	Seek collaborative partnership for development and implementation of research and monitoring activities for effective management of manatees	Collaborative monitoring with Wildtracks and BlueVentures, input from Caryn Self Sullivan (IUCN/SSG) for monitoring at resting holes. In discussion with J. Galves / CZMAI re. closer collaboration. Aerial surveys in collaboration with Lighthawk	Improved monitoring under a dedicated Programme Manager	1 st - 5 th	RM Programme Manager	
Research and Monitoring – Conservation Targets						
B11	Build knowledge base of fish species of Corozal Bay Wildlife Sanctuary	New data from ECOSUR and beach trap catch assessment, but not yet integrated into management plan	Good baseline species list for fish of Corozal Bay Wildlife Sanctuary			Need to incorporate data from R. Graham on elasmobranch surveys BlueVentures

Research and Monitoring Programme – 2013 (Draft)						
Programme Objective: To ensure adequate knowledge for biodiversity and human resource use management						
Management Actions		Present Status (2012)	Desired Status	Year	People	Notes
B12	Continue and strengthen monitoring of fish traps catches	Monitoring is of commercial catch only	Include monitoring of bycatch (juveniles) to provide more information on cohorts	2 nd – 4 th	RM Programme Manager Wildtracks	Fisheries Consultant Blue Ventures
B13	Identify and map key fish nursery areas	An identified gap in knowledge of use of the Bay by commercial fish species	SACD has identified and mapped key fish nursery areas, as part of the Sustainable Fishery Plan	3 rd	RM Programme Manager	
B14	Build knowledge base of manatee use within Corozal Bay Wildlife Sanctuary	Current data summarized in Manatee Conservation Plan. Data from Dry and Norte season aerial surveys in collaboration with Lighthawk. Still missing Wet Season survey	Complete year of aerial survey data (3 seasons, 3 replicates). Ongoing monitoring of resting holes	1 st – 5 th	RM Programme Manager Wildtracks	
B15	Monitor large marine vertebrates (turtles, sharks, crocodiles, dolphins)	SACD currently monitors large vertebrates through opportunistic sightings, aerial surveys and collaborative projects	SACD continues to monitor large vertebrates through opportunistic sightings, aerial surveys and collaborative projects, with improved data management	1 st – 5 th	RM Programme Manager Wildtracks	Northern Shark Project
B16	Build knowledge base of bird nesting colonies within Corozal Bay Wildlife Sanctuary	Data collection sporadic – needs better organization. New data collection sheets developed.	Effective monthly bird colony monitoring under the Research and Monitoring Programme Manager	1 st – 5 th	RM Programme Manager	
B17	Assessment of current human impacts on mangroves	Baseline mapping completed	Annual surveillance of coast and comparison with baseline – Updated report on condition of coastal ecosystems	3 rd	RM Programme Manager Wildtracks	SDS (Adam) Blue Ventures

Research and Monitoring Programme – 2013 (Draft)						
Programme Objective: To ensure adequate knowledge for biodiversity and human resource use management						
Management Actions		Present Status (2012)	Desired Status	Year	People	Notes
B18	Continue SeagrassNet monitoring	Site exists, but not monitored	Quarterly monitoring of seagrass using SeagrassNet protocols	1 st – 4 th	RM Programme Manager	
B19	Develop a climate change adaptation plan for CBWS and its stakeholder communities	SACD has not yet started climate change adaptation planning	SACD has a climate change adaptation plan, with stakeholder participation	3 rd	RM Programme Manager Wildtracks	
B20	Develop database for effective management of monitoring data	Sightings database housed with Wildtracks and feeding into BERDS (national biodiversity database)	SACD management of database and training in data entry	1 st – 2 nd	RM Programme Manager Wildtracks	SDS (Adam)
B21	Develop system for effective storage of digital references	No system in place – documents on all computers	Single storage library for digital documents	1 st – 2 nd	RM Programme Manager Wildtracks	BlueVentures
B22	Ensure annual State of the Park Reports are submitted to Forest Department and Fisheries Department, summarizing research and monitoring output	First State of the Park report being prepared for submission at end of 2012	Second State of Park report completed and submitted in December	1 st – 5 th	ED RM Programme Manager Wildtracks	
B23	Disseminate research and monitoring outputs where applicable	Current reports and data feeding into ERI and national programmes	Continued dissemination of reports, including website for downloading	1 st – 5 th	ED RM Programme Manager Wildtracks	

Research and Monitoring Programme – 2013 (Draft)						
Programme Objective: To ensure adequate knowledge for biodiversity and human resource use management						
Management Actions		Present Status (2012)	Desired Status	Year	People	Notes
B24	Maintain the Volunteer and Internship Programme, incorporating community involvement in research and monitoring activities	Volunteer and Internship Programme is ongoing, with involvement in research and monitoring activities. Could be strengthened but needs dedicated Research and Monitoring staff	Research and Monitoring Programme has dedicated Programme Manager and staff to provide a network for integrating interns	1 st – 5th	RM Programme Manager Wildtracks	

3.5.2 Education and Outreach

Programme Objective: To create awareness of the importance of CBWS and an understanding of and support for conservation

Three major strategic areas fall under this programme:

- Dissemination of Information
- Participation and Engagement
- Education and Outreach

Dissemination of Information

The importance of community awareness and participation is key to successful management, and mechanisms have been identified to ensure that stakeholder communities are aware of the environmental values and services of the Corozal Bay Wildlife Sanctuary and the benefits effective management can bring to Sarteneja. Short term mechanisms included:

- Information on the Wildlife Sanctuary, transmitted on the local cable TV
- Posters displayed throughout the stakeholder communities
- Community surveys to validate outputs and facilitate and encourage participation
- Word of mouth dissemination by SACD participating organizations
- Community meetings to ensure participants have an opportunity to express their opinions

Participation and Engagement

The Volunteer and Internship Programme (VIP) is currently being established (2009/2010) to provide mechanisms for students and local, national and international volunteers to volunteer and participate in conservation management activities. This will also offer internship opportunities for local students seeking longer term capacity building placements. Active participation of local fishermen in the Patrol Unit is considered critical for management to be effective, and is addressed under the Natural Resource Management Programme.

Engagement mechanisms currently focus on stakeholders in Sarteneja, the key stakeholder community. Current strategies include sponsorship of culturally important events (primarily the Sarteneja Easter Regatta), and provision of high school scholarships, the latter linked to the Volunteer and Internship Programme.

Also of importance is SACD's focus on providing opportunities for continuing education as a key mechanism for reducing the number of people entering the fishing industry in Sarteneja, through strengthening of the local high schools and provision of scholarships for both High School and higher education.

C. Community Participation Programme						
Objective: To increase community awareness and participation in the conservation of the natural resources of Corozal Bay Wildlife Sanctuary						
Management Actions		Present Status (2012)	Desired Status	Quarter	People	Notes
C1	Engage a Community Outreach Officer (COO)	SACD does not have a Community Outreach Officer to liaise with the stakeholder communities	SACD has a qualified Community Outreach Officer maintaining communication with the communities	1 st	ED Board	
C2	Clearly define the role of SACD in context of local communities	SACD just recently established but needs greater awareness within broader community	A clear understanding of the role of SACD by stakeholder communities	1 st – 2 nd	ED COO	It is important for the broader community to understand the role of SACD and to disassociate from SWEET's background. To include Copper Bank, Chunox, Corozal and Consejo Shores
C3	Implement collaborative activities for the Alliance that will promote and strengthen collaboration	Alliance members are communicating and identifying areas for collaboration,	Strengthen the Alliance through development of a Collaboration Plan and implementation of collaborative activities	1 st – 2 nd	ED COO	Eg. Cenote access for tourism, regatta activities, open day exhibition etc.
C4	Revitalize the Stakeholder Advisory Committee (SAC) with representation from key stakeholders to advise on management issues	SAC has been established but has not been fully active.	Stakeholder Advisory Committee established with clear ToR	1 st – 2 nd	ED COO	
C5	Develop capacity and knowledge of SAC members	SAC currently inactive	SAC members should have greater knowledge of biodiversity, basic conservation issues, biodiversity legislation, conflict resolution, etc	1 st – 5 th	COO	Include in Green Laws training
C6	Ensure active participation of community members in SACD activities and associated training initiatives	Mechanism for active participation of community members in SACD activities and associated training initiatives	Active participation from community members in Surveillance and Enforcement Team and associated training initiatives	1 st – 5 th	ED	See Natural Resource Management Programme

C. Community Participation Programme					
Objective: To increase community awareness and participation in the conservation of the natural resources of Corozal Bay Wildlife Sanctuary					
Management Actions	Present Status (2012)	Desired Status	Year	People	Notes
C7 Ensure active participation of community youths in conservation activities	VIP active for upper primary school participants	Active participation from community youths in SACD conservation activities through VIP	1 st – 5 th	EO COO	See Education and Outreach programme
C8 Develop and implement ongoing community awareness programme	Some community awareness activities completed in the past	Community awareness of the biodiversity value of the protected area increases	1 st – 5 th	EO COO	Tied in with Education and Outreach
C9 Provide support for the development of environmentally and socially sustainable Alternative Livelihoods in Sarteneja through the support of SFA	Collaboration and support of SFA projects	All organizations take ownership of Alternative Livelihoods development	1 st – 5 th	ED COO SFA	
C10 Collaborate with STGA towards development of Sarteneja as a tourism destination	SACD and STGA collaborating on development of Tourism Development Plan	Continued collaboration towards development of Sarteneja as a tourism destination	1 st – 5 th	ED COO STGA	
C11 Support Homestay initiative in Sarteneja	Homestay programme implemented and successful	Homestay continues to be a success	1 st – 5 th	COO	SACD managing Homestay microloan
C12 Seek other alternative livelihood skills for Sarteneja and other stakeholder communities	SACD working with local fishermen in establishing household chicken farming	Sarteneja and other stakeholder communities are less dependent on the natural resources	1 st – 5 th	ED COO	
C13 Increase liaison with Government Agencies and NGOs that can assist communities in social issues	Opportunities may exist to leverage assistance for community development from Government and NGO bodies	Opportunities are seized to leverage assistance for community development from Government and NGO bodies	1 st – 5 th	ED COO SACD BoD	

3.5.4 Sustainable Development Programme

Programme Objective: To ensure public use of Corozal Bay Wildlife Sanctuary is conducted in an environmentally aware and environmentally sensitive manner

Alternative Livelihoods

A number of strategies have also been identified to provide and improve opportunities for alternatives to natural resource use for Sarteneja, (as one of the key stakeholders of Corozal Bay Wildlife Sanctuary and the Belize reef) and other communities that use the Wildlife Sanctuary. For Sarteneja, many of these strategies are focused on facilitating the development of Sarteneja as a tourism destination, to provide opportunities for alternative livelihoods.

- Strengthen the Sarteneja Tour Guide Association and Sarteneja Fishermen Association
- Implement strategies towards development of Sarteneja as a tourism destination, as an alternative to fishing (see STGA Strategic Plan and Sarteneja Tourism Development Plan)
- Identify and implement other alternative livelihood strategies for fishermen of Sarteneja

Five primary public uses have been identified for Corozal Bay Wildlife Sanctuary:

- Commercial Fishing
- Subsistence Fishing
- Recreation
- Tourism
- Sport Fishing

Also identified are the potential impacts of increasing coastal development, much of it linked to foreign investors and retirees, and the need to mitigate environmental damage whilst still ensuring development can continue to provide socio-economic benefits to the area.

D. Sustainable Development						
Programme Objective: To ensure public use of Corozal Bay Wildlife Sanctuary is conducted in an environmentally aware and environmentally sensitive manner						
Management Actions		Present Status (2012)	Desired Status	Year	People	Notes
D1	Provide support for the development of environmentally sustainable tourism in Sarteneja through the support of STGA	Collaboration and support through the development of the Sarteneja Tourism Development Plan (ongoing)	All organizations take ownership of Sarteneja Tourism Development Plan	1 st – 5 th	ED COO STGA	
D2	Incorporate tourism use areas into Sarteneja Tourism Development Plan	Tourism Development Plan for Sarteneja incorporates tourism use areas	Tourism use areas have been mapped and incorporated into the Tourism Development Plan	1 st	COO STGA	
D3	Identify major public use areas	Only limited identification and mapping of public uses and public use areas	Primary public use areas have been identified and mapped	1 st	COO	Fish traps, net use areas, water taxi routes etc.
D4	Develop Rules and regulations for Public Use	No rules and regulations currently exist for CBWS	Rules and regulations developed for CBWS, in collaboration with local stakeholders	1 st	ED NRM PM STGA	Could be discussed during planning workshops
D5	Install “No wake Zone” signs and “CBWS Rules and Regulation” Signs at major traffic areas/routes	Some signs installed, some ready for installation, others still need to be developed and funding located (CBWS Rules and Regulations)	Signs installed	1 st	NRM PM COO	
D6	Develop and implementing Best Practices plans for CBWS	STGA developing Best Practices for tours. Other Best practices could be adopted /amended from existing initiatives	Best Practices identified for critical areas	1 st – 5 th	NRM PM COO	Tourism Best Practices (STGA) Fishing Best Practices Development Best Practices (Glover’s Reef)
D7	Develop and implementing Best Coastal Development Practices plans for CBWS	No best practices in place. Best practices could be adopted /amended from existing initiatives	Best Development Practices identified and disseminated	1 st – 5 th	NRM PM COO	Development Best Practices (Glover’s Reef)

D. Public Use Programme					
Programme Objective: To ensure public use of Corozal Bay Wildlife Sanctuary is conducted in an environmentally aware and environmentally sensitive manner					
Management Actions	Present Status (2012)	Desired Status	Year	People	Notes
D8 Ensure that data on visitation and public use is collected and available to assist in management decisions	No system in place	Work with STGA and other stakeholders to develop system for monitoring visitation and public use	1 st – 5 th	NRM PM SACD	Other partners – hotels, tour operators / guides
D9 Develop baseline and monitoring programme for environmental and socio-economic impacts	Baseline data for monitoring and socio-economic impacts exists (2008), but analysis needs to be completed and integrated into management	Baseline report is completed and integrated into monitoring and management activities	1 st – 5 th	COO	

3.5.5 Governance and Administration Programme

Programme Objective: To provide SACD with effective governance and administration systems and structures, with mechanisms to promote financial sustainability.

The Governance and Administration Programme includes a number of sub-programmes:

- Governance
- Administration
- Reporting
- Human Resource Management
- Equipment and Infrastructure Management
- Planning, Monitoring and Evaluation
- Financial Sustainability

E. Governance and Administration Programme						
Objective: To provide SACD with an effective administration system and structure, with mechanisms to promote financial sustainability						
Management Actions	Present Status (2012)	Desired Status	Year	People	Notes	
Governance						
E1	Ensure SACD has an effective Board of Directors	SACD has an active, effective Board of Directors	SACD continues to have an active, effective Board of Directors	1 st – 5 th	SACD BoD	
E2	Increase capacity of Board members for their role	Only limited capacity building of the Board has occurred since its establishment	The SACD Board of Directors has the capacity for effective direction of SACD activities	1 st – 5 th	SACD BoD	
Administration						
E3	Ensure the Administration Programme is fully staffed and equipped for effective management	SACD needs to increase its staff capacity in effective Administrative management	SACD has qualified staff and the equipment required for effective management	1 st – 5 th	ED SACD BoD	
E4	Maintain and improve administration structure for record keeping, accounting for management for project funds etc.	Funds have been secured for the establishment of administration structure	An administration structure in place for management for project funds	1 st – 5 th	ED Administrator SACD Treasurer	
E5	Review Standard Operating Procedures for SACD on a bi-annual basis	No formal Standard Operating Procedures	SACD has formal Standard Operating Procedures	1 st – 5 th	ED SACD BoD	
E6	Formalize co-management agreement with the Forestry Department	Discussion with FD is ongoing and SACD has been recognized as the potential co-management agency by FD	Co-management agreement with the Forestry Department finalized	1 st	ED SACD BoD FD	
E7	Formalize agreement with the Belize Fisheries Department	No current agreement – only Research Permit	Agreement formalized with the Belize Fisheries Department	1 st	ED SACD BoD BFD	

E. Governance and Administration Programme						
Objective: To provide SACD with an effective administration system and structure, with mechanisms to promote financial sustainability						
Communication						
E8	Ensure SACD has effective communication ability (Phone, internet, radio)	SACD has some limitations in communications	SACD has an effective communication system	1 st – 5 th	ED	
E9	Establish and implement Communication Plan	No communication plan in place	Communication plan in place and implemented	1 st – 5 th	ED COO	With BoD Community / SAC Other Communities Government Agencies Funding Agencies
E10	Ensure that required reporting commitments to FD and BFD are fulfilled	No communication plan in place. 2011 Annual report delayed	FD and BFD are supplied with monthly summary updates, quarterly and annual reports	1 st – 5 th	ED	NRM PM COO Administrator
E11	Create and implement information sharing systems that improve integration of other stakeholder communities into management of CBWS	No information sharing system in place	Effective information sharing system in place	2 nd – 5 th	ED COO	Corozal / Consejo Shores Copper Bank Chunox San Pedro Also through development of partnerships
Human Resource Management						
E12	Ensure SACD has enough qualified staff for effective management of CBWS	SACD has identified the lack of Programme Managers (Natural Resource Management and Research and Monitoring Programmes) as a major barrier to management effectiveness	SACD has added two Programme Managers (Natural Resource Management and Research and Monitoring Programmes), and a Communication Officer	1 st – 5 th	ED SACD BoD	Current staff: Executive Director, Education Officer, Administrative Officer, Head Ranger, 2 Assistant Rangers
E13	Identify staff training needs and address where feasible	Capacity building for staff occurs on an ongoing, opportunistic basis	All staff are trained to a level that increases management effectiveness of SACD	1 st – 5 th	ED	

E. Governance and Administration Programme						
Objective: To provide SACD with an effective administration system and structure, with mechanisms to promote financial sustainability						
Management Actions	Present Status (2012)	Desired Status	Year	People	Notes	
Human Resource Management						
E14	Ensure all staff are familiar with management policies, including job descriptions, employee policies and gender issues	Staff are employed based on clear ToRs, but there is no clear guidance or SACD employee policies	All staff are familiar with management policies, including job descriptions, employee policies and gender issues	1 st – 5 th	ED	
E15	Ensure all staff have uniforms	Ongoing	Ongoing	1 st – 5 th	ED	
E16	Organise annual Board and staff retreat	No annual retreat	Annual retreat for Staff and Board	1 st – 5 th	ED SACD BoD	For review of strategic plan, team building
Equipment and Infrastructure Management						
E17	Ensure SACD has adequate equipment for effective management of Programme areas	SACD has identified key equipment gaps in 2012	SACD has adequate equipment for effective management	1 st – 2 nd	ED	Key gaps include boat and engine for Research and Monitoring Programme
E18	Ensure SACD has the infrastructure required for effective management	SACD has the infrastructure in place for effective management	SACD has the infrastructure in place for effective management	1 st – 5 th	ED SACD BoD	All buildings to be built to hurricane standards and incorporate green technologies where possible
E19	Provide a fully equipped boat and engine for the Research and Monitoring Programme	No operationalised Research and Monitoring Programme	Research and Monitoring boat has been purchased and is in use	1 st – 2 nd	ED RM PM	
E20	Purchase an SACD vehicle	SACD does not have access to a vehicle	SACD has a vehicle for better access to meetings, education and community outreach activities	1 st – 2 nd	ED SACD BoD	

E. Governance and Administration Programme						
Objective: To provide SACD with an effective administration system and structure, with mechanisms to promote financial sustainability						
Management Actions	Present Status (2012)	Desired Status	Year	People	Notes	
Equipment and Infrastructure Management						
E21	Ensure SACD equipment, boats, vehicles and infrastructure is adequately maintained	SACD has ongoing maintenance of equipment and boat / engine	SACD has ongoing maintenance of equipment, boats / engines, vehicle	1 st – 5 th	ED Administrator	
Planning, Monitoring and Evaluation						
E22	Finalise and implement Strategic Plan	Draft Strategic Plan in review	SACD is implementing its Strategic Plan	1 st – 5 th	ED SACD BoD	
E23	Develop Annual Operational Plan and monitor implementation and evaluate outputs of the Operational Plan on a monthly basis	Operational Plan for 2013 has been developed, with an integrated monitoring and evaluation mechanism	Continual monitoring and evaluation of the Operational Plans has taken place throughout the year, with outputs integrated into planning	1 st – 5 th	ED SACD BoD	Monthly project evaluation meetings of SACD organizations will assist in monitoring and evaluation of the Operational Plan
Financial Sustainability						
E24	Secure additional grant funding for the continued management for the CBWS	Ongoing	Ongoing	1 st – 5 th	ED Wildtracks	
E25	Develop and implement Financial Sustainability Plan	No Financial Sustainability Plan	SACD has and is implementing an effective Financial Sustainability Plan	1 st – 4 th	ED	
E26	Investigate financial sustainability mechanisms	No mechanisms in place	Financial sustainability mechanisms in place	1 st – 5 th	ED NRM PM SACD BoD	Own office, shared facilities with other Alliance members, tourism fee collection, supporting memberships,

3.5 Timeline, Evaluation and Review

For the review process, 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, as shown in the following example.

Monitoring and evaluation are integral components of the SACD management system and annual evaluation of the Management Plan will take place in November / December of each year, tied in with the development of the Annual Operational Plan.

The management plan is not considered to be static, and the annual review will 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.

A. Natural Resource Management Programme										
Management Actions		Present Status	Desired Status	Year					Responsible Party	Limitations/Requirements
Surveillance and Enforcement Sub-Programme - Staff				1	2	3	4	5		
A1	Engage a Programme manager for the Natural Resource Management Programme (NRM PM)	SACD does not have a Programme Manager directing the staff	SACD has a qualified Programme Manager directing the staff						ED SACD Board	
A2	Maintain current patrol team and recruit a second	SACD has one patrol team to cover the largest mpa in Belize. To be effective, it needs a second patrol team	SACD has two patrol teams under a qualified Programme Manager						ED SACD Board NRM PM	
A3	Increase patrols / surveillance presence in CBWS	SACD has one semi-equipped patrol boat and limited fuel	SACD has sufficient fuel, equipment and personnel for effective patrols						NRM PM	
A4	Sign co-management agreement with the Forest Department	Unwritten recognition of SACD as co-management agency for Corozal Bay Wildlife Sanctuary by Forest Department	Signed co-management agreement between SACD and administrating agency (currently Forest Dept.)						President ED FD	Waiting for finalized co-management framework from Forest Department.
A5	Develop Memorandum of Understanding between SACD and Fisheries Department	No MoU with Fisheries Dept.	MoU signed with Fisheries Department for collaboration						ED SACD Board BFD	Very important to have clear understanding of Forest / Fisheries responsibilities and jurisdictions.

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 23), and following the outline example (Table 24).

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 23: Criteria for tracking implementation

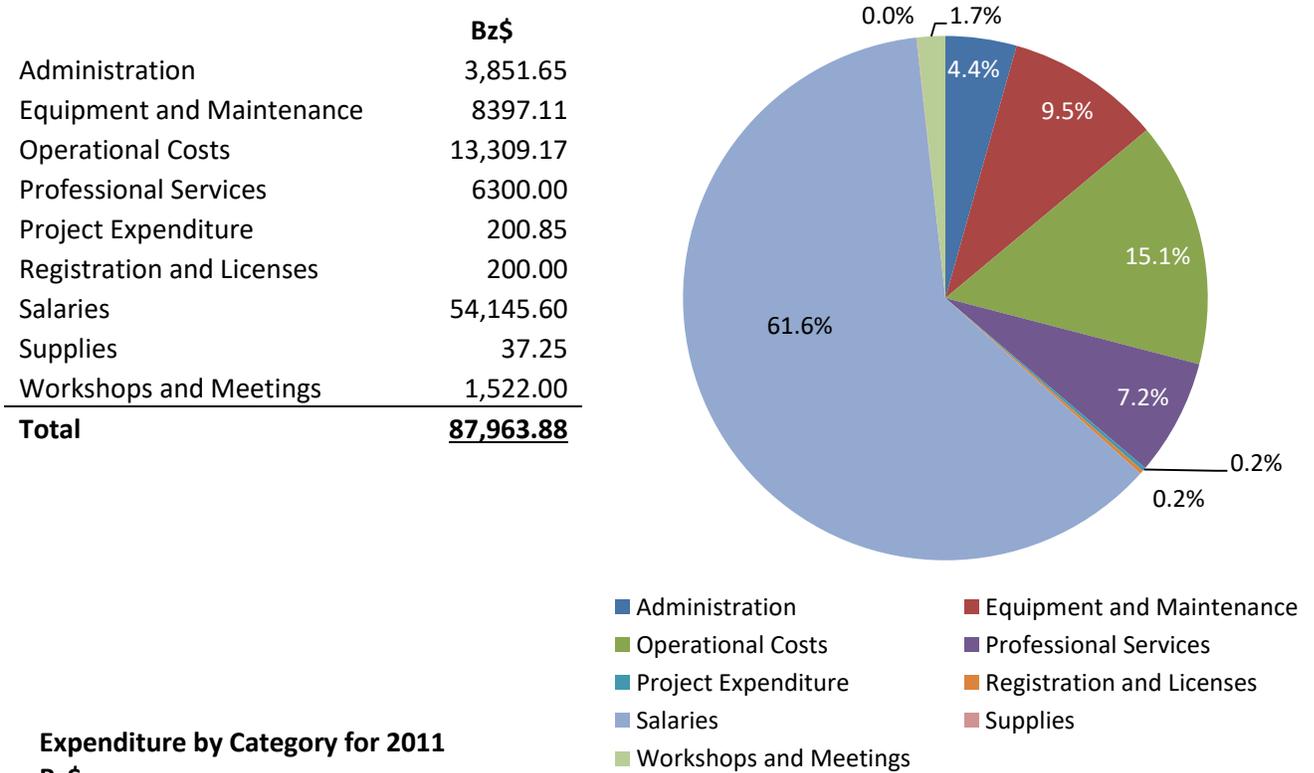
Management evaluation is also achieved by an assessment of management effectiveness. A baseline should be established at the end of the first year of operation using the national indicators for management effectiveness.

Table 24: Tracking of Management Action Implementation								
Management Actions		Present Status	1 st Year	2 nd Year	3 rd Year	4 th Year	5 th Year	Desired Status
A1	Engage a Programme manager for the Natural Resource Management Programme (NRM PM)	SACD does not have a Programme Manager directing the staff						SACD has a qualified Programme Manager directing the staff
A2	Maintain current patrol team and recruit a second	SACD has one patrol team to cover the largest mpa in Belize. To be effective, it needs a second patrol team						SACD has two patrol teams under a qualified Programme Manager
A3	Increase patrols / surveillance presence in CBWS	SACD has one semi-equipped patrol boat and limited fuel						SACD has sufficient fuel, equipment and personnel for effective patrols
A4	Sign co-management agreement with the Forest Department	Unwritten recognition of SACD as co-management agency for Corozal Bay Wildlife Sanctuary by Forest Department						Signed co-management agreement between SACD and administrating agency (currently Forest Dept.)
A5	Develop Memorandum of Understanding between SACD and Fisheries Department	No MoU with Fisheries Dept.						
Ratings: 1: Not started 2: Started, but some limitations to implementation					3. Ongoing but behind schedule 4. On schedule			

3.6 Financing

An annual budget is prepared based on the Annual Workplan. The Executive Director is responsible for preparing the budget, with the assistance of the Programme Managers, and submitting it to the SACD Board and Forest Department for approval. SACD is then responsible for sourcing funds for implementation. In the past, this has been through grant funding from a variety of agencies.

In 2011, the financial breakdown of expenditures for the organization was as follows:



The Sarteneja Alliance for Conservation and Development does not yet have a Financial Sustainability Plan in place, though will be developing one to guide the development of its funding portfolio in 2013 / 2014. A major source of funding will be grants from both national and international agencies.

Cost sharing mechanisms

The Sarteneja Alliance for Conservation and Development reduces overheads for each of the Alliance members through cost sharing mechanisms – the SACD office, utilities and internet costs are shared by SACD, SFA and STGA, and training opportunities are made available to all organization members.

Optimal capital cost investment for the five year management timeframe would include:

US\$					
	Year 1	Year 2	Year 3	Year 4	Year 5
Equipment					
8 Demarcation buoys	8,000				
10 Signs (all entry points)	5,000			5,000	
SACD vehicle	30,000			30,000	
Storage boxes	1,200		900		
Maintenance equipment	2,000		500		500
Laptops	3,000			3000	
PCs	2,000			2000	
Furniture (Tables, chairs, fans, filing cabinet)	2,000			500	
Office copier / printer	1,000			1,000	
Maintenance equipment (lawn mower, weed eater etc.)	1,500	250	250	1,500	250
Equipment for Natural Resource Management Programme	11,900				
Equipment for Research and Monitoring Programme (including equipped boat)	30,800	1,000	1,000	1,000	1,000
Equipment for Education Programme	10,000	500	1,000	1,000	1,000
Infrastructure					
Phase 2, SACD building	100,000				
Solar system for building		40,000			
Ranger's Station	14,000				
Consulting Services / Training					
Climate Change Adaptation planning	20,000				
GIS consultant - retainer	1,000	1,000	1,000	1,000	1,000
Financial Sustainability Planning	15,000				5,000
Revision of Strategic Plan				3,000	
Consultancy to establish Quickbooks accounting and training	2,000				
Training of rangers in NRM	4,000			4,000	